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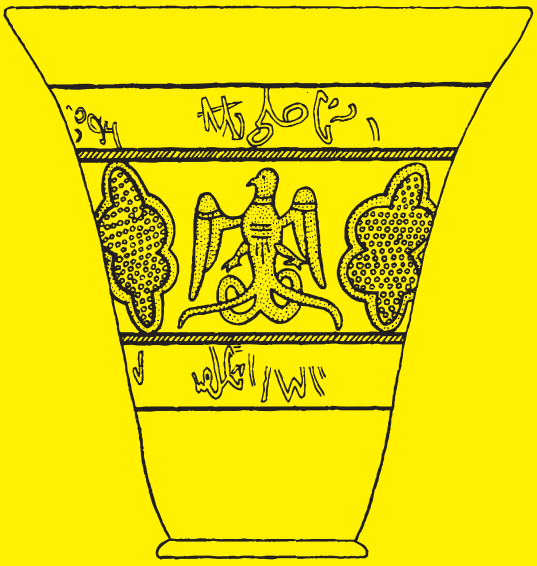

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Special theme:
Pottery and glass in contemporary studies

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Cover illustration: Beaker with ornamentation from Novogrudok,
from the paper by Ekaterina K. Stolyarova and Asya V. Engovatova in this volume

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Editorial

Pottery and glass are common finds at archaeological sites, contributing importantly to research on ceramic and glassware production, and the use and significance of these products in all historic periods. Formal analyses along with in-depth studies of production techniques and types of decoration, complemented with physical and chemical analyses, lead researchers to present hypothetical chronologies for particular artifacts and to identify production sites. Such studies also let us reconstruct various aspects of everyday life, extending our knowledge of the economic and cultural relationships of a town, stronghold or settlement with other regions, sometimes very distant ones. Indirectly, they allow us to draw conclusions on the economic status of inhabitants, as well as their preferences and lifestyle. The materiality and contextuality of pottery and glass finds permit a wider application of quantitative, spatial and instrumental analyses leading to more precise results. Ceramic and glass objects may well become a means to resolving many historical issues.

Mastering the skills of pottery and glass production, two closely related but different workshop patterns, was undoubtedly one of the most important technological achievements in human history. Knowledge of these resources has not found a reflection in our manner of distinguishing historic periods in the way that the introduction of metals has, but even so, ceramics and glass changed the cultural environment and the quality of life wherever they appeared. The perennial needs, desires and values of humanity have been embodied in pottery and glass.

Bearing this in mind, the Centre for Late Antique and Early Medieval Studies of the Institute of Archaeology and Ethnology, Polish Academy of Sciences, and the Ceramics & Glass Reconstruction and Restoration Department of the Academy of Art and Design in Wrocław, taking advantage of their respective scientific backgrounds in these fields, acted jointly to organize an International Symposium on Pottery and Glass OSTRAKON. The conference created the opportunity for researchers to meet and present their current projects from the fields of archaeology, conservation and arts. Current trends in studies on historic pottery and glass were well represented. The open and interdisciplinary character of the event aided in crossing the borders of narrow specialisations that are typical of many different scientific and artistic disciplines, and enabled new cooperation.

This volume of Archaeologia Polona (55: 2017) is the second publication to contain, i.a., articles on ceramics and glass based on presentations given during the Symposium.

A book in Polish 'Ceramika i szkło w archeologii i konserwacji (Pottery and glass in archaeology and conservation)' (Wrocław 2017) has already been published, focusing on articles dealing mainly with Polish archaeological and conservation issues. The present volume encompasses studies of a more international character. It contains papers on production, distribution and use of ceramics, glasses and radiolarite (A. Námerová, M. Żuchowska, B.Sz. Szmoniewski; B. Gruszka, P. Gunia, M. Kara; I. Boháčová; E.K. Stolyarova, A.V. Engovatova; S. Siemianowska, K. Sadowski, T. Stawiarska, A.B. Szilasi). Some of the authors also discuss the important questions of the reasons for and character of workshop changes (E. Černá, K. Tomková). A significant part of the publication are papers interpreting the symbolism of artifacts or their elements (M. Miziur-Moździoch; L. Tyszler, A. Jankowiak; A.E. Marek; E.J. Kowalczyk; D. Mazur). Papers specifically on the conservation and restoration of archaeological artifacts are present as well, similarly as in the volume in Polish (D.H. Hasgüler). The book contributes significantly to the development of research on historic pottery and glass.

Sylwia Siemianowska, Paweł Rzeźnik, Krystian Chrzan

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Remarks on the sign of the swastika on pottery from Ożańsk site 5

Edyta Anna Marek[a]

The author discusses examples of the swastika on ceramic vessels from an early Slavic village excavated at site 5 in Ożańsk, Jarosław region in Poland and presents several parallels, on ceramics as well as other artifacts coming from different parts of the world, different times and cultures, thus showing the popularity of the ornament and its wide range of symbolic connotations. The swastika was initially associated with light, prosperity and good. It was incorporated as a motif on objects connected with Christianity, where it could have taken on a new meaning: the cross of Christ seen as a symbol of the Christians themselves.

KEY-WORDS: swastika, Ożańsk, Slavic pottery, Middle Ages

Archaeological investigations preceding building investment, such as were conducted on site 5 in Ożańsk in the Jarosław commune, can add substantially to the body of knowledge as well as lead to its reevaluation (Fig. 1). Sławomir Kadrow discovered the site in 1989 (Fig. 2), but it was not until 2010 that it started to be excavated as part of the A4 motorway construction project. Dariusz Niemasik and Wojciech Pasterkiewicz explored it on behalf of the Foundation of the Archaeological Center in Rzeszów, uncovering a sunken hut (No. 395) that was dated by the assemblage to the early Slavic period. One of the ceramic finds was a piece of pottery decorated with a swastika. Professor Michał Parczewski first drew attention to the symbols of swastik on the fragments of vessels from this position.

This piece of honey-colored coarse ware was reconstituted from two fragments (Fig. 3). The temper consists of chamotte of varied size and crushed rock. The break bears evidence of secondary burning. It was not possible to reconstruct the whole pot from the sherds found in the hut, but it is evident that it was from a large vessel, possibly a pot, pots being the most common type of vessel recorded from the site[1].

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[1] The region is rich in Miocene clays under the sands and Quaternary loess, which could have been of significance for a pottery craft in the area; numerous Bronze Age and modern pottery fragments are scattered all around.

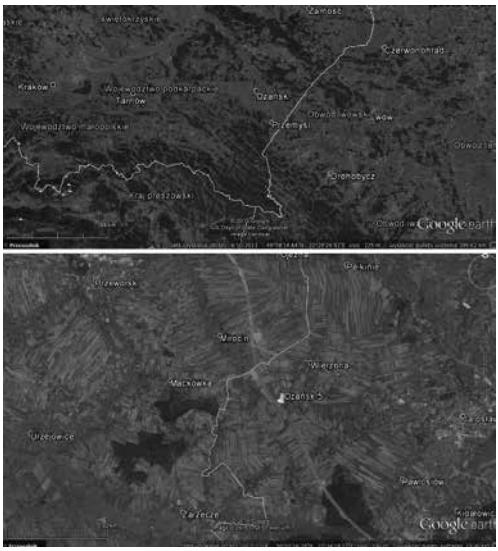

Fig. 1. General plan of the Subcarpathian province with the location of Ożańsk village and archaeological site 5 (source: Google Earth)

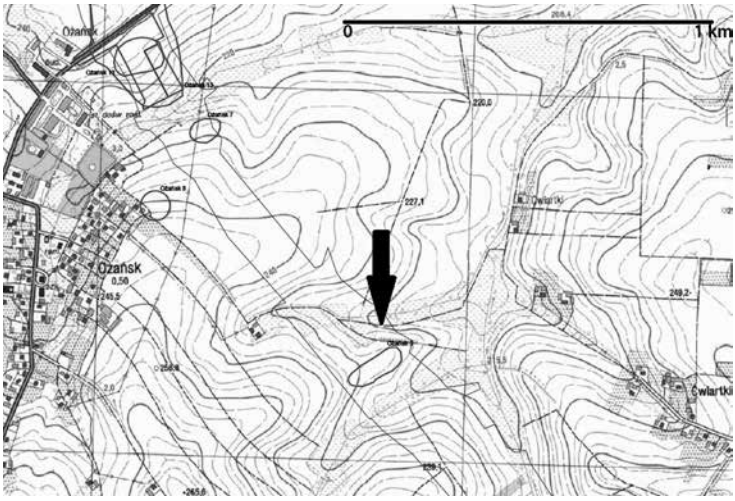

Fig. 2. Topographic map of the excavation site and its environs ('Opracowanie wyników ratowniczych badań wykopaliskowych na stanowisku numer 5 w Ożańsku, gm. Jarosław' report, courtesy D. Bobak)

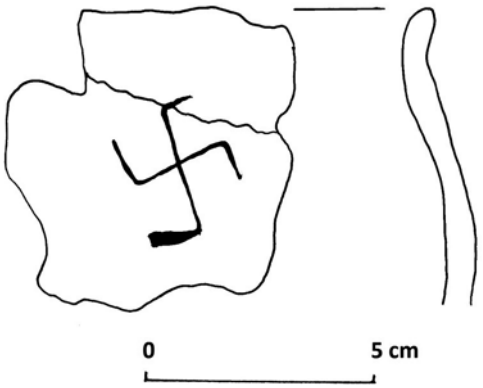

Fig. 3. Swastika sign on a vessel (No. 395), Ożańsk, site 5. Drawing by E.A. Marek

Technological skill is apparent in the making of this vessel, which was modeled by hand, not on the heel, bearing characteristically uneven marks of finger-modeling, just like other sherds from this and the other huts excavated at the site.

A swastika motif was cut into the surface of the upper body of the pot just under the rim, using a stick or a similar kind of tool. The arms of the swastika are turned to the right, even as the motif as a whole leans gently to the left. The lower arm is slightly longer, possibly because the craftsman found it difficult to cut the motif precisely on the curved body of the pot. The crossing lines are not at right angle and the arms also do not form precise right angles. The arms are not quite parallel with their opposites and the lower one is even thicker and more curved than the other three, which are of fairly equal thickness. The one on the left is also slightly longer. The appearance of the motif could reflect the limited capabilities of the artist or his ignorance of the motif. However, its size and position on the vessel indicate a desire for the motif to be seen, thus making it clear that it was recognized and intended.

A second example of the swastika on a pottery fragment from the archaeological site came from feature 38 (Fig. 4). It is not complete, preserving just one arm, the right one with the horizontal in reverse to the left; it may even not have been a swastika at all. We can take recourse to examples of vessels with incompletely preserved swastikas with arms turning all the different directions. Finds of this kind are known from early Slavic sites in Romania, Dulceanca I and Bratei (Fig. 5), and from the Polish Gniewkowo (cf. Werczyński and Rodak 2012: Fig. 2a) and Wzgórze Świętojakubskie in Sandomierz. The head of a flail from the second part of the early Middle Ages, an object made of entirely different material and with a different function, had two intertwined swastikas engraved on it, one growing from the other (Fig. 6; Kotowicz 2006: 54). Most of these examples of swastikas are of later date or from other regions and they

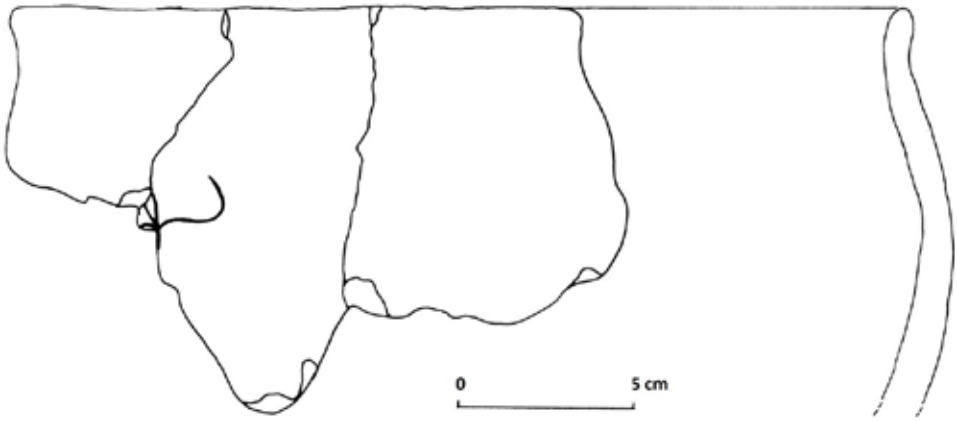

Fig. 4. Presumed swastika sign on a pot (No. 38), Ożańsk, site 5. Drawing by E.A. Marek

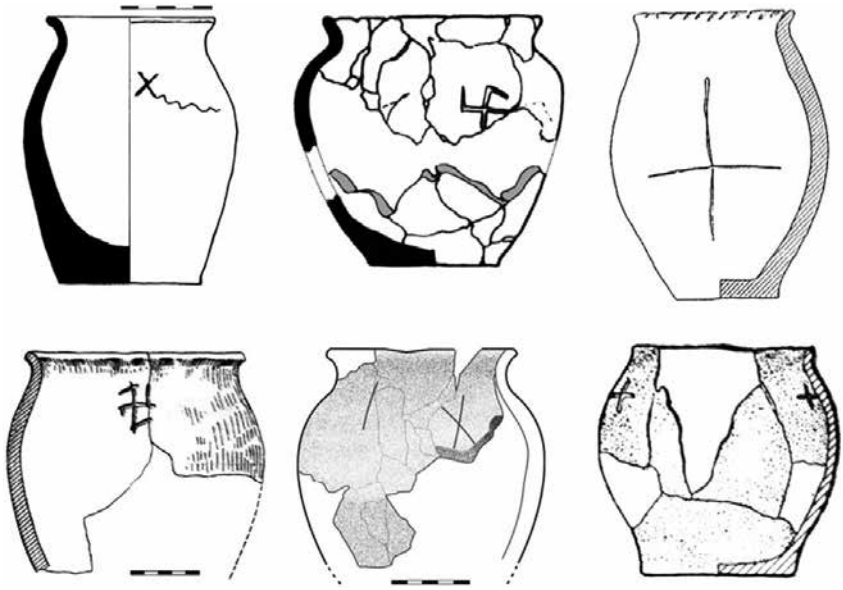

Fig. 5. Vessels with incomplete swastika marks from Romania (after Paliga and Teodor 2009: Fig. 27)

Fig. 6. Head of a flail decorated with two swastikas and concatenated arms (after Kotowicz 2006: Fig. 1)

show that the idea for the motif was not always presented correctly. However, we have no way of knowing whether swastikas without the proper arms or with the arms in reverse direction bore the same meaning as the most popular version.

Consequently, let us now focus on examining the motif of the swastika, its origin and symbolism. Obviously, as a motif it had many different meanings, specific to the ornamental context in which it was found. In the case of the Ożańsk site, it could well have been part of a message or some long-lost content. Looking at other examples of this decoration(?) on vessels and other objects may be of help in deciding this issue.

The Ożańsk sherd is not the only example of such a symbol on ceramic vessels from the early Middle Ages or from either earlier or later periods. It is known from almost all parts of the world and from different times and it is important to know what it was and what it was identified with. The simplest idea is that it is a cross with arms of the same length, bent at right angel either to the left or to the right. There exist many interpretations, but foremost is the belief that the swastika is associated with the worship of the sun going back to the Bronze Age. The sign was associated with light: the bent and rotating arms were interpreted as the sun's rays. It was one of the oldest characters in Chinese and Indian culture, recognized in India even 2500 BC (Eberhard 1996: 243). In Buddhism, Hinduism and Jainism, the swastika is considered a sacred symbol associated with prosperity and infinity. It is interpreted as a sign of cyclical fluctuation. The meaning of the word in Sanskrit is 'prosperity, charm' (literally *asti su* 'this is good'). The first such signs appeared in the Neolithic. This millennial custom

of placing the swastika on a variety of objects and in a variety of contexts was compromised in Europe by association with Adolph Hitler and Nazi rule, which made it synonymous with evil, bestiality and death. Increasingly, it is explained in different sources that the Nazis appropriated an ancient symbol for their own purposes. Europe remains ambivalent as to this sign, but the East, Asia in particular, appreciate the original positive meaning of this sign (cf. Zasuń 2011: 251).

The earliest examples of the use of the swastika on ceramics are vessels of the Globular Amphora culture from the last centuries of the fourth millennium BC in central and eastern Europe[2]. The two vessels from Rębków-Parcele village in Mazowieckie province (Garwolin municipality) appear to bear the first attestation of the sign in Polish territory. They come from graves I and II (see Nosek 1950: 83, 103). Four of the at least eight vessels from grave I were reconstructed almost completely (see Nosek 1950: 91). They constitute typical forms for this culture: amphorae, bowls, goblets. A swastika was engraved on the body of one of the amphorae, to the left of a handle, between two zones of dotted vertical ornament and immediately under horizontal lines of the same dotted ornament at the top of the body and around the neck. It runs to the left, its crossing arms straight and perpendicular to one another (Fig. 7)[3]. Of greater interest is an amphora from grave II, one of 14 vessels[4], bearing the sign of the swastika surprisingly inside the vessel, according to the excavator (cf. Nosek 1950: 94). The amphora had a short cylindrical neck decorated with an impressed rope pattern around it; the drawing of the swastika, set in a circle, on a sherd does not allow it to be positioned with regard to the vessel as a whole (Fig. 8)[5]; one can only assume that the sign was somewhere inside on the upper body, because otherwise it would never be visible and there is no reason to think that that was intended in this case. An unlikely scenario is that the swastika was drawn in the course of producing the vessel, but it is fairly evident that being as it is, a symbol of prosperity, the sun and well-being, it should have been easily recognized by all who discerned it. Of importance is the present author's conviction that this vessel was buried standing to the left of the head of the deceased[6]. A grave is where the *sacrum* meets the *profanum*, where things used during lifetime take on magical significance by being needed in the afterlife, where many things are different or even opposite from what they are on earth.

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[2] See www.ma.krakow.pl/wystawy/czasowe/przemoc_i_rytual

[3] There is no scale given in the source.

[4] Eight vessels were marked on the plan of the grave recording the group at the bottom, whereas Nosek's account totaled the number of vessels at nine; the upper and middle groups consisted altogether of five vessels, giving a total of fourteen, which is consistent with the number given by Nosek.

[5] There is no scale given in the source.

[6] The location of the vessel was marked on the plan of the burial; however, the skeleton did not survive and it can only be surmised that the body was laid to rest with the head to the north and in anatomical order.

Fig. 7. Amphorae from Grave I, village Rębków-Parcele (after Nosek 1950: Fig. 17)

Fig. 8. Jar (No. 3) from Grave II, village Rębków-Parcele (after Nosek 1950: Fig. 25)

Cemeteries are places where artifacts are often discovered in their original position. Both inhumation and cremation burials can hold grave goods (excluding graves of the very young or where Christianity banned grave furnishings). Ceramic vessels hold special significance, being containers for food and beverages intended for the afterlife in inhumations[7] and urns for the ashes in cremations. In the latter case, the urns were often covered with characteristic lids depending on the site and period. In Roman times urns were richly decorated. Decoration occurred also at the inception of the Bronze Age. A house urn from Etruscan territory now in the Vatican Museum (see Wilson 1896: 855, Fig. 183) has a richly decorated conical top seldom seen on similar vessels, including several swastika-related motifs; it is poorly dated with Wilson placing it in the Bronze Age (see Wilson 1896: 855).

The swastika sign on ceramic vessels from the pre-Roman and Roman period in Polish territory appears on two hole-mouthed vessels, one from Biała (Łódź province, Zgierz municipality) and the other from Gać (Subcarpathian province, municipality loco)[8]. The latter, dated by Bugaj to phase A_3 of the Pre-Roman period, shows an ornamental dextral swastika among other motifs in the second zone of decoration on the upper part of the vessel (Fig. 9). The vessel from Biała is decorated with alternately standing and suspended triangles below concentric grooves running around the body. The triangles are filled with line-hatching that goes in the opposite direction, the better to be seen. The decoration below the triangles is eye-catching (Fig. 10) (described in detail in Bugaj and Makiewicz 1995: 89, 91, 93, 96): three human figures, two possibly mounted on animals (horses?), the third as if in a side saddle. To the right of the latter figure is a cross with arms terminating in five prongs (only the right arm has six), similarly as the hands of the mounted human figurines. The first swastika appears to the right of the cross; it is dextrorotatory with doubled bars of the ending of the arms. Last is yet another mounted human figure with the same pronged hands. A second zone of decoration is on the base. There is a cross, like the one above, each arm ending in five prongs. The fields between the arms are filled with left-turning swastikas, two of them (lower left and upper right) with the ends of the arms doubled. Figures of two horned animals moving right appear to the right of this cross; they are approaching the last motif on the frieze, which is a mounted human figure like the ones in the upper zone.

Vessels from Romania from the early Slavic period are of the Prague-type with a sign of the swastika on each one; they come from the following sites: Bucharest-Cătelu

[7] Traces of alcohol and a variety of foods were found inside the vessels, for instance, in the grave of 'King Midas', cf. www.dydaktyka.fizyka.umk.pl/Wystawy_archiwum/z_omegi/naturemid.html (26.11.2014 r.).

[8] A *situla* from a Roman-age barrow in New Kraków, commune Darlowo site 1, has a narrow neck and is decorated at the base with a swastika ornament and staggered meandering *quad* zigzag lines (Skrzypek 2005: 232, Fig. 2).

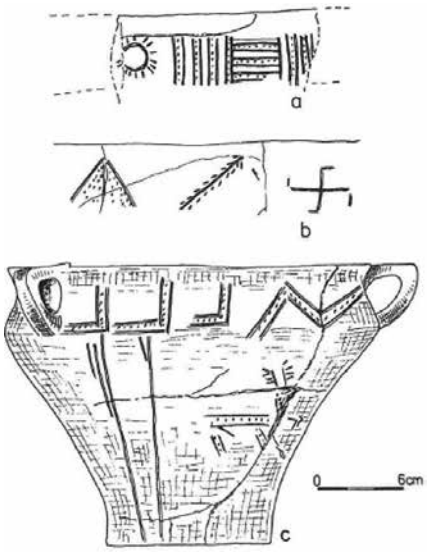

Fig. 9. Vessel from the village of Gać (after Bugaj 1995: Fig. 6)

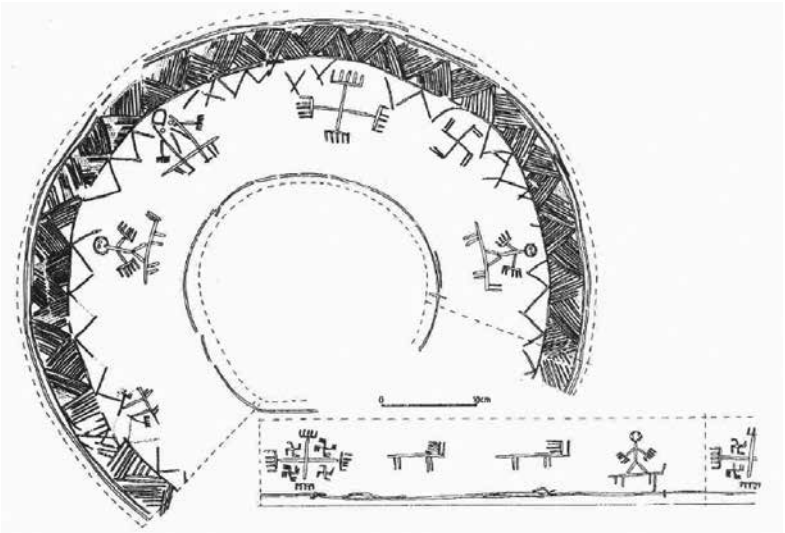

Fig. 10. Vessel from Grave 30 in the village of Biała (after Bugaj 1995: Fig. 4)

Nou Damaroaia Bucharest, Bucharest Str. Soldat Ghivan, Bratei and Dulceanca Dulceanca I and IV, and are discussed more extensively by Romanian researchers (e.g. Paliga and Teodor 2009: 150).The Slavs of the late sixth century AD from the territories of the modern Romania and Moldova were already in touch with the Christian world (Parczewski 2001: 15). The present author is of the opinion that the appearance of the swastika sign on ceramics associated with the Slavs should be attributed to this period and this part of Europe[9]. In the second half the early Middle Ages and later, the swastika was one of a number of potter's marks appearing on vessel bottoms. Examples illustrated here are a pot from Sandomierz (site of Wzgórze Świętojakubskie) dating to the eleventh or first half of the 12th century (cf. Gąssowska 1967: 159, Table. I, 13) and a vessel from Igołomia Wschód (Gajewski 1957). Other examples of swastika marks on vessel bottoms come from Jadowniki Mokre, Giecz, Gniewkowo, Wrocław, Prałkowce, Wiślica, and Kraków Okół.

Coins also often showed the swastika. The sign appears already on Indian silver drachmas in the second century AD (Fig. 11)[10]. In Scandinavia, the swastika can be seen on gold bracteates, associated most frequently with a human face in profile or a mounted horse rider (see Rosen-Przeworska 1980: Fig. 3a, d, e; 5a). An ancient coin from the territory of Palestine bears the motif set between two darts facing in the opposite directions, one pointing up, the other down (see Wilson 1896: Fig. 235). Of the Polish coins it is a denarius of Mieszko II that features a swastika on the reverse[11]. The pattern is repeated: a cross with dots between the arms set within a circle and swastikas outside the circle, marking the position of the ends of the arms of the cross. It is all the more surprising that these examples come from the second half of the early Middle Ages when we are dealing with a nascent state and not an unenlightened tribe, communicating in other ways than by generally recognized metaphors with the same meaning.

The examples discussed in this paper, a fraction of the artifacts bearing the sign of the swastika, come from different cultures, time periods and parts of the world. The first and most likely also the second vessel from Ożańsk indicates that the swastika on

[9] It cannot be excluded that when they first settled in Polish territories the Slavs came in contact with the peoples inhabiting the region earlier. The could have adopted the sign of the swastika from them, although the assumption today is that they considered it as little more than a decorative element and not a symbol of the solar cults. However, the swastika may have become associated with Christianity in the second phase of the early Middle Ages; in the early centuries of Christianity, the cross was not a common symbol of the religion, probably because of its connotations of persecution and sanctification resulting from the fact that the Son of God ended his earthly life on it, see Budda 2000: 98–99).

[10] There is no scale given in the source.

[11] Stanisław Suchodolski has demonstrated persuasively that the coin with the obverse inscription 'MISICO' and the swastika on the reverse belonged to Mieszko II and not his grandfather Mieszko I (cf. Suchodolski 1998, pdf version).

Fig. 11. Indian silver drachma from the 2nd century AD (www.coinindia.com/galleries-parata-rajas.html)

ceramic containers was intended to be seen. Its symbolic meaning as a symbol of light and the sun in this case is determined by the fact that while the settlement at Ożańsk dated to the early Slavic period, its population would not have associated the motif with the Christian religion, even if it had come in contact with the new faith. Assuming however contacts with other peoples, perhaps of Roman or Germanic provenance (possibly even Iranian or generally Eastern) and that as a people they were not originally associated with Christianity, we can interpret the discussed swastika ass a symbol of good fortune or merely a decorative element. The Ożańsk example may have also had an eclectic background, being associated with a pagan sun cult on one hand and a still not fully incorporated understanding of the Christian cross as a symbol of rebirth.

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State of research and research possibilities of early medieval pottery from the Prague production zone

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The current aim of the study of pottery from the Prague production zone is a detailed understanding of the changes in the pottery in connection with chronology and an explanation of the essence and causes of these changes while also capturing similarities and differences within the studied region. Accomplishing these goals will require a detailed evaluation of a larger number of pottery collections from key stratified contexts, i.e., from specific, chronologically well-defined contexts which were, for example, unaffected by post-depositional processes, created in clearly demarcated intervals or allowing an absolute chronology to be established for the events that they document. A comparative online database of pottery from the Prague production zone created for this purpose should speed up the flow of information on key reference collections from the studied area.

KEY-WORDS: early Middle Ages, archaeology, pottery, Prague, chronology, Ceramic Reference Collection

INTRODUCTION

As a basic archaeological source, pottery has long been a subject of study from various points of view and using a range of different methods. Pottery can be used to study a wide variety of subjects and phenomena, from learning about pottery as part of a living culture to questions concerning raw materials, technology, distribution and exchange, up to interpretations of post-depositional processes and their chronology. In this article, the early medieval pottery from Prague, the historical centre of Bohemia, is considered from the perspective of the evidence it can provide on socio-economic issues and transformation taking place in Bohemia between the second half of the ninth century and the beginning of the High Middle Ages. The core research was conducted on pottery from stratified layers in the historic centre of the city of Prague,

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discussed subsequently in a comparative study of key pottery collections from other historically known Přemyslid dynasty centres (Boháčová 2011).

In the case of pottery from the Prague distribution zone, the objective was to trace the qualitative changes in pottery over time in a specific micro-region, that is, central Bohemia, which is linked to the emergence of the early Přemyslid state. Pottery from various parts of this area reveals striking qualitative changes of specific attributes over time, indicating a concentration of manufacturing in specialised workshops in the Prague agglomeration or its immediate surroundings. These changes have been recorded throughout the entire historical centre of Bohemia. Considering that the evidence of stratification and other related sources indicate the synchronous nature of these changes in the studied area, pottery could be a possible source of data on many socio-economic issues of the period, including the conditions that led to the establishment of the early state.

There are still large gaps in our knowledge of this pottery and its development despite the existence of an extensive body of high quality data. This is because the data is not accessible. Moreover, not all of the results are accepted without reservation and in the long run it has proved impossible to achieve a consensus even on how to present and describe this pottery, not to mention the choice of documentation and analytical methods, which remain of marginal importance. However, the use of additional sources and a comparative study of the evidence provided against existing data will be essential to verify and expand current knowledge on the subject. Building a comparative database of reference collections is one possible way of resolving this research quandary. Being easily accessible, it would greatly facilitate the exchange of information between researchers from different disciplines, providing regularly updated and most importantly standardized (to the degree that is essential) data on fabrics, find contexts and chronology.

MEDIEVAL POTTERY FROM PRAGUE AS A SOURCE

The pottery assemblages from the earliest stratified contexts in the historical centre of Prague are consistent with assemblages from sites with long-term intensive development characterised by a bipolar development of the cultural layer. Interest is limited in this case only to pottery from the period of natural deposition, which ended in left-bank Prague generally in the course of the first half of the thirteenth century. The thickness of these layers depends on individual site morphology and exposure, fluctuating in the studied area from several centimetres up to several metres thick, the latter occurring exceptionally on the slopes of the Hradčany promontory.

Pottery from the said age is heavily fragmented, the sherds in the collected assemblages seldom exceeding from 5 to 15 cm^2 and intact vessels being rare. The size of

individual collections is dependent on the excavation scope, but also and perhaps primarily on the find context and its origin. Numbers of potsherds range between several to hundreds and even thousands. The assemblage composition depends both on the character of the find context and on the intensity of post-depositional processes and their nature. In the case of pottery from the earliest phase of early medieval development in Prague, it comes from mostly fragmentary cultural layers or terrain with numerous and substantial developmental gaps. The distinctive and varied morphology of the Hradčany and Malá Strana areas strongly impacted the formation of the cultural layer in left-bank Prague with parts of the district being subjected to spontaneous human activities as well as erosional processes. It should also be kept in mind that the construction of the royal residence and the vast system of fortifications necessitated large-scale landscape modification and the movement of considerable amounts of soil. Even so, the deposition of the cultural layer in this part of Prague is regarded as natural because relocation concerned only parts of the layer locally and the soil was never removed. In contrast, the historical centre of Prague on the right bank, which was settled later, has yielded pottery only from the latest phase of the early Middle Ages and later, and for these periods sustained accumulation processes were more typical.

Collections from key stratified positions were chosen for detailed pottery analysis. These included positions that: 1) represented natural accumulation without later intervention; 2) were sealed from bottom and top with chronological dating evidence for the time of the sealing; 3) were linked to absolute chronology dating (from the nature sciences, art history, clearly associated reports from written sources). Collections from the fill of features excavated in Prague were mostly of minimal testimonial value for pottery analysis. One exception was a small number of uncontaminated fills of features from the earliest settlement horizon dug into the subsoil, or entirely rare features producing artifacts from the period of use.

The basic developmental phases of early medieval pottery from the period between the second half of the 9th century and the first half of the 13th century are known and have been described thanks to the long-term study of early medieval pottery from stratified contexts in the historical centre of Prague. Recent decades have witnessed the development of the exact sciences and, thanks to the systematic search for support in the effort to refine the chronology of individual pottery horizons, not only to a more precise dating for specific pottery types, but also to a significant shift of the entire later part of the early medieval Prague pottery sequence deeper into the past. Two factors play an important role in refining the pottery chronology. The first is the fact that the historical left-bank centre provides the possibility for the repeated verification of the same find context at multiple locations (the origin and the development of the fortification of both castle and suburb, preserved complexes of historical features, churches). Second is the occurrence of early medieval Prague pottery throughout central Bohemia. Large collections enabling a comparative study of pottery development linked to

absolute dates come from fortified sites, be they historically known centres or merely archaeologically confirmed locations. The study of pottery from Prague is based today primarily on an analysis of fabrics and pottery morphology. Detailed research, which unfortunately includes only limited and unsystematic exact documentation and analytical methods, is increasingly focused, apart from chronological issues, on the study of the organisation of production, distribution and exchange of pottery and the inherent changes over time. Due in part to the nature of the find collection, the morphological variety of the vessels and their functional use remain an entirely marginal subject for this period.

STATE OF RESEARCH ON MEDIEVAL POTTERY FROM PRAGUE

Researchers have generally accepted the following basic development characteristics of Prague pottery:

1) a rapid development of vessel morphology (rims) at the end of the Middle Hillfort period (first half of the 10th century) and during the Late Hillfort period (from the middle of the 10th to the end of the 12th century); 2) a close relationship between morphology (and often decoration types) and the ceramic matrix; 3) the relative sequence of a small number of basic defined types (Figs 1 and 2); 4) a general link between the relative sequence and timeline; and 5) beginning in the 1990s, a significant shift in the absolute dating of the latest early medieval pottery (pushed back by 100–150 years).

These characteristics are based on the latest processing and revision of the findings of earlier archaeological excavation, clearly demonstrating the indefensibility of an earlier chronological concept which placed the primary occurrence of the latest horizon of Late Hillfort pottery in the thirteenth century.

The current study of pottery from Prague is impeded by a range of factors, the first being a mostly individualistic approach ('personal' chronology tied directly to absolute dates with the possibility for their revision, personal typology). The second factor is the lamentable state of publication of key reference collections, which, once presented, could verify or refine current views on the pottery development, e.g., stratified contexts dated by coins and other significant assemblages. Moreover, interdisciplinary cooperation is mostly based on random personal contacts, not on the professional abilities of the parties involved. Prague archaeology lacks the appropriate experts with an interdisciplinary focus and is unable to take advantage of the results of frequently costly analyses for comparative studies. A new general problem is the rising wave of new archaeological organisations lacking any experience with the Prague environment and with research on urban agglomerations as such. The specific situation of investigating major European cities requires a systematic solution for processing Prague's vast and

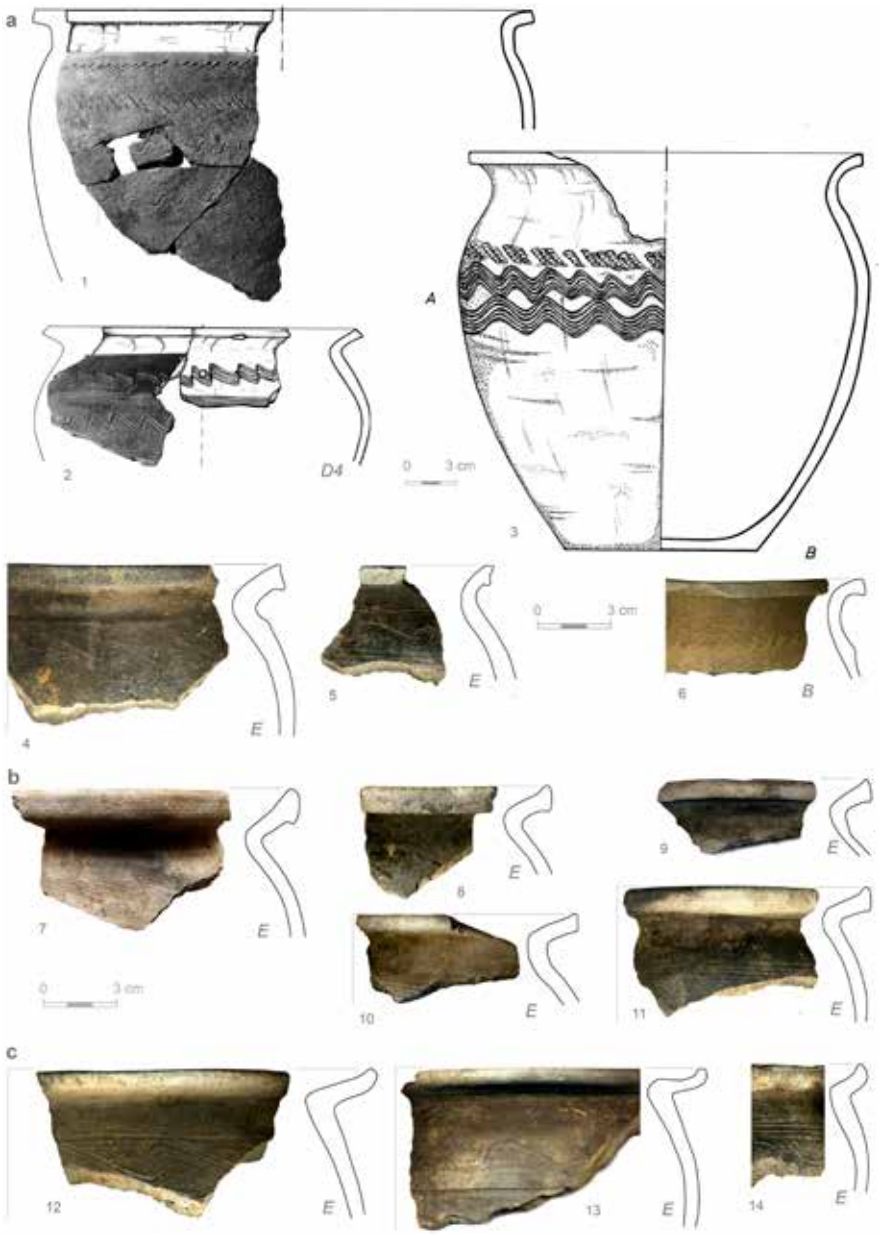

Fig. 1. Development of pottery from Prague between the second half of the 9th century and the first half of the 10th century (Middle Hillfort Period). Selection of representative pottery types from the find collection of Hradčany for specific defined pottery horizons. a – horizon A; b – horizon Bo (10, 11?); c – horizon B1. The letters in *italic* indicate the vessel matrix

Fig. 2. Development of pottery from Prague between the second half of the 10th century and the beginning of the 13th century. Selection of representative pottery types from the find collection of Hradčany for specific defined pottery horizons (Late Hillfort Period 1 and 2). a – horizon B1/B2 (1); horizon B2 (2–5); b – horizon C, typologically and technologically differentiated pottery horizon with trussed rims. The letters in *italic* indicate the vessel matrix

rich archaeological find collection which, however, is not a top priority for objective reasons. These factors hinder a long-term comprehensive study of Prague pottery in all of its aspects, including a basic synchronisation of the development of the Prague agglomeration as a whole.

METHODOLOGY, OBJECTIVES, RESULTS AND CURRENT ISSUES IN THE STUDY OF POTTERY FROM THE LEFT-BANK OF THE HISTORICAL CENTRE OF PRAGUE (PRAGUE-HRADČANY)

Based on the study of selected collections from Prague-Hradčany (the Přemyslid castle and its Hradčany suburbs), key *pottery horizon* definitions for pottery from Prague between the second half of the 9th century and the first half of the 13th century were refined and further subdivided in several cases. Collections found in multiple locations beneath the first wood-and-earth rampart, as well as pottery from the body of the wall were chosen as being of key importance for the study of the earliest pottery from the Prague Castle. Support for an understanding of the development that followed was provided by a lone find context that captured a stratified cultural situation in a recessed part on the inside of the wall linked to a date in the absolute chronology. The next pottery development stage was captured in collections of finds from a later expansion of the transverse wall of the acropolis. These collections were studied macroscopically, paying special attention to identifying classes of the ceramic matrix, vessel morphology and links with employed decorative elements. Two chosen reference collections were studied in detail (Fig. 3), whereas other collections were subjected to comparative study. The results were used to establish basic pottery horizons which were gradually linked to absolute dates and, for the first time in Bohemia, to a series of dendrochronology dates from a structure dividing the earliest part of the stratified layers from the wall body (Dvorská and Boháčová 1999). This led to a refinement of the chronology of primarily the earliest part of the sequence prior to the emergence of advanced and unified Late Hillfort pottery with *calyx-shaped rims* (in the 930s and 940s). The problem that persists is refining the chronology and gaining a more detailed understanding of the development of this dominant type of pottery in a period until at least the middle of the 11th century. Systematic attention was also paid for many years to the latest phase of early medieval pottery, that is, the pottery horizon with *trussed rims* (for a division of the horizon, see Hrdlička 1993; Fig. 2: b). Although certain sub-variants in its development were confirmed and even newly identified, no support for refining its chronology was found at Hradčany (cf. Budeč--Bartošková 1999). The latest defined horizon, which extends already into the High Middle Ages, also has no clear link to dates in the absolute chronology. Support for its placement in the Prague sequence has been found only at the short-term site of Sekanka (Richter 1982), which is outside, but not far from Prague territory.

The results of the study of pottery from Hradčany were published in the 1990s (Boháčová 1996a; 1996b). Subsequent analyses of pottery, including ceramics from other Přemyslid localities, led to the first synchronisation of their development

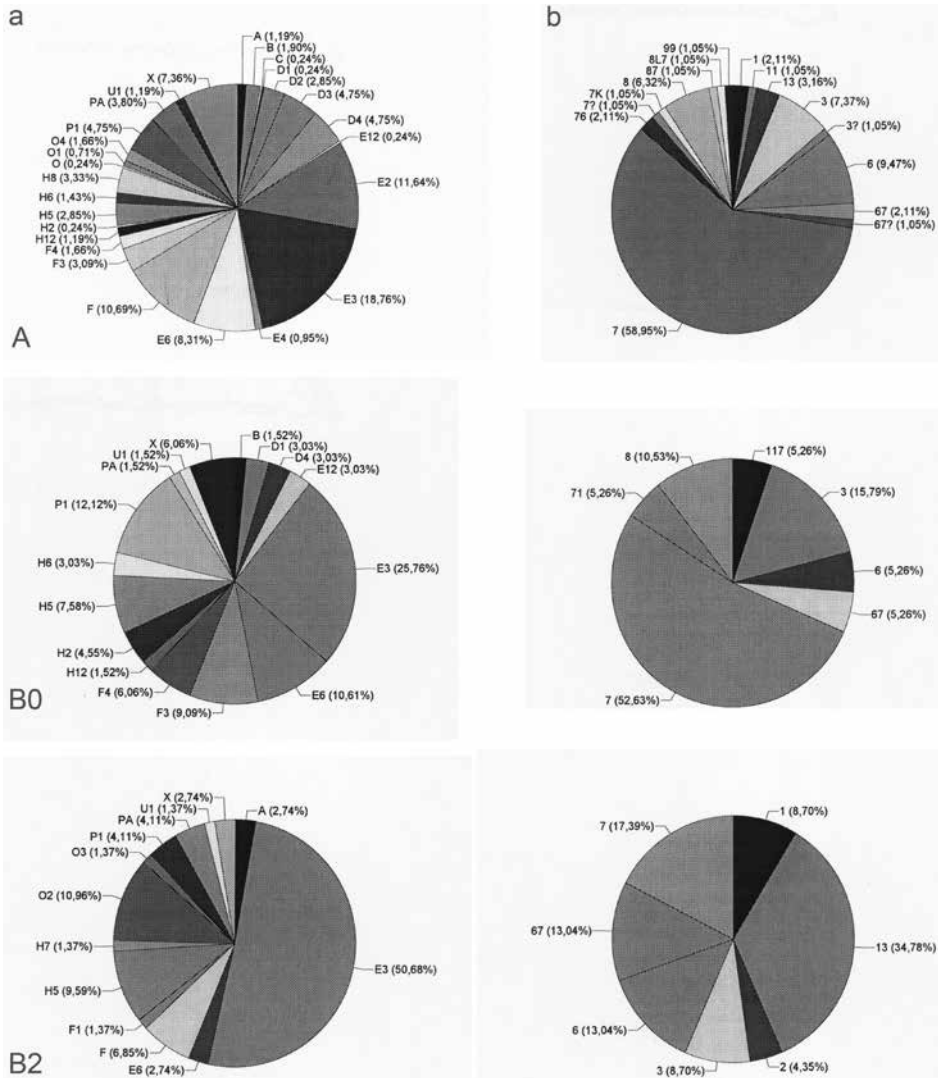

Fig. 3. Development of the presence of pottery classes (a) and decoration (b) in reference collections linked to stratigraphy (horizons A: 421 pcs, B1: 66 pcs and B2: 73 pcs). E3 (=E) *grey ware*, which is typical especially of pottery production in Prague in the late phase of the early Middle Ages (see Figs 1–2 and 7)

(including left-bank Prague); these were then verified and deepened (Boháčová 2003; 2008; 2009), laying the groundwork for a more generalized approach. The conclusion is that significant qualitative change in pottery production during the course of the early Middle Ages in the historical centre of central Bohemia took place in three distinct waves, reflecting socio-economic processes related to the emergence and subsequent consolidation of a central power, the Přemyslid state (Boháčová 2011; 2013).

Qualitative change in pottery production has been recorded macroscopically, but the theory of the development of this pottery has not been precisely defined and still needs refinement and verification. Firstly, there are specific points of the theory, like the emergence of *rims with a collar-shaped indentation*, which are based on a single find context and are not supported with sufficiently strong arguments (this point was challenged: Čiháková 2012: 103–106; although with flawed argumentation, especially in the case of pottery type identification). Secondly, existing knowledge of pottery development is uneven and has many gaps, for which sources are still missing. Verifying the general validity of the hypothesis concerning the association of qualitative pottery development with socio-economic issues is possible only through a comparative study of pottery from important stratified sites in Prague and its surrounding area.

In addition to verifying basic pottery development and systematically refining its connection to absolute dates, the present study was aimed at a detailed understanding of the technological process, its transformation and the links between specific types of pottery and the raw material used in its production. Exact science methods (considerably limited by their cost) were applied to the analysis of a small number of samples of representative pottery types from the individual pottery horizons (Boháčová and Kašpar in press; Gregerová 2012). Agreement between their testimony was sought and the testimonial value of available macroscopic studies was verified, although so far the results are on a documentation level, rather than analytical, due to the small number of petrographic and especially chemical analyses. To date, the sole unequivocal result of the analyses is the provenancing of the raw material for the production of a dominant typical group of late medieval Prague pottery. This *grey ware*, which is a quality-fired, medium-tempered, medium- to thin-walled pottery (matrix symbol E, E1–E4, E12, O1, O4 in the figures) was made of clay coming from deposits in an unknown location in the Prague Basin.

Given the predictably diverse origin of pottery used in medieval Prague and the described character of the pottery collections from the city, it is clear that even in this case research will require sources from additional sites at which pottery from the Prague sequence occurs along with local production. The first results in this direction were provided by an analysis of pottery from Přemyslid Stará Boleslav (Boháčová 2003), where pottery from a local and the Libice production zone was identified and verified using exact methods (Fig. 4).

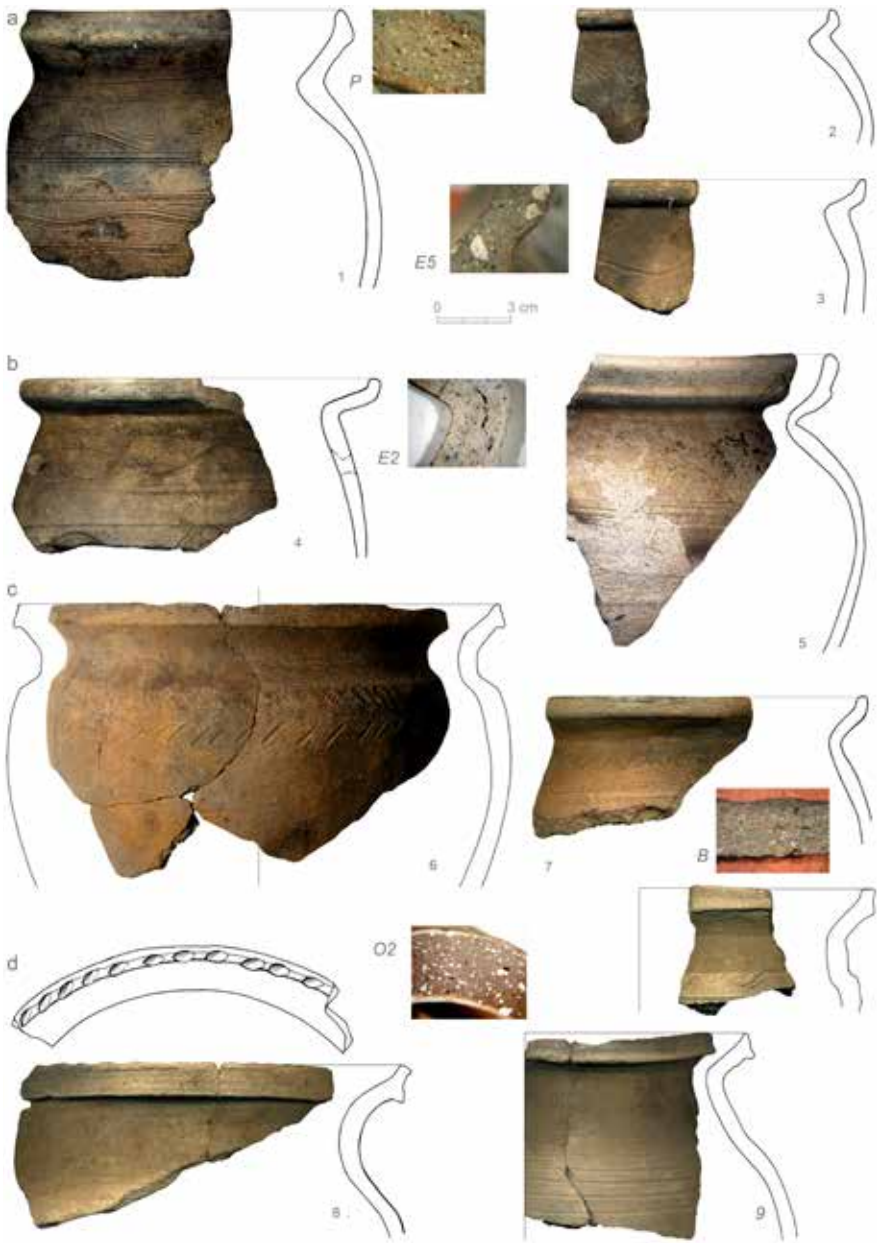

Fig. 4. Samples of pottery from regional production zones. 1 – Stará Boleslav: a – local production of the Middle Hillfort period (with petrographic and chemical evidence); b – production from the Prague zone (?) of the Middle Hillfort period; c – production of Libice on the Cidlinou zone (c: 7 with petrographic and chemical evidence) of the Middle Hillfort period; d – local production of the Late Hillfort Period (with petrographic and chemical evidence; after Boháčová 2003)

CURRENT POSSIBILITIES FOR STUDYING EARLY MEDIEVAL AND EARLIER HIGH MEDIEVAL POTTERY FROM THE PRAGUE PRODUCTION ZONE

Still missing from the study of pottery from Prague is the important link between data on pottery from the historical city centre and from its immediate surroundings as a whole. Although some of the conclusions were confirmed by an analysis of stratified contexts outside of Prague, further progress in research is dependent on comparing the results with the evidence from other key pottery collections. In the current situation of Prague archaeology and its continually increasing collection of finds, the sole viable and possible form of disseminating information among researchers is an online, editable comparative database of pottery from the Prague production zone. This should increase information flow concerning key reference collections from the studied area, giving access to descriptions and analyses and enabling a basic comparison of the collections, thus facilitating the development of descriptive systems and interdisciplinary studies.

The concept of the database is based on the availability of information , which is easy to use and complemented with simple and adequate graphic presentations of selected collections with exceptional testimonial value from Prague and its hinterland, and their find context. The aim is to bring together in one place all the relevant information for pottery research, such as descriptive systems, professional assessments, etc. These can be either directly accessible for professional use while respecting established copyrights or at least recorded by the system in the form of bibliographic references. At the same time, the database should be an open system that presents pottery horizons defined by date and with well-grounded definitions. It is built as part of the online Integrated Information System of Prague Archaeological Sources (NAKI program project DF13P01OVV014 for 2013–2017, funded by the Ministry of Culture of the Czech Republic), the goal of which is to provide access to information on archaeological sources in GIS to the research community. The primary objective of the project is to facilitate the evaluation of the extensive archaeological collections from Prague, including pottery, which is a basic archaeological source, in broader contexts and on a wider scale corresponding to the cadastral map, as well as smaller scalesThis system is constructed to be used with data from any archaeological sitethe study and evaluation of which requires spatial data in a relevant degree of detail.

DATABASE STRUCTURE AND STANDARDS

The database is conceived as five separate data classes independent of one another. They are composed of two types of reference collections: 1) **key pottery collections**, i.e., collections with extraordinary testimonial value (Fig. 5); and 2) **samples of local pottery**, drawn from a more or less defined selection of pottery typical of the selected

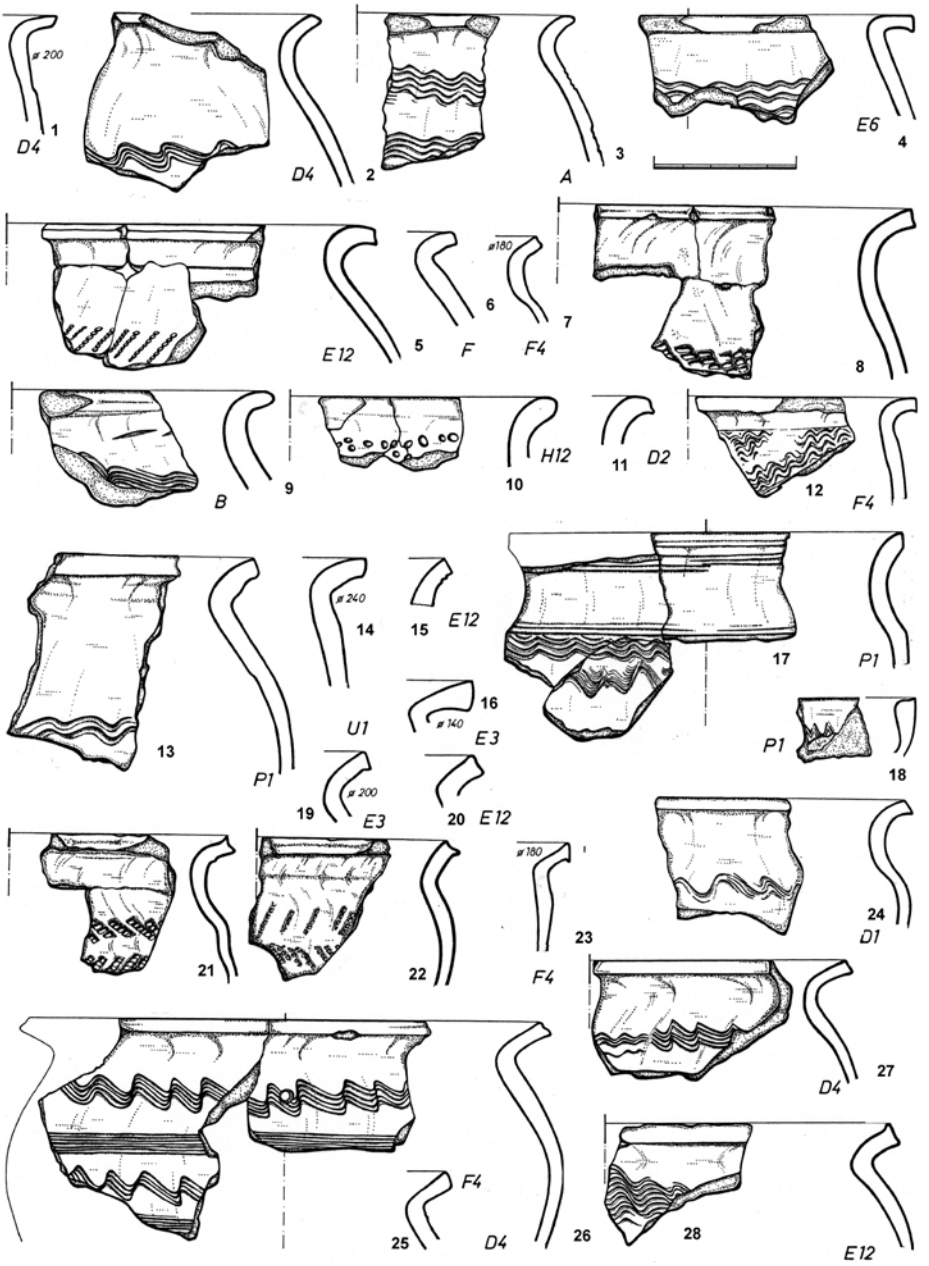

Fig. 5. Example of a reference assemblage: rim types and decoration from a stratified context in the body of a wall. *Terminus ante quem* for the assemblage: dendrochronological dating to 908–917 from the oak structure in the immediate overlying layer

sites (Prague, central Bohemia and possibly other relevant collections), sometimes older in terms of their dating (Fig. 6; Šolle 1966: Figs 32, 59, 60). Other (already interpretive) data classes are: 3) **defined pottery horizons,** which should be accompanied by documents supporting their chronology, and 4) **pottery classes**, which have been identified and which are represented by macro- and micro-images of the ceramic matrix of specific pottery vessel types (Fig. 7).

The database will also include information taken from another part of the Information System (**data class analysis**), providing links to results of existing exact analyses and bibliographies. The data class analysis will collect information from completed analyses that can be searched by the type of matrix and the type of analysis, and potentially also the results. These analyses have not yet been included in any specialistic

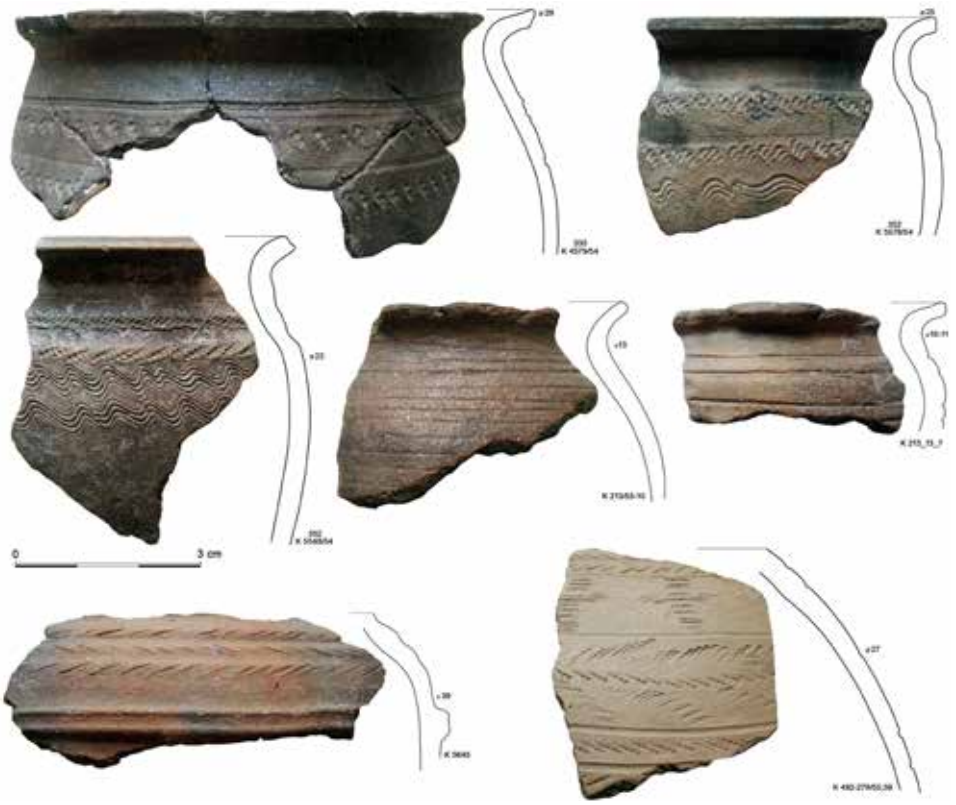

Fig. 6. Example of a reference assemblage: samples from Kouřim (central Bohemia, Kolín district; part of horizon B1; excavations of the Institute of Archaeology, Prague; after M. Šolle 1966).
The author thanks the Regional Museum in Kolín for providing the material

(maybe professional) records and some are not even publicly accessible. Each of the data classes will contain graphic and textual documents and their relevant metadata (Table 1). Basic common standards are assumed for the graphic data presenting pottery collections (resolution size, document, scale, documentation of vessel cross-section, documentation authorisation). Since the database is conceived as a working tool, it

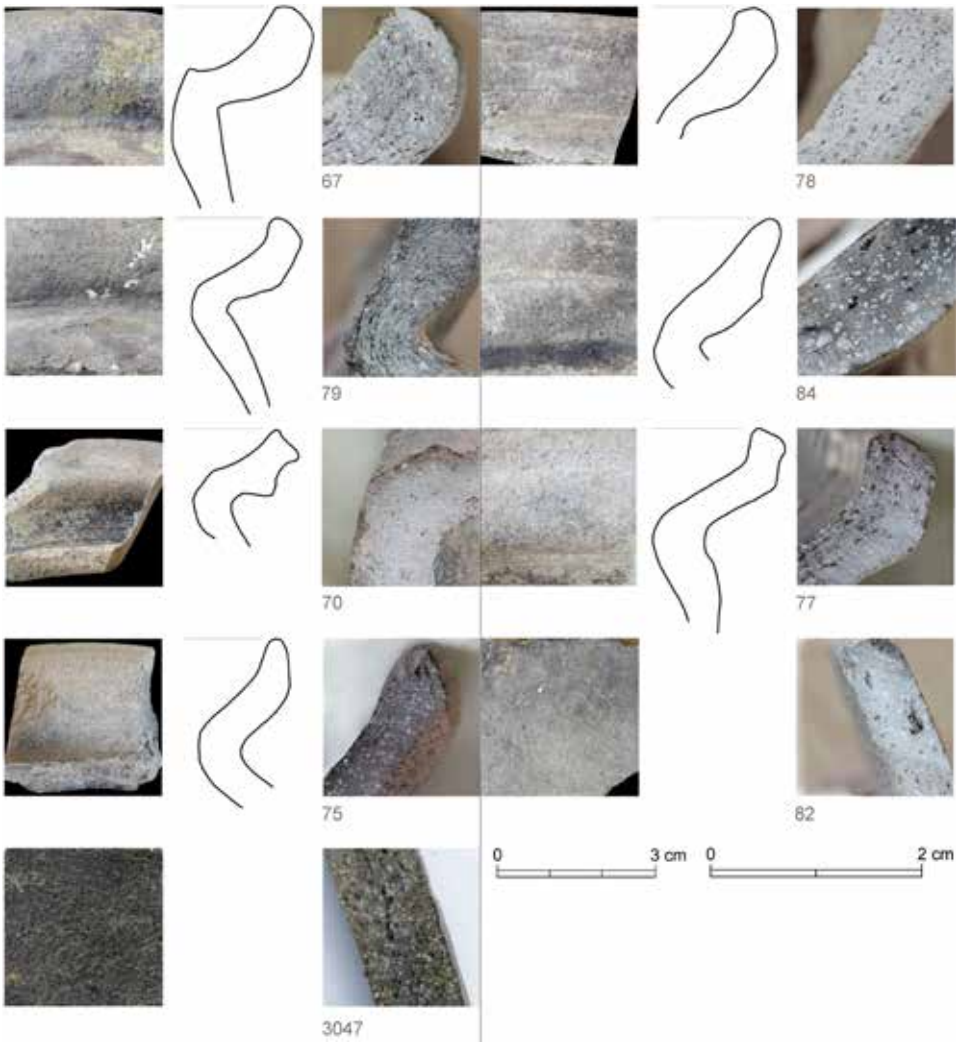

Fig. 7. Example of the presentation of defined pottery class representatives. Macro images of the ceramic matrix of the *grey ware* pottery with *calyx-shaped rims* from Prague

Table 1 Structure of data for the database catagories: a reference pottery collection, pottery horizon and matrix.

Reference pottery collection (RPC) – data files	**'Examples of data (a fiction)'**	**'Pottery horizon – data files (catagory of interpretation)'**	**Fabric – data files**
site	Prague	pottery horizon – autor´s indication	general description of pottery type (incl. morfology, decor)
zone of distribution	Central Bohemia	chronology	description of matrix
chronology – interval of finds dating	MHP-MHP/LHP1	comment on the find context	description of admixture
horizont of stratification /a period/ – autor´s indication	D	chronology – first appearence	petrocraphic data (if any)
horizont of stratification – ceramic´s type	FAP of calyx shaped rims	chronology – ending	chemical data (if any)
id of excavations	7777	indication of pottery types (PT)	raw material
charakter of RPC according to the find context	rempart inventory	description of inovation elements	
charakter of RPC (type of selection, sampler etc.)	selection of rim types	comment on the definition state	
specification of chronology: archaeological context	LHP1	comment on possible segregation	
specification of chronology: absolute data	after 900	synchronisation with another local pottery (if any)	
presented type of matrix	A, D, E, O	autorization	
summarization of complex	352 pieces/500 g	bibliography	
presented special type of pottery/of element	bottle/handle		
autorization			
bibliography			
links to the figures of pottery	www.prague-archeo-184	links to the figures of PT	links to the figures of pottery surface
links to the field documentation	www.prague-archeo-284	links to the data and the description of PT	links to the figures of pottery section
links to the special analyses records (if any)	www.prague-archeo-289		links to the figures of potery microstructures (if any)
			links to the presentation (if any)
			links to the analyses (if any)

Key: FAP – first appearence period; RPC – reference pottery complex; MHP – Middle Hillfort Period (c. 850-950); LHP – Late Hillfort Period (1 – *c.* 950–1050; 2 – 1050–1200); PT – pottery type. Version: January 2015

also assumes the possibility of using entirely standard work documentation. The condition for key pottery collections will be the publication of accompanying field documentation, making it possible to verify the find context. Searching the database will be possible by region (distribution sphere), site and the generally accepted chronology, as well as by chronological classification, taking into consideration the state of research on a given regional chronology and certain technological pottery characteristics. Although the database is not primarily focused on vessel typology, it will be built as an open database also from the perspective of possible descriptive categories, and it is assumed that a general system for the description of morphological types and the recording of metric data will gradually be designed and developed. Existing attempts to build a universally applicable system have touched on the problem of individual needs and access to descriptions, but also on objective causes such as divergent demands on the description of early medieval material, mostly potsherds representing simple pot-shaped vessels, and on the description of typologically differentiated and frequently reconstructable (thanks to being found in sealed contexts like pits or wells) pottery from the High Middle Ages and the early Modern period. Current imaging techniques and the possibility for comparison on the Internet nonetheless facilitate a quick transfer of relatively precise information, which is the primary condition for further possible advancement in knowledge of the pottery from Prague.

CONCLUSIONS

The study of medieval pottery from Prague calls for closer cooperation within and between disciplines. The foundations for a systematic study of pottery were laid during the first large-scale rescue excavations in the 1970s. Although knowledge of medieval pottery from Prague has expanded, the current state of research is not in line with the testimonial potential of the rich collection of finds that Prague archaeology possesses and which continues to grow exponentially. Under the current conditions of Czech archaeology, the sole effective solution that will prevent further aggravation of this situation is a generally accessible information system that will facilitate the exchange of basic information within and between disciplines, and thus encourage the study of pottery and other types of archaeological sources and their comprehensive analysis. There are numerous current tasks in this field. From a general point of view and from the perspective of priorities, the study of the Prague agglomeration offers the following subjects:

1 – further refinement of the typological content of pottery horizons;
2 – refinement of the absolute chronology of pottery horizons;
3 – study of qualitative changes in pottery and their clarification;

4 – study of sources of raw materials and their provenance; and
5 – study of distribution zones.

The first two thematic areas are important from the perspective of the essential synchronisation of development, especially in the Prague agglomeration, as well as and at the very least in central Bohemia. They are also pressing with regard to the integration of archaeological testimony into the current approach to a reconstruction of the past. The study of the next three subjects should help to clarify the striking agreement between the distinct qualitative changes that can be traced in early medieval Prague pottery and the individual stages of the building of the early Přemyslid state – be they manifestations of the society's economic growth or the centralised power of the ruler and the satisfaction of his needs.

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Restoration and conservation of Tilmen Mound ceramics

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Tilmen Mound in the province of Gaziantep in southeastern Anatolia in Turkey was first discovered by Prof. Bahadır Alkim and his assistant Refik Duru in 1958. Excavations were carried out until 1972 and restarted in 2003 within the framework of Turkish-Italian cooperation conducted by Nicolò Marchetti from the University of Bologne; this work was continued through 2007. Restoration and conservation work was carried out on site and in the laboratory, in the latter case including ceramics from various seasons, which differed in their state of disintegration depending on how well they had been fired and the quality of the original craftsmanship. The article presents conservation practices applied to the ceramics from the Tilmen Mound and the results that were achieved.

KEY-WORDS: Tilmen Mound, ceramics, restoration, conservation

The İslahiye region is a narrow strip of land 80 km long, extending from the southwest to the northeast between the Amanos and Kurt mountains, surrounded by the provinces of Osmaniye, Kahramanmaraş, Gaziantep, Kilis and Hatay. In geomorphological terms, it is a land-filled fault line. A series of small plains: Hassa, Altıntop, İslahiye, Zincirli and Sakçagözü are located along this line. The İslahiye valley extends from the Taurus Mountains to the south, through the Biga and Jordan valleys to Syria, Lebanon, Palestine and Israel, and to the Red Sea and East Africa. Karasu is the most important stream of the region and it flows into the Amik plain.

Archaeological research in the region began in 1883 with the discovery of a large number of engraved stone orthostats. Osman Hamdi Bey who excavated the stone slabs, was the first Turkish archaeologist on the mound that is the site of the village of Zincirli near Fevzipaşa. Excavations unearthed evidence of cultures going back as far as the 6th millenium BC. An extensive archaeological research program was carried out in the İslahiye Region in 1955–1972, headed by Prof. Bahadır Alkim of the İstanbul University Faculty of Letters, Department of Ancient Near Eastern Languages and Cultures. Almost all of the ancient sites in the area were surveyed in 1958 and Tilmen Mound was first identified then. Excavations were carried out in the years that followed, up to 1961, at the site of the so-called Yesemek Sculpture Workshop, which had

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become important for local tourism, and then at Tilmen, Gedikli Karahöyük and the Kırışkal Mound. Excavations were restarted in 2003 and continued through 2007 by Nicolò Marchetti from the University of Bologne working within the framework of Turkish-Italian cooperation. With this new project, old centres from the mountainous regions to the plains, including some ancient settlements in Islahiye were examined for conservation (Duru 2000, 2001, 2003; Marchetti 2008).

Tilmen Mound is situated in a mountainous plain with a large number of hill peaks and basalt veins, on the coast of Karasu stream to the east of Islahiye town in the province of Gaziantep. Nine building phases over a period of one thousand years between 3000 BC and 2000 BC accounted for the accumulations. During the first five phases, walls of mud brick were raised on the walls of earlier settlements; later stone architecture was introduced. The current project aims at reevaluating old settlement patterns, learning about land cultivation models and understanding society development, which reached a peak during the Roman Empire with the highest density of settlement in the valley and the hills bordering it.

Ceramics were an important find at Tilmen Mound. The main difference between the Late Chalcolithic and Early Bronze Age was the disappearance of 'Obeid like' pottery, replaced by a local wheel-made fabric with a reddish orange paste, which was generally in the third millennnium BC the main pottery found in the Islahiye plain; it is known from the mounds in the Plain of Amik and the Çukurova 'Gözlükule Mound' where it is referred to as 'Brittle Orange Ware' or 'Red Gritty Ware'. The most developed examples of this pottery have been found in the İslahiye region. The people here from 3000 BC to 2000 BC were apparanetly native to the region, but under strong cultural and material influence of their neighbors, especially from central Mesopotamia, as attested by individual finds of a pointed base belonging to a Syrian bottle and a bulla from the Akkadian period.

CONSERVATION WORK

Restoration and conservation work was carried out on site and in the laboratory. Interventions on site included ground consolidation and integration of displaced stone parts, wall bondings and plaster at risk of collapse.

Laboratory applications, which constitute the subject matter of this paper, include clay objects found during different excavation periods. Their state of preservation depended on their firing and quality of craftsmanship.

In 2006, a kiln and two large clay vessels were discovered in the courtyard of the Big House. The pottery was studied and documented prior to conservation and found to be handmade with a porous structure dependent on the degree of firing, covered

with surface dirt and partly deformed, but in a condition that permitted conservation without the need to consolidate.

Following documentation, the objects were cleaned of the surface dirt using a soft brush and 50% solution of alcohol and water or water alone, and were left to dry in a shady place under control. To enable temporary assembly, the pieces were numbered from the inside, the surface being treated first with an acryllic resin (Paraloid B72) solution; numbers were introduced with an acetate pen which is easy to remove later using acetone. Vinyl resin K60 in alcohol was used for assembly of the smaller parts in order to ensure reversibility. In the assembly of base parts or bigger pieces, a two-component epoxy resin (Sintolit C) was preferred, being heat resistant and having a high binding power. Pieces were fitted together experimentally first. They were fixed from inside and braces of epoxy resin were introduced to enable better fastening in view of the size and weight of the vases. Epoxy resin was also used to assemble parts, the surface of which was covered with white plaster to have a better appearance. Missing parts were completed after the parts were assembled and the surfaces were sanded using sandpaper of various thickness to remove any irregularity. Integration not coloured at once for lack of time was coloured later during four days of work at Gaziantep Museum where the objects are kept. Lastly, the remaining adhesive and plaster were cleaned and the last touches were made. As the overall condition of the pottery was good, it was not necessary to apply any kind of surface protector or consolidator.

In 2007, excavation of a monumental stairway of stone leading to the palace quarter in the lower city and acropolis uncovered a great deal of pottery. It belonged to three different periods. A jar for storing food was found in very good condition in the Palace Region. The object was cleaned of surface dirt by brushing with water. Lime-stone covered parts were cleared off mechanically using a bisturi. The jar was handmade and had a porous structure like the vessels from the Big House treated earlier. Their state of preservation was good and did not require pre-consolidation. The dirt was removed by washing with water and leaving to dry in a shady place under control. The insoluble salty efflorescence was treated with a chemical solution by immersion in a bucket filled with formic acid (10% in water), but only after the pieces had been soaked in water for 5 hours to avoid penetration of the acid solution into the porous structure. After the acid treatment the pieces were left in distilled water for 24 hours, the water being changed every 5 hours. Lastly, the pieces were tested one by one with a Ph meter. Broken parts were assembled using a two-component epoxy resin (UHU Hart). The pieces were fixed from inside considering the size and weight of the object and to enable better fastening, fillings were made with another epoxy resin (Sintolit C), which was also used to assemble the parts, the surface of which was covered with white plaster. The missing parts were completed with quick-drying plaster and coloured in a paler

shade than the clay itself. By applying a second coat of paint where necessary, the homogenous spread of paint on the surface was attained. Based on the original colour of the surface, a different colour was prepared, and spurted on the first application by the help of a toothbrush. In this way, the porous structure of the object and variations of shades of colour were emphasized.

Other finds were also reassembled following cleaning. Pieces were all brushed with water to remove surface dirt and earth. Mechanical methods were applied to hard soil covering some pieces. Assembly was done with an acryl resin (Paraloid B72 in 45% acetone) to ensure reversibility. However, some objects needed to be assembled and filled with epoxy resin (Sintolit C) to enable better fastening. The missing parts and the epoxy fillings were completed using quick-drying plaster. Surfaces were sanded using sandpaper. Lastly, surfaces were coloured a paler shade than the clay itself.

CONCLUSION

The excavation officially ended in 2007 and the Archaeological Park project applications which started in 2006 were resumed and the park was officially opened on 24 October 2007. The Tilmen Mound ceramics and other finds are exhibited at the Zeugma Mosaic Museum in Gaziantep.

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Workshop pottery from the early phases of the early Middle Ages in the Middle Odra basin in the light of specialist analyses

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Recent specialist analyses of the early medieval pottery from the area of south-western Wielkopolska and the south-eastern part of Ziemia Lubuska have revealed the presence of traits typical of workshop production, including temper selection by fraction and type, slip application, and use of a pottery wheel. The research used the results of petrographic analyses of selected vessels from the sites in Bonikowo (Wielkopolska Province), Połupin and Stożne (Lubuskie Province), whereas age determination of the assemblages was based on thermoluminescence dating of potsherds (Stożne) and results of ^{14}C dating of bone and charcoal (Bonikowo, Połupin, Stożne). There is a marked contrast between the older phases (*c.* 6th/7th–9th century) and the younger phases (10th–mid-13th century) of the Early Middle Ages in terms of the occurrence of workshop pottery, which is absent in the latter period.

KEY-WORDS: Poland, Wielkopolska (Great Poland), Ziemia Lubuska, Bonikowo, Połupin, Stożne, earlier phases of Early Middle Ages, workshop pottery, petrographic analyses of pottery, slip, absolute dating

The paper presents both 'archival' and new finds of vessels displaying traits typical of workshop pottery, dated by archaeological means to the earlier phases of the early Middle Ages, i.e., the period before about the 9th/10th century, coming from selected archaeological sites in south-western Wielkopolska (Bonikowo, site 1, Kościan District, Wielkopolska Province) and south-eastern Ziemia Lubuska (Połupin, site 2, Krosno Odrzańskie District, Lubuskie Province; Stożne, site 2, Zielona Góra District, Lubuskie Province) (Fig. 1). Specialist studies refined the chronology of the finds and pointed to possible sources of inspiration for the potters. They also corroborated the results of

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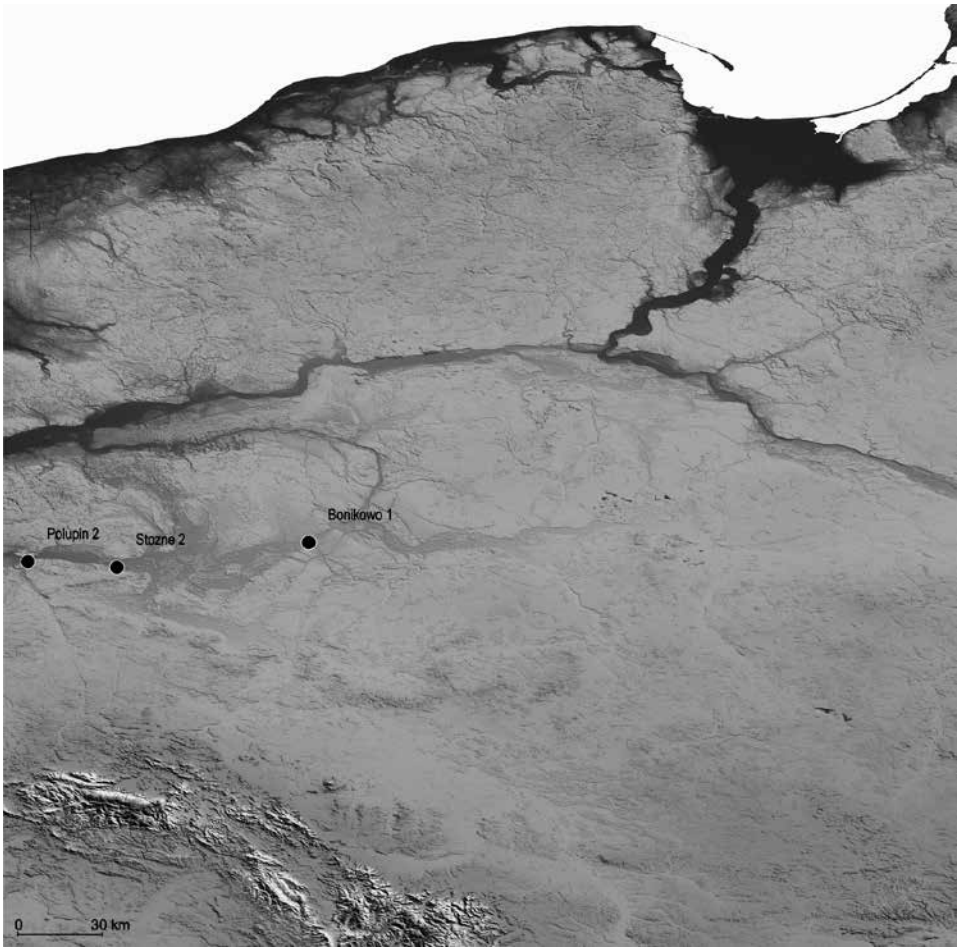

Fig. 1. Location of Bonikowo (Wielkopolska Province), Połupin and Stożne (Lubuskie Province). Prepared by A. Łuczak

a macroscopic examination of the vessels that had identified them as a specialised form of pottery production.

Let us first discuss the findings for the pottery from site 2 in Stożne near Zielona Góra, then follow up with the material from the strongholds in Bonikowo and Połupin.

Stożne is located in the floodplain of the Oder (about 3 km from the river bed), on the left bank, near a small watercourse called Zimny Potok, which is a left tributary of the Oder. The settlement site is situated on a small elevation, which is the highest local point (51–52 m a.s.l.) (Figs 2; 3). Vessel sherds were found in feature 9 (Figs 4; 5), believed to have been associated functionally with the aqua-palustrine sacrificial site. Radiocarbon (Gruszka 2010: 249) and thermoluminescence dating of the sherds

Fig. 2. Stożne, site 2, Zielona Góra District. Site area based on soil marks and pottery distribution. Photo by B. Gruszka

(Gruszka *et al.* 2013) gave a date for the functioning of this feature in the second half of the 6th through about the mid-7th century.

The several hundred potsherds from the feature (Gruszka 2010: Pls III–IV) were recorded in distinct clusters concentrated on the level of the wooden structures (Fig. 6). The clusters evidently represented a few different vessels, judging by the varied formal, stylistic and technological features. In some cases, the workmanship is evidently skilled. One vessel is remarkable for the use of a rotating wheel and excellent body surface treatment resulting in a characteristic 'goose bumps' texture that obliterated all traces of production. Petrographic analyses of this vessel designed to ascertain its workshop origin (Gunia and Gruszka 2010) established the use of tempered clay, the temper selected intentionally in terms of the mineral composition (preferred pink feldspar) and fraction. Very likely the temper was sifted to obtain more or less uniform granulation (very fine grain sifted out). The use of the rotating wheel, perhaps in the final stages of the vessel's production, was confirmed by petrographic analyses[1]. The distinctly structured texture of grains of temper observed in thin section demonstrates

[1] Petrographic analyses discussed in the paper were financed by the National Center of Science (NCN) in Poland within the frame of Preludium grant UMO-2012/05/N/HS3/01425 'Interdisciplinary examination of the early medieval (seventh-tenth/eleventh c.) workshop pottery in the Middle Odra River basin'.

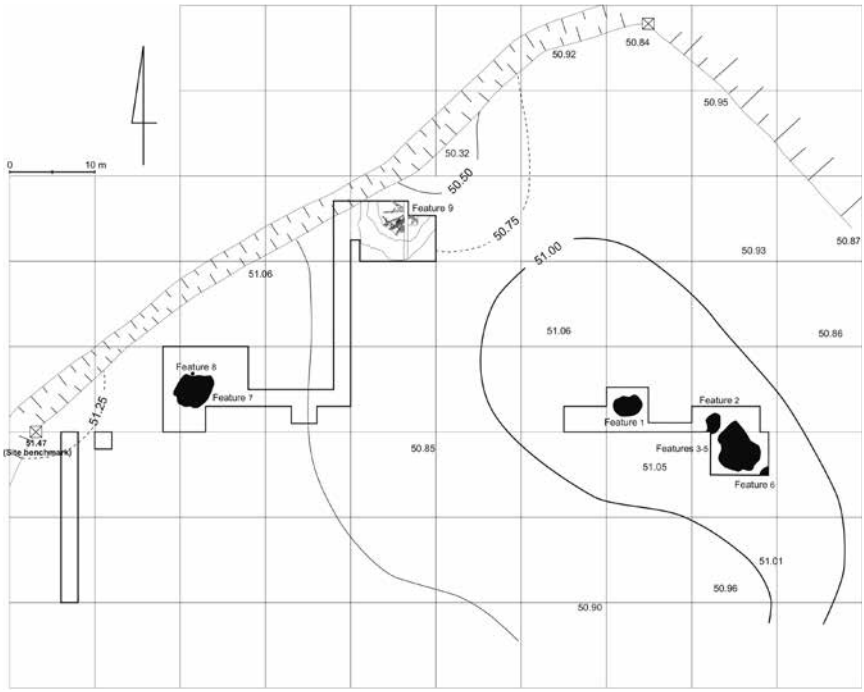

Fig. 3. Stożne, site 2, Zielona Góra District. Plan of the site showing location of excavated features. Drawn by S. Kałagate; prepared by B. Gruszka

that the vessel walls were subject to considerable directional pressure. The most likely time of its production was determined by thermoluminescence dating of a sherd as being in the first half of the 7th century (AD 633±96), which is concurrent with the ^{14}C dating of the wooden structure (feature 9), on top of which the vessel was found.

The concomitance of vessel fragments showing evidence of being formed both with and without the use of a fast-rotating potter's wheel has been documented in the Middle Oder basin in the early Middle Ages at Buków, site 1, Lubuskie Province (Dąbrowski 2001: 146–147, fig. 5:3), Kalsk, site 1, Lubuskie Province (Dąbrowski 1997: 130; Gruszka 2011) and Połupin, site 2, Lubuskie Province (Dąbrowski 1965: 68–71; 1997: 124–127) among others.

Furthermore, surface body slipping was found to be characteristic of the oldest early medieval pottery and was practiced at least until the late 10th/early 11th century; it was particularly common in the earliest assemblages[2].

[2] Examples of vessels with body slipping are known from: two features at Kalsk, site 1, Zielona Góra District, Lubuskie Province, which yielded pottery dated by the thermoluminescent method to AD 570±86

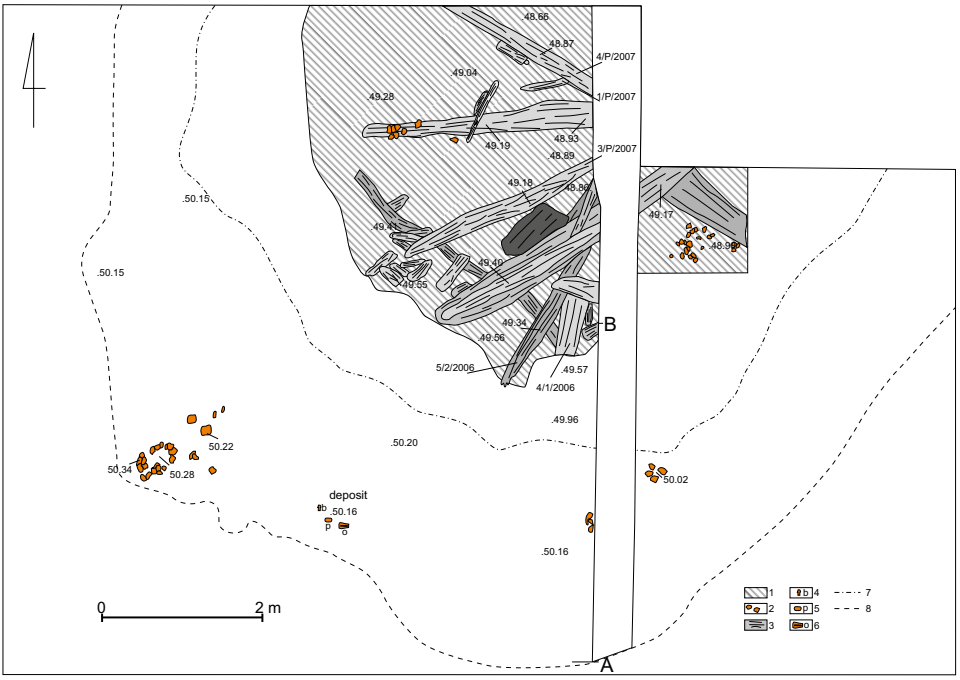

Fig. 4. Stożne, site 2, Zielona Góra District. Mapped remains of the roof of wooden structures from feature 9 with location of clusters of potsherds, the deposit and places of sampling for absolute dating. 1 – layer of peat, rich in organic debris (twigs, oak leaves); 2 – clusters of pottery; 3 – parts of a wooden structure; 4 – lump of amber from the deposit; 5 – spinning whorl from the deposit; 6 – whetstone in a deposit; 7 – extent of stratigraphic unit 3; 8 – extent of stratigraphic unit 9. Drawn by B. Gruszka

Excavation of the early medieval stronghold in **Bonikowo** (Fig. 7) in the 1950s yielded an assemblage of vessel-type ceramics, including potsherds resembling finds from the Merovingian cultural circle from the area of the Lower Danube basin. The assemblage was found in cultural layer IV (of considerable thickness) and a fragmentarily registered pit (possibly a ditch) dug into primary humus deposited above undisturbed subsoil and stratigraphically related to layer IV. The layer was deposited directly under the rampart of the second phase of the stronghold, dated to the second half of the 9th–first half of the 10th century (Fig. 8), and the floor thereof produced a fragment

and 574±93; a settlement site from the second half of the 7th–early 8th century in Mozów, site 23, Zielona Góra District, Lubuskie Province (Gruszka *et al.* 2013: Table 1); a 7th-century settlement at Jordanowo, site 7, Świebodzin District, Lubuskie Porvince; a settlement at site 10 in Sulechów, Zielona Góra District, Lubuskie Province, where the older phase is dated to about the mid-8th century (Gruszka *et al.* 2013: Table 1).

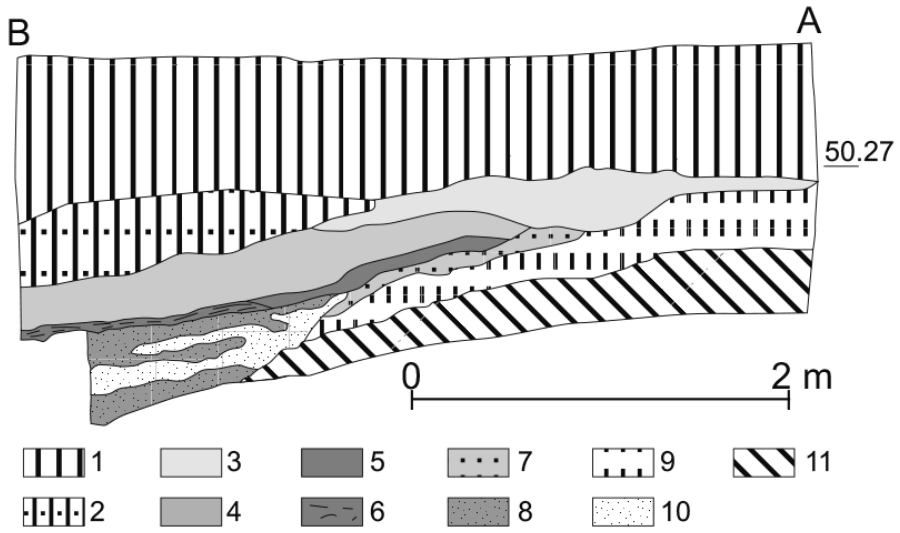

Fig. 5. Stożne, site 2, Zielona Góra District. Section through feature 9 looking east. 1 – tan brown, heavily sanded humus (humus = stratigraphic unit 1); 2 – tan brown humus, slightly loamy, with rust-coloured lenses of clay (stratigraphic unit 1a); 3 – dark grey-brown humus, slightly sanded, with small lumps of charcoal and burnt layer (stratigraphic unit 9); 4 –dark grey, very oily alluvium rich in organic debris and numerous small lumps of charcoal (stratigraphic unit 2); 5 – grey brown, loamy sand (stratigraphic unit 4); 6 – parts of a wooden structure; 7 – dark yellow sand; 8 – bright yellow sand with twigs (stratigraphic unit 10); 9 –light grey, fine-grained sand (stratigraphic unit 8); 10 – twigs and turf; 11 – yellow, fine-grained undisturbed sand. Drawn by E. Dąbrowski; prepared by B. Gruszka

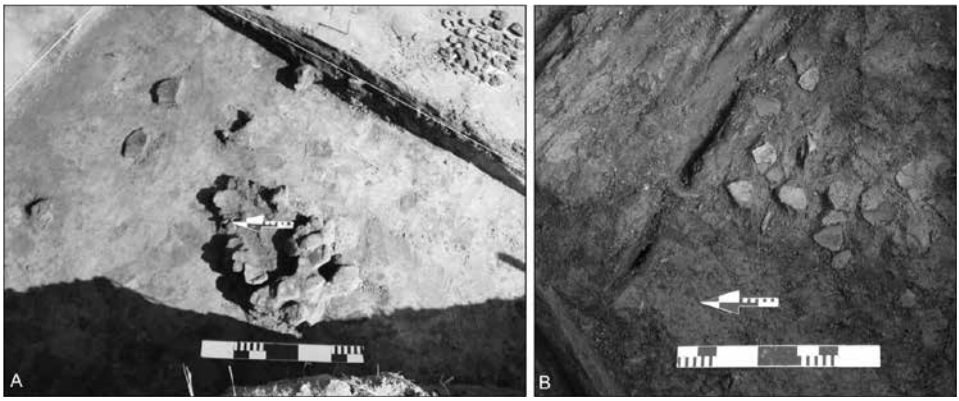

Fig. 6. Stożne, site 2, Zielona Góra District. Cluster of potsherds in stratigraphic unit 9 next to the south-western side of feature 9 (A) and at the level of the wooden structure in the south-eastern sector (B). Photo by B. Gruszka

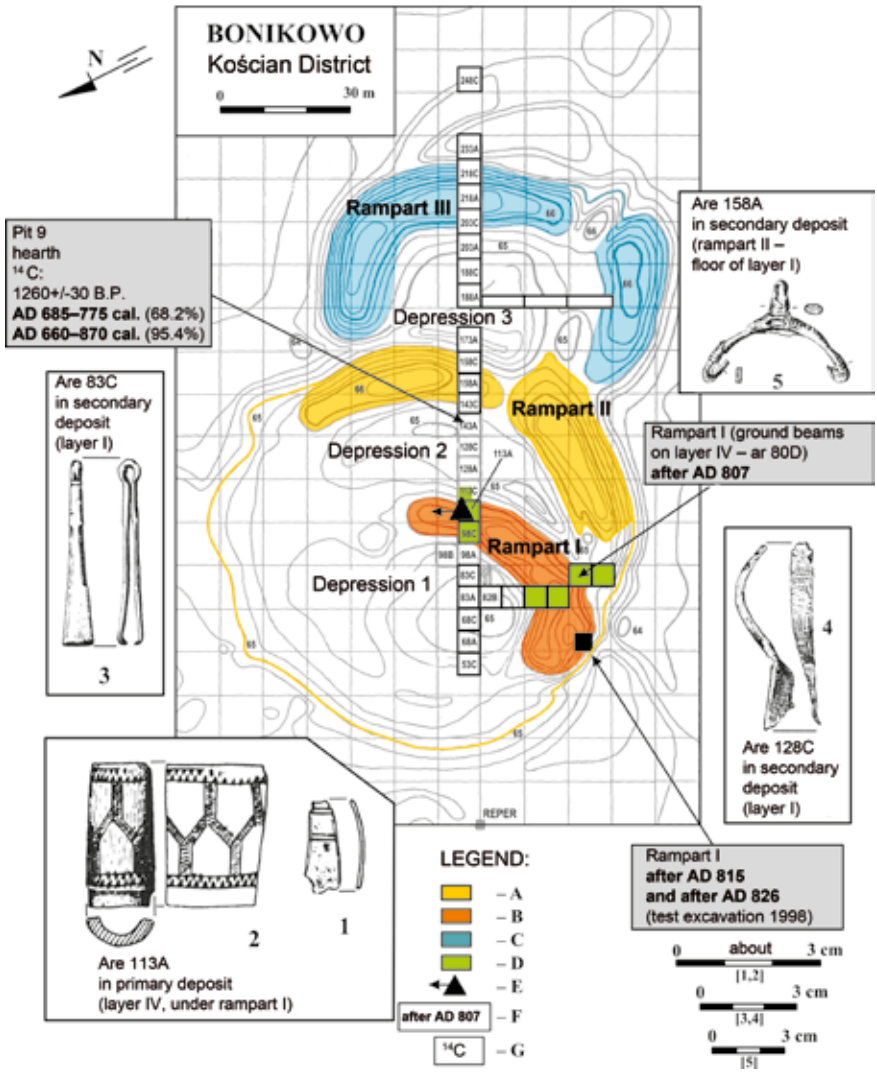

Fig. 7. Bonikowo, site 1, Kościan District. Contour map of the early medieval stronghold showing the location of excavation trenches, barrow-like stone mound and the extent of the unearthed fragment of cultural layer IV related to the said mound. Marked location of sampling points for absolute dating and findspots of luxury items from either late antiquity (1, 3, 4) or the earlier phases of the early Middle Ages (2, 5): 1, 4 – fragments of bronze fibulae; 2 – antler mounting; 3 – bronze pincers; 5 – bronze-coated iron spur. A – stronghold phase I; B – extensions in phase II; C – extensions in phase II or III; D – excavated section of cultural layer IV; E – location of mound (arrow marks the direction in which it continues); F – dendrochronological dating of the oak used in the construction of the rampart (estimated calendar *Anno Domini* date indicates when the tree was cut down; G – intervals of calibrated calendar years (*Anno Domini*) for the charcoal from a hearth dated using the AMS radiocarbon method, together with the percentage probability of the result. After Kara 2009: fig. 11

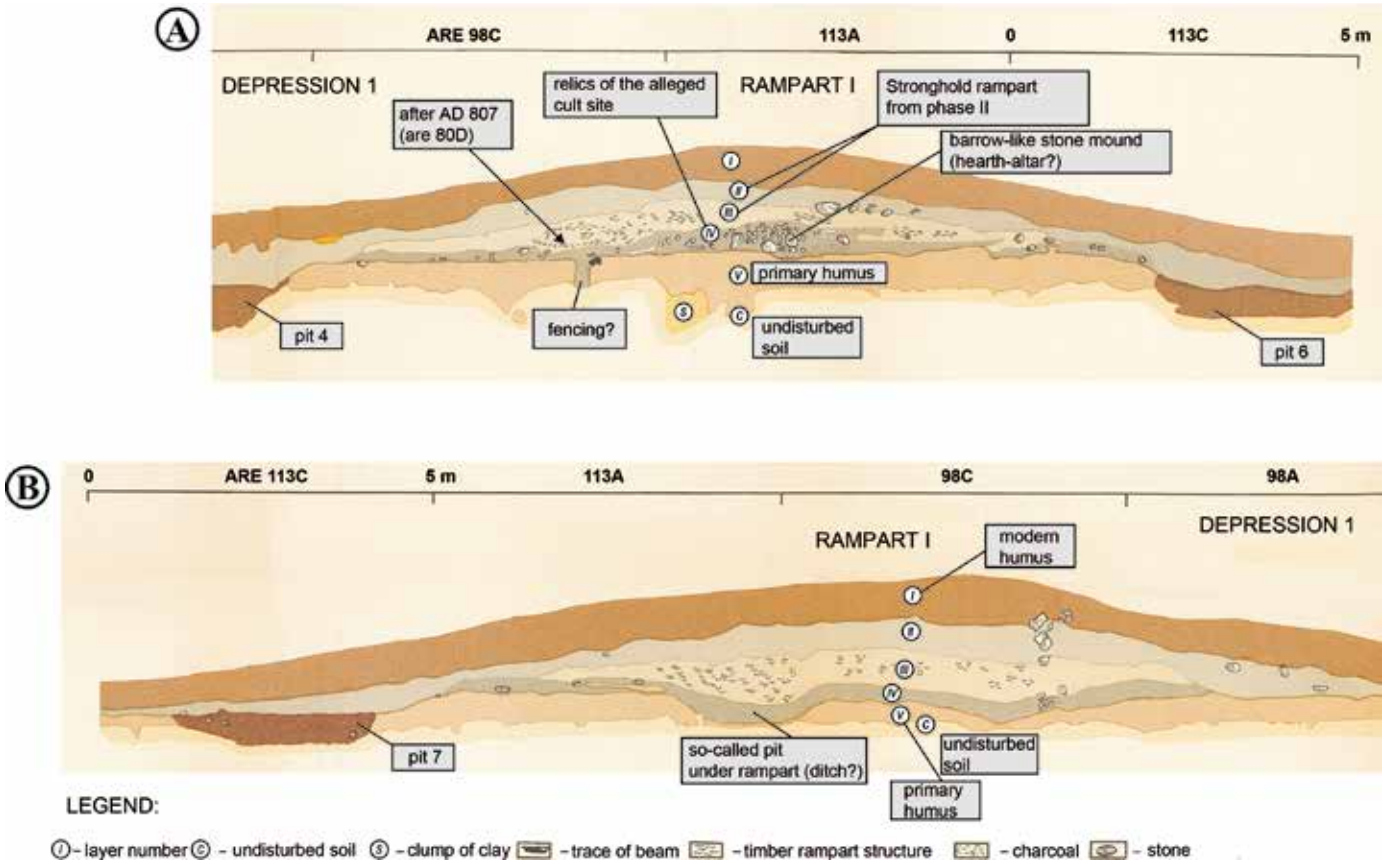

Fig. 8. Bonikowo, site 1, Kościan District. Sections of stronghold rampart I: A – fragment of the north section of the trench: visible relics of the alleged cult site (layer IV, primary humus), overlaid by remains of the rampart of stronghold phase II (layers II–III); ground beams of the wooden structure of the rampart core, in layer IV, dendrochronologic date after AD 807; B – fragment of the south section of the trench with layers as above. After Kara 2009: fig. 12

of a fibula of Niemberg type chronologically related to Late Antiquity (Figs 9: 7). The layer is believed to have formed at the site before the stronghold was erected and during the functioning of the oldest stronghold; the age of the earliest relics was determined as the second half of the 8th and first half of the 9th century[3].

Fragments of high quality vessels, the upper parts of which were modelled extensively as the pot was being turned on a wheel, merit close attention. Classified by Zofia Hilczerówna as ceramic group A_1, they include biconical, relatively squat pots and similarly fashioned wide-mouthed vases, as well as slender S-profiled pots, covered with a motif of applied bands of clay or alternately deep grooves, which were applied using a template or a broad graver-type tool (with horizontally cut-off end) during a fast rotation of a potter's wheel (Hołowińska 1956: 29–35, fig. 25A, C; 30B; Hilczerówna 1967a: 62–78, fig. 9i, j, l, p) (Fig. 10).

Other pots were of distinctly inferior technological and utilitarian quality, completely hand-modelled, or possibly with parts near the pot mouths finished on the wheel. Occasionally decorated, pottery of this kind fits the southern Wielkopolska type of local pottery production dated to the earliest phases of the early Middle Ages (ceramic groups A and B after Hilczerówna 1967a: 53–86, particularly 63–64). No differences in the levels of deposition of both categories of vessels were registered.

Petrographic analyses were performed on a fragment of one of the vessels from layer IV (Fig. 10: 5). The potsherd (unearthed in layer IV_3, are 113C) came from a slender vessel decorated in the upper part with broad, well-worked applied bands of clay. The pot was made of ferruginous sandy clay of poor plasticity, tempered with fine well sorted crushed rock probably of erratic origin. With regard to grain size, nonplastic components can be divided into two categories: sized from 0.1–0.25 mm, with quartz as the dominant inclusion, and 0.4 to 1 mm with a substantial share of sharp-edged quartz and potassium feldspars (see Appendix 1). The clay body was fairly poorly prepared, as evinced by sections completely devoid of temper and others containing nodules of unworked clay. Once the vessel had been formed, a slip, that is, a thin layer of temper-free clay, was applied to its surface. The container was fired at temperatures below 600°C under reducing conditions[4].

The discussed vessels – products of specialised pottery production and luxury items at the same time – have been widely discussed. The early dating of the Bonikowo

[3] For an analysis and chronology of stratigraphic units see Kara 2009: 87–114. Therein layer IV is regarded as a relics of an alleged cult site, a long-functioning natural sanctuary.

[4] The potter's proficiency in his craft may have been much better than suggested by the results of specialist analysis. Since the analysed container was unearthed among the relics of the so called cult site (cf. footnote 4), its production quality may have been symbolically conditioned. Vessels of poorer quality (including exclusive pieces, such as aforementioned ceramic containers from Bonikowo) with intentionally flawed form, decoration and/or production techniques, which differentiated them from the high quality utilitarian ceramics, tended to have been used as containers for offerings (cf. Kara 2009: 106, 113).

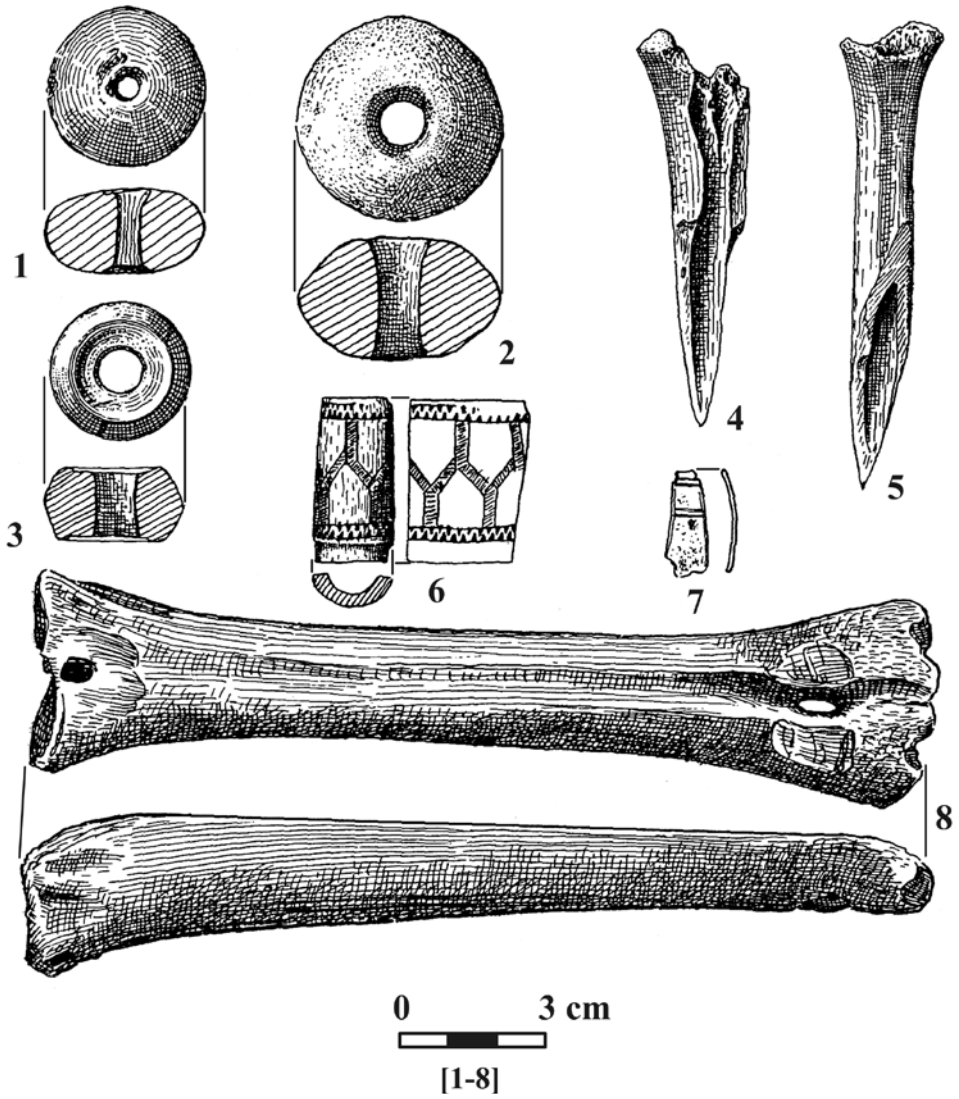

Fig. 9. Bonikowo, site 1, Kościan District. Assemblage of small finds from cultural layer IV: 1–3 – clay spindle whorls; 4–5 – so-called bone spikes; 6 – damaged antler mounting; 7 – fragment of the bow of a bronze fibula; 8 – bone skate or ski. After Hołowińska 1956: fig. 27

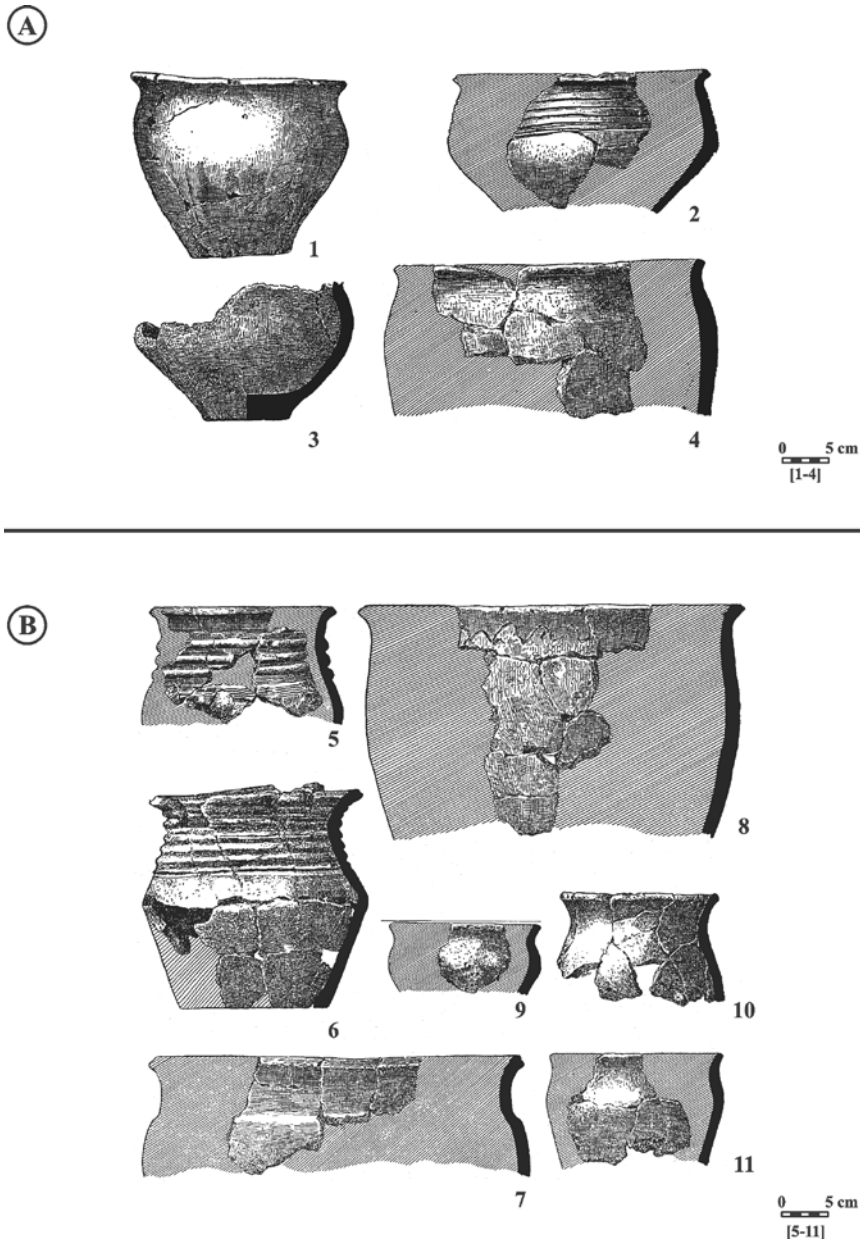

Fig. 10. Bonikowo, site 1, Kościan District. Selection of pottery (2, 4, 5–11, vessels wheel-finished in the upper parts), coming from the alleged cult site: A – from a so-called pit dug in the primary humus under stronghold rampart I; B – from cultural layer IV, deposited on top of primary humus and overlaid by the rampart structure. After Hołowińska 1956, figs 25; 30

assemblage (5th/6th–7th century) proposed by Hilczerówna[5], has been questioned by other authors, who argue for a late chronology, i.e., 9th century at the earliest, as attested presumably by the presence of 'vessels of undoubtedly Tornow-type' (Dulinicz 1994: 39, fig. 2b) among the workshop pottery in this assemblage. In our view, the argument is spurious, inasmuch as the discussed vessels of the Bonikowo group A_1 find close analogies in the Merovingian circle, mostly in the Middle and Upper Danube basin (including the lands of the Alemanni, cf. *Die Germanen* 1986: fig. 75c; 81g) or the Rhine basin (territory of the Franks, cf. *Die Germanen* 1986: fig. 102: 11, 23, 24; *Die Franken* 1996: Cat. no. VIII.5.8j, fig. 215; 576) (Fig. 11), as well as sites dated to the 6th–first half of the 7th century, situated at the mouth of the Danube, in the territory of present-day Moldova (Harhoiu 2005: 182–183, fig. 23A2: 16). Vessels similar to group A1 containers from the Obra basin, i.e., biconical or S-shaped pots, showing a tendency towards a biconical form are found there in enclaves, just as in the oldest Bonikowo, the only functional-settlement complex of that type in Poland (Fig. 12). It is noteworthy that archaeologists tend to interpret the said vessels either as Byzantine 'imports' or locally fashioned products of highly skilled potters who for some reason forsook the Eastern Roman Empire (Harhoiu 2005: 183).

Specialised production of wide-mouthed biconical vases or squat biconical pots (so called *Knickwandtöpfe*), akin to the Tornow or Bonikowo ware, by the Franks or the Alemanni is believed to have been influenced by products of the Roman provincial workshops (mostly from Raetia and Noricum). These vase-shaped or cup-shaped ceramic vessels decorated with a band of broad grooves, for example, fashioned on the potter's wheel or wheel-thrown, were produced before AD 500, at least in some Alemanni centres (Müller 1976: 62–63, 70–71, Pl. 9B:1; 10C: 1; *Die Germanen* 1986: fig. 75, Pl. 47, there the fourth-century *terra nigra*-type ware). Such containers, dated fairly firmly to the 6th century (including the first half of the 6th century) have been registered in the Danube zone at sites attributed to Germanic cultures (*Die Langobarden* 1988: 190). At the same time, luxury *Knickwandtöpfe* forms (Fig. 11: 8), also shaped on the wheel, were produced primarily in East Francia: forms resembling early medieval Slavic Tornow A ware probably not earlier than the second quarter of the 6th century and forms similar to ceramic containers of Tornow B type not later than the first half of the 7th century (cf. *Die Germanen* 1986: fig. 102: 11, 23, 24; *Die Franken* 1996: Cat. no. VII.1.17; VIII.5.8, fig. 215; for the Tornow-type ware see Herrmann 1966). Note that the registered similarities to the vessels from Bonikowo regard not only the form

[5] Hilczerówna 1960; 1967a: 78, Table XI: 2, therein the dating of the settlement side preceding the stronghold; XV: 2, therein the dating of the stronghold. Cf. Hilczer-Kurnatowska 1986: 506; Kurnatowska and Łosińska 1990: p. 135, no. 11, p. 137, no. 6. Furthermore, Z. Hołowińska (1956: 77) and Z. Woźnicka (1961: fig. 1:1) dated the relics of the so-called open settlement site preceding the stronghold to the period between the 6th and 8th century.

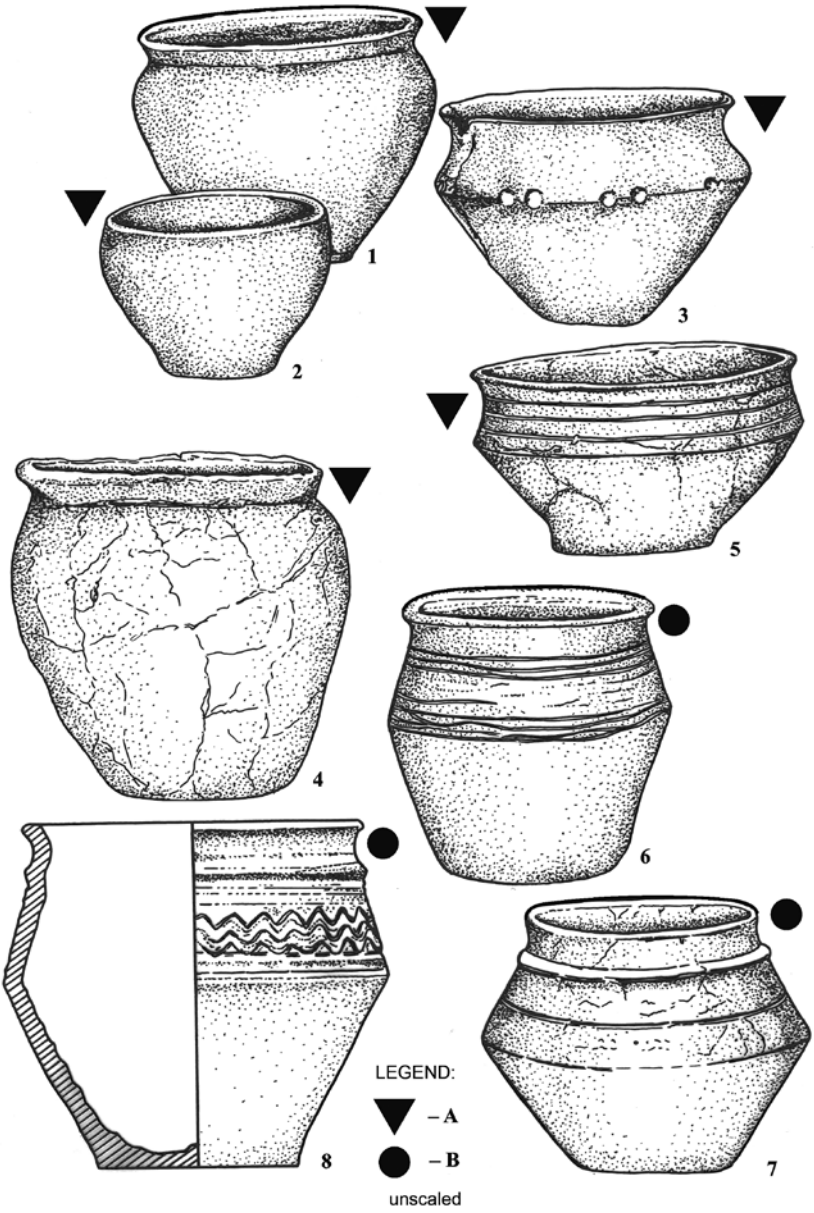

Fig. 11. Pottery from the eastern territories of the Frankish cultural milieu: 1–3, 5 – vessels from cremation burials dated to the 4th–5th century; 4, 6–7 – vessels from an inhumation grave dated to about the mid-7th century; 8 – *Knickwandtopf*-type vessel (from an inhumation grave), typical of the middle and late Merovingian period (mid-6th century). A – handmade; B – wheel-made. After Kara 2009: fig. 14

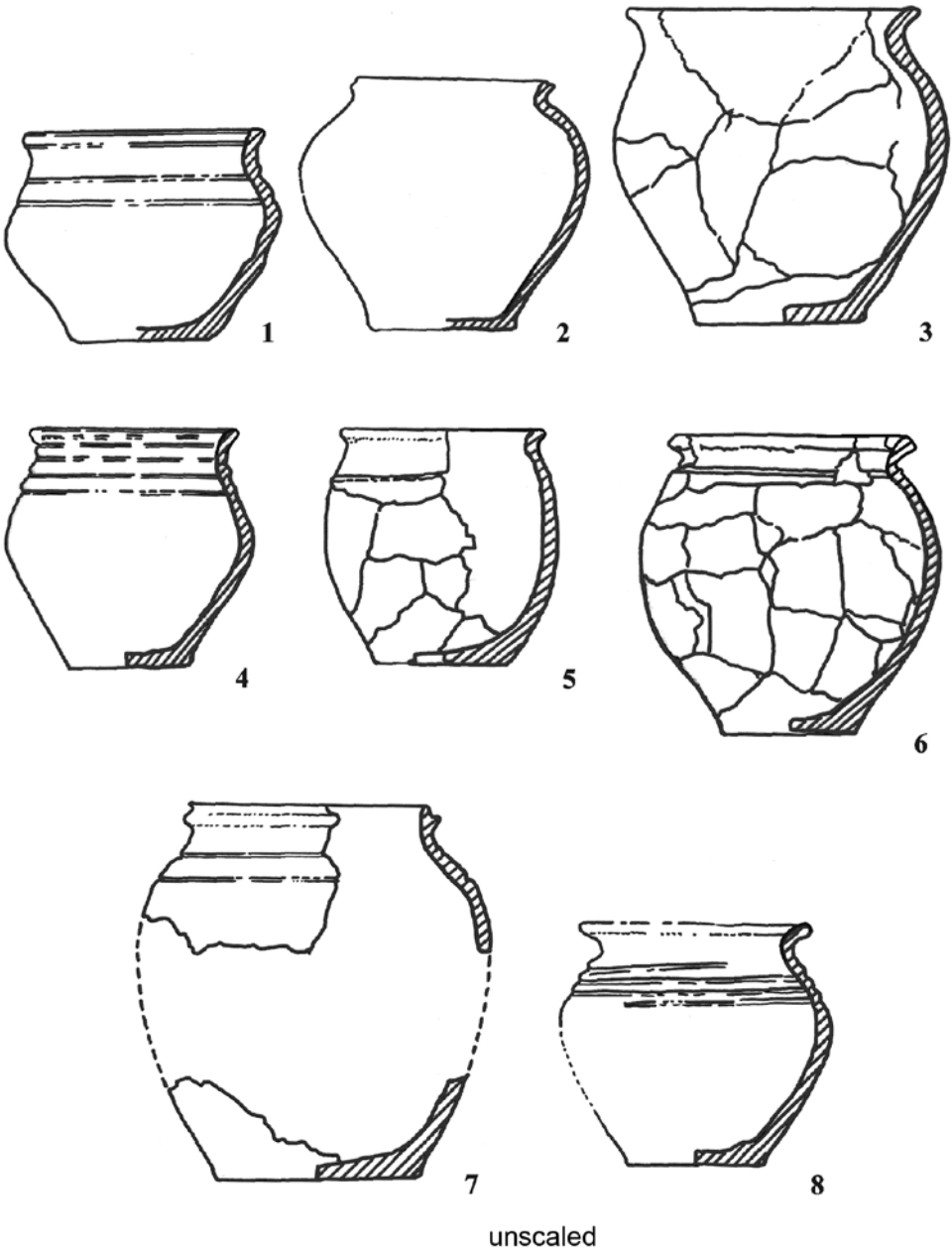

Fig. 12. Wheel-modelled vessels, from the Lower Danube basin (Moldavian territory), dated to the 6th through first half of the 7th century. After Harhoiu 2005; redrawn by M. Śniedziewska-Lerczak

(biconical) and decoration (grooves or broad flutes all around the vessel) or production techniques (pots substantially modelled on the wheel), but also seemingly minor features, such as firing colour, composition of the ceramic mass or surface treatment (all reflecting the poster's mastery in his craft). One likely explanation is that the luxury forms of A_1 vessels deposited in layer IV at the stronghold in Bonikowo were fashioned by a remarkably skilled expert potter, who had originally worked in the Middle and Upper Danube basin or, more likely, on the East Francia border, although this is not the sole possibility. Tadeusz Makiewicz recently confirmed (2005a; 2005b; 2006) the validity of the views proposed already by some researchers that ancient, strictly workshop pottery production techniques, including throwing pots on a potter's wheel and modelling ceramics on the wheel, survived in the Odra and Vistula basins until the early Middle Ages (Hensel 1956; Hilczerówna 1963; 1967a; 1967b; Dąbrowski 1968; 1970; 1971). Significant departures from archetypes, most notably in decoration, suggest that even though the pottery production was based on foreign patterns, it was nevertheless already adapted to the needs of a local elite culture.

Given the chronology of parallels, most notably Merovingian ones, and to a lesser extent Byzantine examples from the area of present-day Moldova, we are inclined to date the Bonikowo pottery assemblage, which is remarkably like the specialised pottery production of the Danube and the Rhine zones in techno-stylistic terms, to generally between the mid-sixth and end of the eight century. In our view, an approximate *terminus post* is provided by the chronology of the incipient 'mass' production of *Knickwandtöpfe* in the Merovingian circle (approximately mid-sixth century): forms typical of Frankish culture, which we consider to have been genetically related to biconical pots from Bonikowo, decorated with applied bands of clay. We also believe that the gradual deposition of layer IV occurred approximately in the said time interval, albeit, admittedly, its sixth-century origin is unlikely. Evidence pointing to the seventh-century provenance of the said layer is more persuasive, most notably chronological and functional *iunctim* between the pottery from layer IV and artifacts of late Antique and Merovingian provenance uncovered at the stronghold in Bonikowo and the nearby site 2 (so-called open settlement site; see Kara 2009: 87–114). All things considered, it is conceivable that these 'imports', meaning in this case an expert potter or potters (perhaps prisoners of war), did not arrive in the area of present-day Bonikowo earlier than after AD 626 A.D., that is, after the failure of the Avar–Slavic siege of Constantinople, the outcome of which was instrumental in establishing Samo's empire (cf. Labuda 1975 and the references cited therein). These specialist potters may have reached the territory on the Middle Odra slightly later, after the mid-7th century, that is, during a period of political instability in the lands on the central Danube unleashed by the disintegration of Samo's kingdom. In both cases, groups of Slavic warriors heading back home could have acted as the 'carriers' of these artifacts of evidently prestigious nature (e.g., luxury ceramics), as well as new experiences or ideas.

The political *status quo* that prevailed at the point of contact of the middle and upper Danube Basin and the central and upper Rhine Basin, definitely favoured the revival of contacts between the well-established Merovingian state, the Byzantine Empire, the emerging Avar khaganate, which solidified its position at the time, and the Slavic communities and the Slavic communities on the northern side of the Danube which either paid tribute to the khaganate or constituted its political clientele (including, in our view, communities from present-day Silesia, Ziemia Lubuska as well as southern and western Wielkopolska).

In Bonikowo, radiocarbon dating of two artifacts (so-called bone spike 1295+/-30 B.P.; bone skate or ski 1250+/-30 B.P.) (Fig. 9: 4, 8) from layer IV, which was sealed between undisturbed soil and the relics of the stronghold (both rampart II from the older phase of the structure and rampart I from the younger phase), produced similar intervals of calibrated calendar age, estimated at AD 662/676–774/870 and 670/688–767/800 with 95.4% and 68.2% confidence respectively (see Appendix 2). According to Hilczerówna (1967a), pots of group A_1 with the upper parts fashioned on the wheel (so-called proto-Tornow pottery), which are products of pottery craftsmanship in a Late Antique tradition and which were concomitant in the said layer with a fragment of a fibula dated to the late Period of Roman Influence and typical undecorated and hand-built Slavic-type ceramics, evinced an early dating of the relics on the one hand and indicated the persistence of certain currents of ancient culture among the early medieval populations of the Warta River basin on the other hand. With this in mind, the finds from layer IV are considered, among others, in the context of the issue of the so-called second zone of crystallisation of the West Slavonic culture, which is believed to have been located in north-western Poland (Kara 2009: 63–201 and the references cited therein). Absolute dates indicate that the said layer is related to (the second half of) the 7th century, 8th century, and even the first half of the 9th century, albeit the chronology of the incipient deposition of that layer remains an open question. Archaeological findings (Kara 2009: 91–114) suggest that layer IV could have accumulated over a long period of time, which can perhaps furnish an explanation for the differences in age of the two radiocarbon dated bone artifacts produced by the said layer (1295+/-30 BP and 1250+/-30 BP), considering that the 'older' item came from the lower levels of the accumulation. Nonetheless, the observed differences may result from imperfections of the method, which does not reflect the actual age of a sample but merely a probabilistic value.

Likewise, the stronghold in **Połupin** near Krosno Odrzańskie (Fig. 13) gives the impression of being a seventh- (?) or eighth-century investment. Radiocarbon dating of two animal bones from consumption waste (pig molar 1200+/-30 BP; fragment of a cattle humerus 1170+/-35 BP) from layer III, lying in the part adjacent to the ramparts and stratigraphically related to the younger (!) settlement level of the structure, yielded similar intervals of calibrated calendar age, i.e., AD 710/770–949/980 (95.4%) and AD 770/775–940 (68.2%). The probability density distribution of the results narrows these

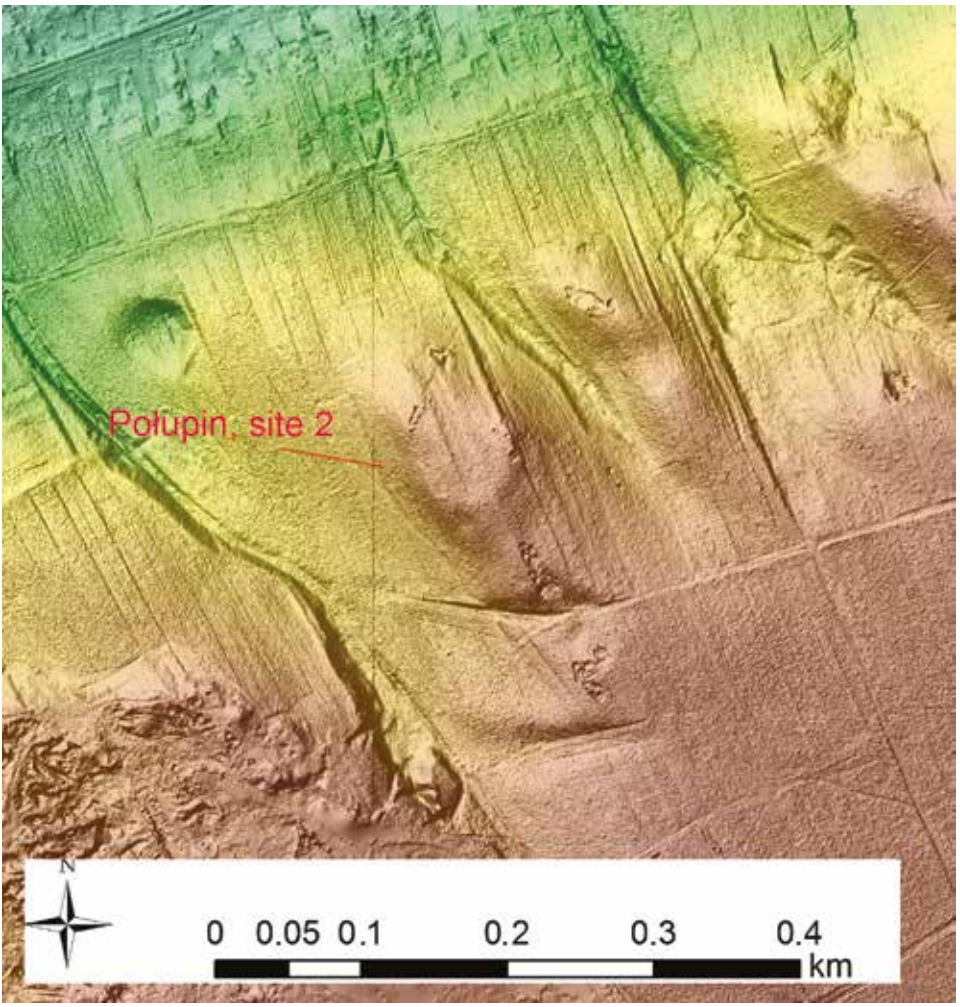

Fig. 13. Połupin, site 2, Krosno Odrzańskie District. Digital Elevation Model of the early medieval stronghold. Prepared by A. Łuczak

time intervals to the end of the 8th and the 9th century. A charcoal sample from a hearth discovered under the debris of the rampart's stone elements (the older phase of the stronghold or the so-called open settlement from the phase pre-dating the stronghold) was also radiocarbon-dated to 1250+/-30 BP. which after calibration gave probabilistic calendar year ranges of AD 687–775 (68.2%) and AD 676–870 (95.4%); in the latter case, the probability density distribution of the result at 74.8% narrowed the span of the examined sample to an interval of AD 676–779. On this basis, taking into account the said results of radiocarbon dating of the younger samples obtained from the

stronghold in Połupin, we are inclined to synchronise the said hearth (although cautiously, given the potential difficulties in evaluating archaeological age of charcoal on the basis of radiocarbon measurements, see Walanus and Goslar 2004) with the period from the second half of the seventh century to the eight century (see Appendix 2).

This absolute dating is not at variance with the results of recent chronological findings regarding artifacts from the younger phase of the stronghold in Połupin. Terminus ante quem for the older phase[6] can be roughly determined at c. 800 AD (Kara 2009: 225–228) or the third quarter of the 8th century (Gruszka ed. 2016: 243). According to Edward Dąbrowski (1970; 2006), who excavated the stronghold, the fortified settlement was erected about AD 550 and lasted through the mid-7th century. The proposed chronology was not corroborated by the results of recent pottery analysis (Kara 2009; Gruszka ed. 2016), which has suggested that in the early Middle Ages, the site in Połupin was first occupied in the second half of the 7th century, possibly even the 8th century. The younger settlement level, unquestionably stronghold-related (relics of that horizon produced two hook-shaped spurs representing variants A and B after Jacek Żak and L. Maćkowiak-Kotkowska (1988), and a decorated bronze plate with an amethyst, possibly of Avar or late Merovingian origin, dated to the 7th–7th/8th century[7]) is considered as having formed not earlier (!) than in the late 7th/early 8th century (Kara 2009: 225), probably in the fourth quarter of the 8th century (Gruszka ed. 2016: 243).

The younger settlement level at the stronghold in Połupin is believed to encompass cultural layers excavated in 1960 in the part of the stronghold adjacent to the ramparts (in the upper part of the so-called residential basin-shaped depression), deposited above groups of large stones tumbled from the rampart. The depression was uncovered in two trenches (NE and SW[8]) located axially on the opposite sides of the courtyard of the stronghold about 80 m apart (Dąbrowski 2006: 27–30). The variant A hook-shaped spur mentioned above came from the former trench, B variant and the amethyst-studded plate from the same level in the latter trench (Fig. 14). A vestigial settlement layer

[6] Initially interpreted as related to the stronghold, the relics attributed to that phase should perhaps be seen as the remains of the so-called open settlement preceding the stronghold (see Gruszka ed. 2016).

[7] In the quoted collective monograph on the early medieval stronghold in Połupin (Gruszka ed. 2016), the said amethyst-studded plate is no longer included in the list of artefacts of Avar origin found in Poland. It is suggested that it should be attributed either to the modern period or to the early Middle Ages. In the latter case, this means that the plate could have been produced within the broadly defined Avar-Frankish zone of cultural contacts (Gruszka ed. 2016: 131–140). Noteworthy is also the similarity (albeit not very close) between the Połupin plate and some ornamented circular disc-shaped fibulae produced by the population of the Olsztyn group of the Western Baltic cultural circle in the late 6th–7th century under the influence of West European (Merovingian) and South European (Germanic/Avar) patterns (see Grzegorczyk 2015: 34–35, fig. 17). Although this similarity is by no means decisive for the determination of the origin of the Połupin specimen, it nevertheless suggests the possibility of the existence of some specific pre-patterns for the mentioned artifacts.

[8] It was not clear which of the trench numbers given were assigned to these two trenches.

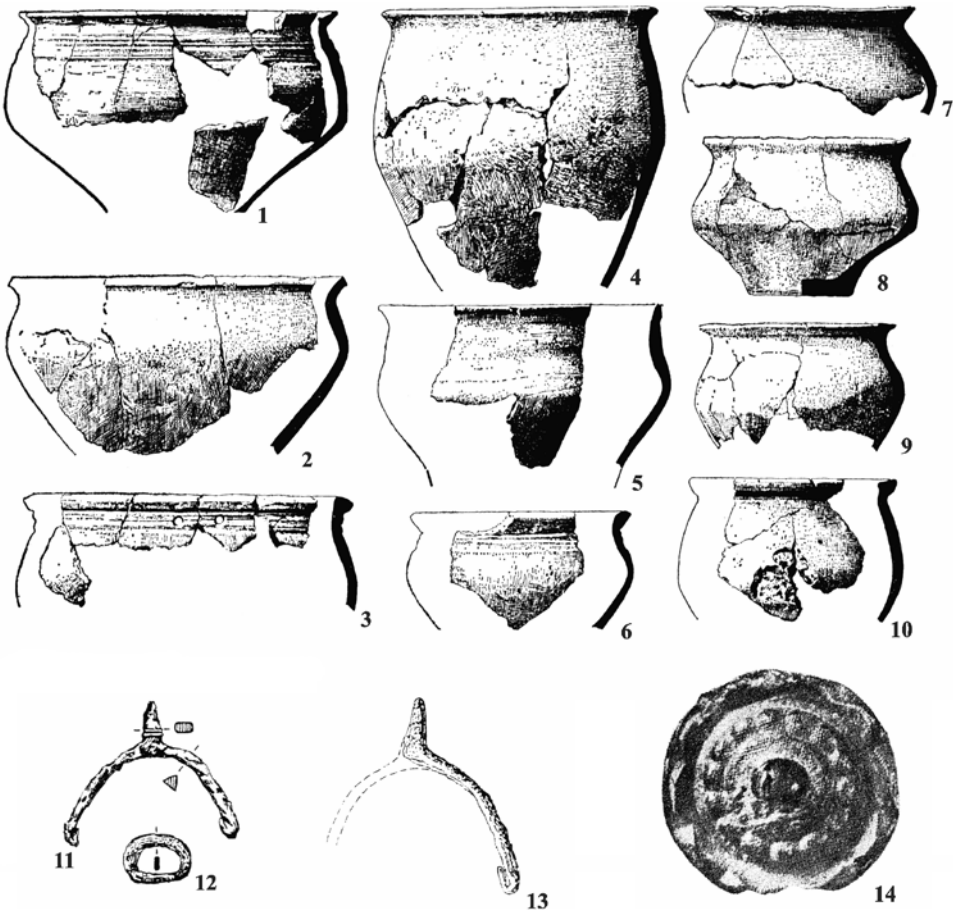

Fig. 14. Połupin, site 2, Krosno Odrzańskie District. Selected finds from the ruins of the younger phase of the stronghold (NE and SW trenches): 1–10 – vessel-type ceramics; 11, 13 – iron, hook-shaped spurs variant A (11) and B (13); 12 – iron buckle or loop of a spur (?); 14 – repoussage-decorated bronze plate with an amethyst. After Kara 2009: fig. 69

at the southern end of the courtyard, in the vicinity of the aforementioned 'residential' depression, observed on undisturbed soil in the form of a few lenses and correspondingly regarded as remains of the younger settlement horizon, produced i.e. a small iron buckle or a loop, perhaps for attaching a thong used to tie on the spur. The relics of

the younger settlement horizon yielded a rich assemblage of pottery, consisting first of all of fragments of vessels (mostly strongly) modelled on the wheel and a few potsherds of completely hand-built vessels. A similar share of decorated forms came from the assemblage from this layer as from the one from the older level. The most numerous are vase-shaped or pot-shaped (spherical) vessels with a narrow band of grooves or possibly flattened bands of clay below the rim, which correspond to specimens of Hilczerówna's A_1 group (1967a) in techno-stylistic terms, albeit (given their inferior quality) only to a certain extent. Likewise, they can be regarded as 'Tornow-like' forms (Fig. 14: 1). A special form of vase-shaped vessels, the rims of which resemble in shape the rims of the Feldberg group according to E. Schuldt (1956) (Fig. 14: 3, 6, 10), was also registered. Compared to the assemblage from the earlier horizon (shown in Fig. 15), the discussed collection is characterised by a much higher technical level, most notably in the case of the aforementioned vase-shaped vessels.

A fragment of a vessel decorated with bands of clay below the rim (Fig. 14: 3) from the younger settlement phase of the stronghold was revealed by petrographic analysis to be made of fat, ferruginous clay of high plasticity, tempered with crushed stone and containing feldspars (alkaline or plagioclases), quartz and rock fragments resembling granites and orthoamphibiolites (including common hornblende) in composition. Intentionally added fluvial sand was also observed in the clay body. Nonplastic components were mostly fine- and medium-grained, whereas the class of grains above 1.5 mm was less common. The walls of the vessel were carefully treated and the outer surface was covered by a thin film of less dense clay with fine-grained quartz fragments (slip). The vessel was probably fired under reducing conditions, at temperatures of about 650°C (see Appendix 1).

The presence of amphibole fragments (including common hornblende) in the composition of the temper may evince the foreign origin of the vessel, given the non-erratic nature of the mineral with outcrops in the Bohemian Massif. Pending in-depth chemical analysis of clay composition, the provenance of the vessel cannot be determined unequivocally.

Notwithstanding the limited number of analysed sources, the results of specialist examination enable reasonable conclusions to be formulated regarding the said category of early medieval vessels. It is worth stating that vessels displaying evident workshop features, such as heavy modelling on the wheel, application of a slip, sophisticated form and stylistics, are present already in assemblages dated to the beginning of the early Middle Ages within the study area (i.e., the Middle Odra river basin). Given the absolute chronology of the finds, the earliest ones date back at the latest (!) to the first half of the s7th–third quarter of the 7th century (Stożne). Vessels with workshop features have been registered also in assemblages of later chronology (*vide* Połupin Phase II), dated approximately to the end of the 8th–9th century. None of the analysed vessels are related to the period after AD 900 (see Gruszka, Pankiewicz 2016). It should be noted

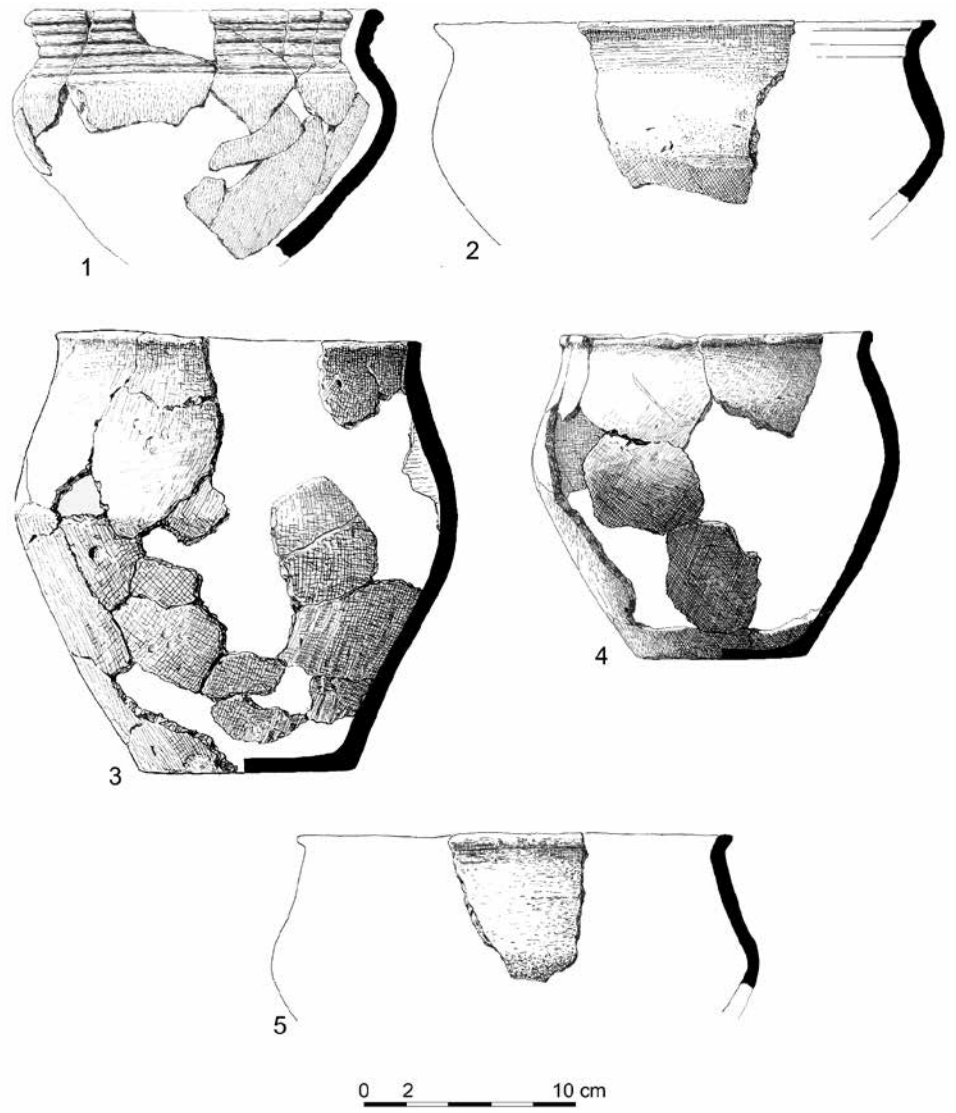

Fig. 15. Połupin, site 2, Krosno Odrzańskie District. Selection of pottery from the older phase of the stronghold (NE and SW trenches). Drawn by E. Dąbrowski

that finds of workshop-type pottery from layer IV at Bonikowo, which have been interpreted as a relic of the alleged cult site that had functioned before the stronghold was erected and within the confines of the stronghold of the earlier phase and were

recently regarded by some authors as related to the cultural-settlement Tornow-Klenica horizon of the second half of the 9th–10th century, can be dated actually to the second half of the 7th century as well as the 8th century. Such a time interval is implied by the results of radiocarbon dating of bone artifacts deposited in the said cultural layer.

The results of petrographic studies of selected ceramic containers, including grain size and modal analysis of nonplastic components of temper together with its distribution in the vessel wall, confirmed the hypothesis about the workshop provenance of the studied specimens. As for single finds (Stożne, Połupin Phase I), they may reflect the activity of an itinerant potter working in a given district. As regards numerous finds (Bonikowo, Połupin Phase II), the results of research suggest that local pottery production (the form and style of the vessels speak in favour of an adaptation of foreign models, including a possibly barbarised technique of production), or, alternately, 'imports' (*vide* the presence of accessory minerals in the temper, notably common hornblende). Of particular significance in the context of the two latter observations are the results of a comparative analysis of vessels from Bonikowo, which suggested early medieval, highly specialised potmaking from the Danube and/or the Rhine basin, crafted in a tradition inherited from the late antique workshops of the Roman Empire in the vicinity of the *limes*, as a possible parallel[9]. Such a widely-defined civilizational and cultural zone could have furnished a broad range of inspirations for potters working in the Middle Odra basin in the earlier phases of the early Middle Ages.

APPENDIX 1

RESULTS OF PETROGRAPHIC STUDIES OF EARLY MEDIEVAL POTTERY FROM BONIKOWO, SITE 1 (WIELKOPOLSKA PROVINCE) AND POŁUPIN, SITE 2 (LUBUSKIE PROVINCE)

Introduction: Two potsherds from two early medieval archaeological sites: Bonikowo, site 1 and Połupin, site 2, were selected for detailed petrographic analysis. Petrographic thin-sections were made from samples of the upper parts of the vessel

[9] When this paper had already been completed, we came across a publication which allowed us to include some finds from Moravia into the list of analogies to the Bonikowo pottery from the Danube area (see Tejral 2009: 140, fig. 29: 5–8, 12–13). Dated to the Migration Period, these finds are believed to continue the tradition of pottery workshops functioning in the Roman provinces in Late Antiquity. We believe that this confirms the accuracy of the above-presented conclusions. It is noteworthy that the range of parallelism of the features of both groups of vessels excludes the replication of patterns; the Bonikowo pottery bears merely a specific resemblance to the vessels from Moravia.

body. This was preceded by a macroscopic examination of the sherd, observing characteristics regarding the surface, colour, presence (or absence) of decoration, and weathering. The studied sections of the fracture surface were about 1×2.5 cm in size. To prepare thin sections for microscopic examination, five rectangular billets 1×2.5 cm in size, and 0.5 cm thick were excised with a diamond saw. Friable samples with low cohesiveness were stabilised with Canadian balsam. The ceramic thin sections were scanned using a Canon PIXMA MP 150 scanner of 1600×1600 pixel resolution to examine the internal features of the clay matrix, most notably size and shape of crushed stone (temper components), quantity of sand and clay fractions, remnants of organic matter and appearance of glassy products of firing (Stoltmann 1989; Garrison 2003).

A detailed petrographic examination of the thin sections was made on a polarizing Nikon 200 Pol microscope. The results were documented photographically using a Canon 450D camera. The samples were inspected in order to determine the morphology and optical characteristics of minerals as well structural characteristics of crushed rock fragments. All petrographic analyses of ceramics from Bonikowo and Połupin were performed by Prof. Piotr Gunia at the Department of Gemmology and Archeometry, Institute of Geological Sciences, University of Wrocław (Poland).

A mineral composition analysis was conducted using the planimetric method under a Leitz microscope equipped with a set of micrometer screws. Point count analysis was employed, for 300 points of thin section surface, whereby the microscope stage was moved in increments equal to the mean grain size of crushed stone in the sample (Stoltmann 1989; Garrison 2003). The counts were then summed to determine overall percentages of different grain types, such as clay minerals, quartz, potassium feldspars (including perthite, antiperthite, myrmekite and micropegmatite), plagioclases, rock fragments (including granites, quartzite or metasandstone, gabbro and amphibolites), mica (light and dark coloured), accessory and heavy minerals (e.g. pyroxene, amphibole, garnets etc.) and others (e.g. loamy rollings, grog, hematite, organic residues). Grain size analysis was conducted for nonplastic components. In order to evaluate the proportions of particular inclusions, five classes of grain size were identified, i.e.1) < 0.1 mm (including glass-bearing veins produced in the course of firing); 2) 0.1–0.5 mm; 3) 0.5–1mm; 4) 1–2 mm and 5) >2 mm. Grain sizes of crushed stone were measured based on scanned thin sections using computer software for image analysis ImageJ (freeware version), every time counting about 1000 grains for each examined sample.

The produced results enabled a detailed analysis of the petrographic characteristics of the tested samples, including the identification of specific minerals in the clay matrix, as well as fragments of crushed rock, sand grain fraction and vitreous firing products. These findings provided a basis for the reconstruction of the processes of clay body formation, temperature and firing conditions, as well as transformation of ceramic body components during firing.

BONIKOWO, site 1 (Fig. 16; 17)
Kościan Commune
Kościan District
Wielkopolska Province
Multi-part stronghold
Sample Nº: BO/Pc1
Are 113C (NW baulk), layer IV_3, depth 2.05–2.15 m
Field inventory Nº: 306/1952
Discovery: Excavated by Zofia Hołowińska and Zofia Hilczerówna on behalf of the Directorate of Research on the Beginnings of the Polish State in 1952.
Collection: Institute of Archaeology and Ethnology, Polish Academy of Sciences, Poznań Branch

Macroscopic features: Sherd (8×6×0.8 cm) from the upper part of a vessel. External surface light brown, smooth, with thick applied horizontal bands of clay. Internal surface smooth, light brown-grey in colour. Colour zoning seen in the break, light brown thin layers being visible in the peripheral parts of the section. These layers contain locally very thin and wavy twisted veins of silty brown material. A brown groundmass with tiny grains of sand or crushed stone and numerous pores and holes predominates in the central part of the break.

Petrography: The clay matrix surface has a fine-grained texture with grains of different size and non-directional structure. The identified nonplastic components can be divided into two categories in terms of size: larger, sized from 0.4 to 1 mm, and smaller, usually 0.1–0.25 mm in size.

The larger components include first of all: sharp-edged quartz, sometimes showing wavy extinction of light, sharp-edged (sometimes rectangular) fragments of potassium feldspars (orthoclase and microcline) with clearly visible mixed-in structures (perthite) and sometimes with well-developed lattice twins; subhedral table-shaped plagioclases locally with albite polysynthetic twinning. Some of them have signs of intensive weathering changes (kaolinisation) visible as efflorescence built of fine flaky-shaped aggregates showing yellowish interference colours. In addition, these components are accompanied by single, rounded fragments of granite of medium-grained biotite granites and fine-grained plagiogranites. Single rounded fragments of quartzite (of granoblastic and heteroblastic structure) and parallel oriented sets of biotite platelets have occasionally been identified in the sherd. Most of the biotites have distinct and perfect cleavage planes.

The smaller size components are represented primarily by fine-grained quartz, which forms sharp-edged fragments of polygonal outlines or, more rarely, well-rounded grains. Feldspar fragments that could not be optically determined with greater precision are relatively rare.

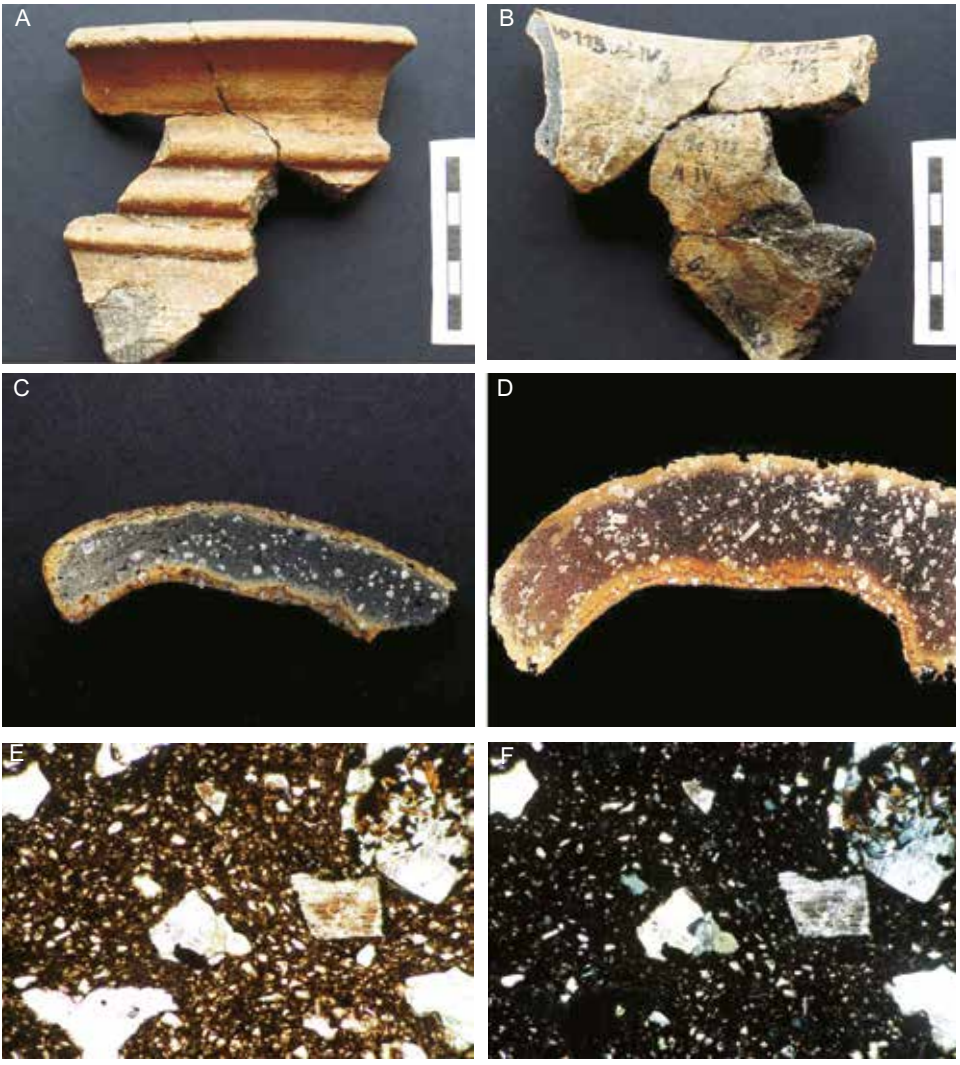

Fig. 16. Bonikowo, site 1, Kościan District – vessel sherd (sample BO/Pc1). A – external view; B – interbal view; C – section view; D – thin section scanned view (1600×1600 pixel resolution, about 4× magnification); E – sharp-edged fragments of quartz and feldspar in the micromass (about 40× magnification, parallel nicols); F – sharp-edged fragments of quartz and feldspar in the clay matrix (about 40× magnification, crossed nicols). Photo by P. Gunia

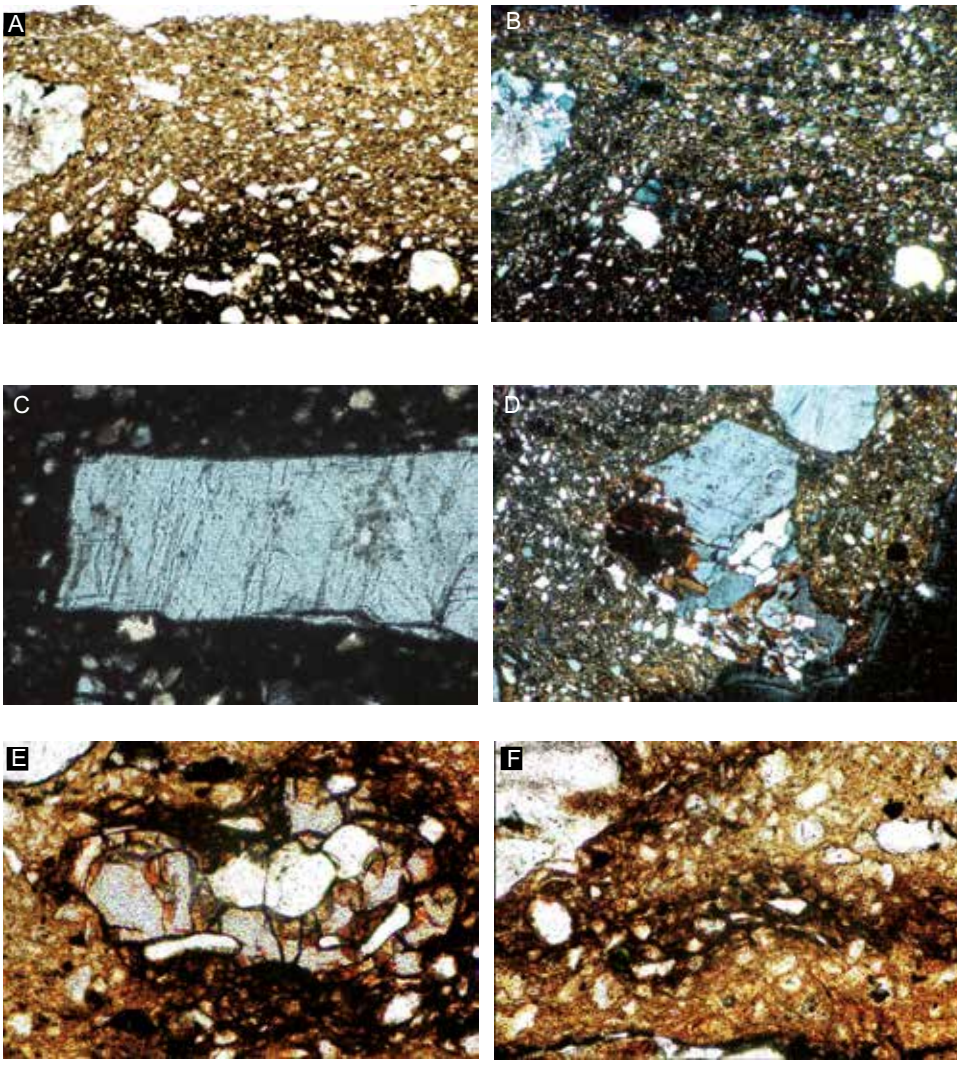

Fig. 17. Bonikowo, site 1, Kościan District – vessel sherd (sample BO/Pc1). A – clay matrix from outer part of sherd (about 40× magnification, parallel nicols); B – clay matrix from outer part of sherd (about 40× magnification, crossed nicols); C – alkali feldspar in the clay matrix (about 60× magnification, crossed nicols); D – crushed biotite granite fragment in the clay matrix (about 60× magnification, crossed nicols); E – crushed quartzite fragment in the clay matrix (about 60× magnification, parallel nicols); F – flattened lump of unworked clay in the clay matrix (about 40× magnification, parallel nicols). Photo by P. Gunia

In the central part of the break, the clay mass is brown, slightly translucent, evincing a compact structure with a relatively large quantity of fine-grained sand (55–60% by volume). Some places in the mass are devoid of crushed stone. There are occasional clumps of unworked ceramic mass surrounded by veins or rings built of darker, ferruginous silty material. The groundmass present in the peripheral parts of the break is light brown, translucent, and its structure is felted or compact depending on the location. Virtually devoid of larger components of crushed stone, the slip zone consists of a matrix with single spots or strips of opaque, ferruginous pigment concentration. A glassy substance occurs at relatively low frequency in larger oval or irregular pores or slits in the clay matrix. Occasionally, single round gas bubbles were also noted.

Results: The described vessel is made of ferruginous sandy clay characterised by poor plasticity, tempered with fine, well sorted crushed rock (or a weathered equivalent) probably of erratic origin. Given the poorly mixed components of the clay matrix and insufficient drying before firing, the container was made without much care. The outer surface of the vessel was covered with a thin film of less dense clay (slip), and then fired under reducing conditions in a low temperature, below 600°C.

POŁUPIN, site 2 (Fig. 15; 18; 19)
Dąbie Commune
Krosno Odrzańskie District
Lubuskie Province
Ring-shaped stronghold
Sample N°: PN2/Pc1
Younger settlement phase
Field inventory N°: 10/1961
Discovery: Excavated by Edward Dąbrowski from the Museum in Zielona Góra in 1961
Collection: Archaeological Museum of the Middle Odra Basin in Świdnica near Zielona Góra

Macroscopic features: Two vessel fragments, sized 10×3×0.6 cm, including the rim with an applied band of clay and the upper part of the body (with a small pierced hole, about 8 mm in diameter). The outer surface is light grey-brown in colour, smooth, with two wide grooves in the upper part of the body. Originally smooth, now rough, the inner part is light grey in colour and undecorated. In the break there is a thin layer, dark cherry red in colour in the part adjacent to the outer side of the vessel, whereas the rest of the break is striped in various shades of brown, with visible light brown and grey fragments of crushed stone, sand grains and glass-bearing veins.

Petrography: The clay groundmass is generally medium-grained with fine-grained parts or areas where the grains (or fragments) differ in size, while the structure is

Fig. 18. Połupin, site 2, Krosno Odrzańskie District – vessel sherd (sample PN/Pc1).
A – external view; B – internal view; C – section view; D – thin section (about 4× magnification); E – single, rounded grains of sand, crushed stone fragment and glass-bearing veins in the clay matrix (about 40× magnification, parallel nicols); F – single grains of sand, crushed stone fragments and glass-bearing veins in the clay matrix (about 40× magnification, crossed nicols). Photo by P. Gunia

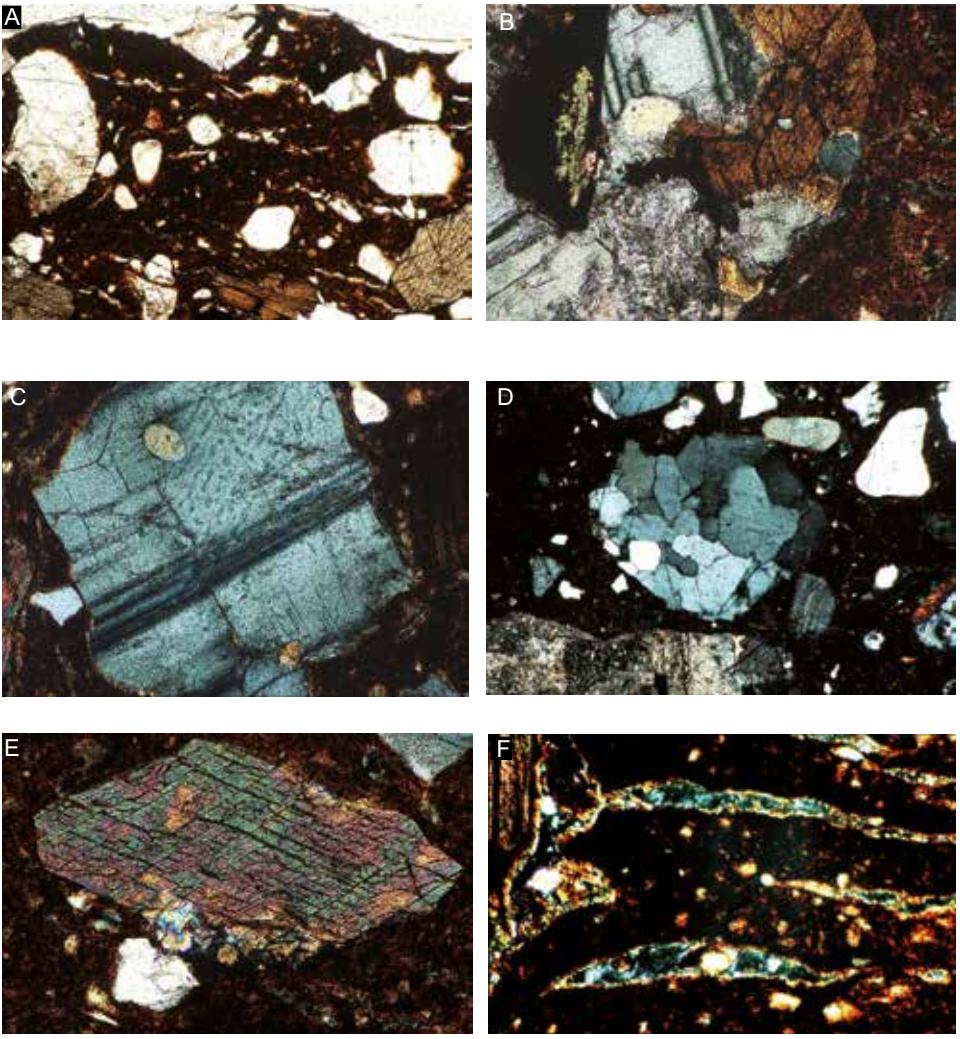

Fig. 19. Połupin, site 2, Krosno Odrzańskie District – vessel sherd (sample PN/Pc1). A – clay matrix from outer part of sherd (about 40× magnification, parallel nicols); B – crushed fragment of gabbro (?) in the clay matrix (about 40× magnification, crossed nicols); C – part of orthoclase as a component of crushed granite in the clay matrix (about 40× magnification, crossed nicols); D – fragment of quartzite as an nonplastic component of the clay matrix (about 40× magnification, crossed nicols); E – idiomorphic prismatic crystal of common hornblende in the clay matrix (about 40× magnification, crossed nicols); F – glass-bearing veins with distinctive reaction rims in the clay matrix (about 40× magnification, crossed nicols). Photo by P. Gunia

unoriented. Nonplastic compounds belong to several classes of grains (fragments). Less common are larger components measuring up to 1.5 mm, which were identified as: sharp-edged quartz fragments sometimes showing wavy extinction of light, fragments of plagioclase table-shaped crystals, often with traces of albite twinning and heavy weathering changes. In some places, larger potassium feldspars occur. Some of them have a well-developed admixture of perthitic intergrowths. Quite common are also idiomorphic or panxenomorphic amphibole prisms representing a common hornblende variety. Many of these prisms display strong pleochroism and exhibit well-defined bi-directional cleavage planes intersecting at an angle close to 120°. Two slightly rounded fragments of plagioclase-bearing ortoamphibolites with granonematoblastic texture were also found. In the clay matrix, temper sized from 0.2 to 0.6 mm includes the same components as described above, commonly represented by sharp-edged fragments of quartz and feldspars. Significant amounts of well-rounded quartz grains, individual or sets of biotite platelets and single needle-shaped muscovite flakes have also been registered.

The ceramic mass is dark brown in colour, opaque and has a compact cryptocrystalline texture. The content of the dipped matrix here is small and does not exceed 10% of the volume of the sherd. Locally, in areas adjacent to the outer surface of the pot, the cherry-brown clayey background is poorly translucent and has a felted structure. This zone, almost devoid of major components of crushed stone, is locally enriched with very fine-grained sharp-edged quartz fragments. Glass-bearing veins are most common here. Typically, they form various forms, from worm-like to toothed, branching, and then connecting with one another around the grains of the temper. Occasionally, smaller fragments of crushed stone are also found, either embedded in the glassy substance or as bent, narrow veins narrowed in both directions. Larger oval areas left after grains of primary sand are often filled with a glassy-like substance.

Results: The examined potsherd was made of fat, strongly ferruginous clay of high plasticity. The most common nonplastic compounds were feldspars (alkaline or plagioclases), quartz and rock fragments resembling in composition granites and orthoamphibiolites. A significant amount of well-rounded quartz sand of fluvial origin was also added to the primary ceramic mass. The outer surface of the vessel was covered with a thin film of less dense clay with fine-grained quartz fragments (slip). The vessel was probably fired under reducing conditions, at a temperature of about 650°C.

Conclusions: Petrographic analyses of the pottery from the archaeological sites of Bonikowo and Połupin have shown the ceramics to be different. In the Bonikowo sample, quartzite and granite fragments predominate among the nonplastic ingredients in the clay matrix, while the sherd from Połupin contains an addition of granites and gabbro-like rocks, together with a large quantity of fluvial sand. These differences may have been caused by different pottery production technologies and might have arisen from the use of a local clay characterised by different petrographic features.

APPENDIX 2

RESULTS OF RADIOCARBON DATING OF ARCHAEOLOGICAL MATERIAL FROM BONIKOWO, SITE 1 (WIELKOPOLSKA PROVINCE) AND POŁUPIN, SITE 2 (LUBUSKIE PROVINCE)[10]

Radiocarbon analyses (^{14}C AMS) were conducted at the Poznań Radiocarbon Laboratory under the direction of Prof. Tomasz Goslar, in connection with the implementation of research task No. 8 of the Project N R 17 0014 06 in 2009–2012 'Multi-disciplinary research as a method of reconstruction of settlement-cultural transformations. Western Wielkopolska in prehistory and the Middle Ages' (bone samples) and in within the frame of a PRELUDIUM grant from the National Center of Science (NCN) in Poland (UMO-2012/05/N/HS3/01425) 'Interdisciplinary examination of the early medieval (seventh–tenth/eleventh c.) workshop pottery in the Middle Odra River basin' (charcoal sample). The radiocarbon age of two bone samples from the stronghold in Bonikowo (order no. 5970/11), two bone samples (order no. 4065/10) and charcoal sample (order no. 8977/14) from the stronghold in Połupin was estimated. The bone samples met the criteria of the method (Walanus and Goslar 2004).

Sample name	**Lab. no.**	**^{14}C age**	**Remarks**
Bonikowo 1–1/2011	Poz-45908	1295±30 BP	2.2%N 9.4%C
Bonikowo 1–2/2011	Poz-45909	1250±30 BP	1.6%N 4.4%C
Połupin 1(6)	Poz-33234	1200±30 BP	0.9%N 4.5%C
Połupin 2(7)	Poz-33235	1170±35 BP	1.2%N 5.9%C
Połupin 2/15/63	Poz-67862	1250±30 BP	

Results of calibration of ^{14}C dates – order no. 4065/10.

Given are intervals of calendar age, encompassing the true age of the samples with a probability of ca. 68% and ca. 95%. The calibration was made with OxCal software.

INFORM: References – Atmospheric data from Reimer *et al* (2004); OxCal v3.10 Bronk Ramsey (2005); cub r:5 sd:12 prob usp[chron]

[10] For the results of radiocarbon dating of archaeological samples from Stożne, site 2, Lubuskie Province, see Gruszka 2010.

Results of calibration of ^{14}C dates – order no. 5970/11.

Given are intervals of calendar age, encompassing the true age of the samples with a probability of ca. 68% and ca. 95%. The calibration was made with OxCal software. INFORM: References – OxCal v4.1.5 Bronk Ramsey (2010); r:5. Atmospheric data from Reimer *et al.* 2009.

Results of calibration of 14C dates – order no. 8977/14.

Given are intervals of calendar age, encompassing the true age of the samples with a probability of ca. 68% and ca. 95%. The calibration was made with OxCal software. INFORM: References – OxCal v4.2.3 Bronk Ramsey (2013); r:5. IntCal13 atmospheric curve Reimer *et al.* 2013.

BONIKOWO, site 1 (Fig. 20)
Kościan Commune
Kościan District
Wielkopolska Province
Multi-part stronghold

Sample Bonikowo 1–1/2011: 1295±30 BP
So-called bone spike (possibly damaged in the upper part, from the inner side, unburnt – Fig. 9: 4)
Sheep/goat, metacarpal bone, young individual[11]
Are 98C, layer $IV_{4–5}$, from NW 2.85 m, from NE 2.88 m, depth 2.38 m
Field inventory no.: 60/1952 (R)
Discovery: Excavated by Zofia Hołowińska and Zofia Hilczerówna on behalf of the Directorate of Research on the Beginnings of the Polish State in 1952.
Collection: Institute of Archaeology and Ethnology, Polish Academy of Sciences, Poznań Branch
68.2% probability
AD 670 (44.4%) AD 713
AD 745 (23.8%) AD 767
95.4% probability
AD 662 (95.4%) AD 774

Sample Bonikowo 1–2/2011: 1250±30 BP
Skate or ski (damaged underside, used, unburnt – Fig. 9:8)

[11] Archaeozoological identification of ^{14}C dated samples from Bonikowo and Połupin by Dr. Marta Osypińska from the Institute of Archaeology and Ethnology of the Polish Academy of Sciences, Poznań Branch

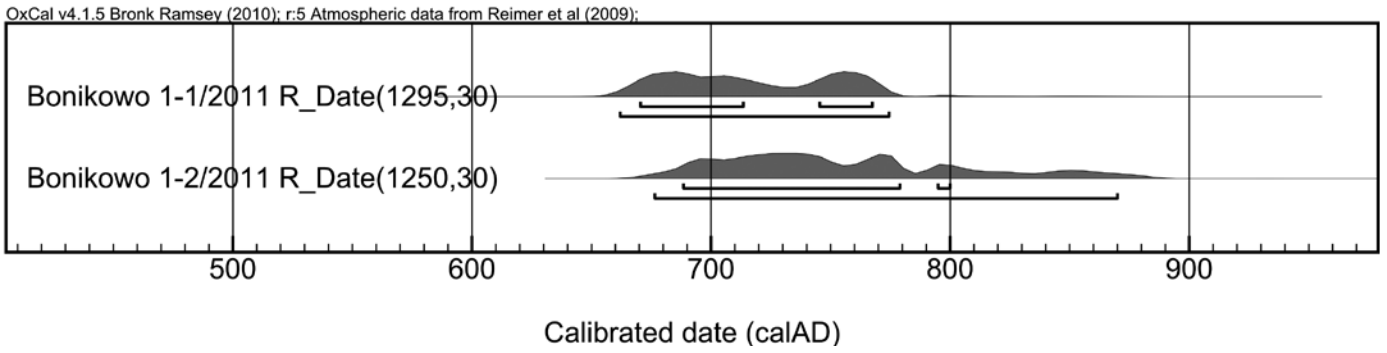

Fig. 20. Bonikowo, site 1, Kościan District. Probability density distribution of the calibrated age for AMS dated samples. After the Poznań Radiocarbon Laboratory

Cattle metacarpal bone, distal extremity missing
Are 98C, layer IV, from NE 2.2 m, from NW 2.35 m, depth 2.29 m
Field inventory no.: 52/1952 (on the artefact erroneously no Bo 51/52)
Discovery: Excavated on behalf of the Directorate of Research on the Beginnings of the Polish State in 1952.
Collection: Institute of Archaeology and Ethnology, Polish Academy of Sciences, Poznań Branch
68.2% probability
AD 688 (65.7%) AD 779
AD 795 (2.5%) AD 800
95.4% probability
AD 676 (95.4%) AD 870

POŁUPIN, site 2 (Fig. 21)
Dąbie Commune
Krosno Odrzańskie District
Lubuskie Province
Ring-shaped stronghold

Sample Połupin 1(6): 1200±30 BP
Pig molar, unburnt
Trench 1, quarter A, layer III (?), among stones (younger phase of stronghold)
Field inventory no.: 19/1961
Discovery: Excavated by Edward Dąbrowski from Museum in Zielona Góra in 1961
Collection: Archaeological Museum of the Middle Odra Basin in Świdnica near Zielona Góra
68.2% probability
AD 775 (68.2%) AD 875
95.4% probability
AD 710 (6.3%) AD 750
AD 760 (87.7%) AD 900
AD 920 (1.3%) AD 940

Sample Połupin 2(7): 1170±35 BP
Fragment of a cattle humerus, unburnt
Trench 1, layer III, among stones which fell from the rampart structure, above clay (younger phase of the settlement)
Field inventory no.: 12/1963
Discovery: Excavated by Edward Dąbrowski from the Zielona Góra Museum in 1963.

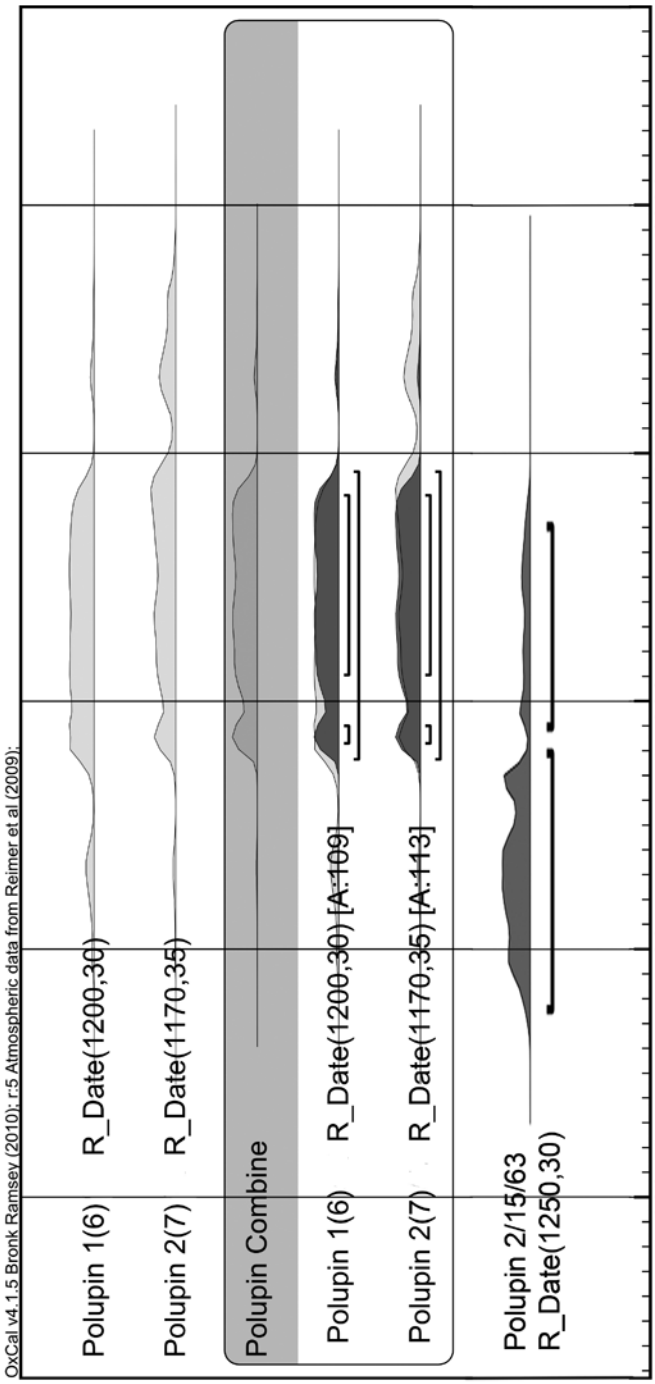

Fig. 21. Polupin, site 2, Krosno Odrzańskie District. Probability density distribution of the calibrated age for AMS dated samples. After the Poznań Radiocarbon Laboratory

Collection: Archaeological Museum of the Middle Odra Basin in Świdnica near Zielona Góra

68.2% probability
AD 770 (65.4%) AD 900
AD 920 (2.8%) AD 940
95.4% probability
AD 770 (95.4%) AD 980

R_Combine Połupin 1–2: 1187±23 BP
68.2% probability
AD 780 (6.0%) AD 790
AD 800 (62.2%) AD 890
95.4% probability
AD 770 (95.4%) AD 900
X2-Test: df=1 T=0.4(5% 3.8)

Sample Połupin 2/15/63: 1250±30 BP

Charcoal

Trench 1, quarter ?, layer IV, hearth discovered under the debris of the rampart's stone elements (older phase of the stronghold or the so-called open settlement from the phase pre-dating the stronghold).

Field inventory no.: 15/1963

Discovery: Excavated by Edward Dąbrowski from the Museum in Zielona Góra in 1963.

Collection: Archaeological Museum of the Middle Odra Basin in Świdnica near Zielona Góra

68.2% probability
AD 687 (68.2%) AD 775
95.4% probability
AD 676 (74.8%) AD 779
AD 790 (20.6%) AD 870

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Late medieval clay figurines – toys, devotional items or decoration? A few remarks on the relationship between function and iconography

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Late medieval clay figurines can be divided into two iconographic groups: religious motifs that are usually interpreted as devotional items and profane motifs believed to have been used as toys or decoration. Nevertheless, this approach needs to be revised in view of the distinction between iconography and function that should be made according to many researchers, who see the owner of an object as the one who decided about usage in specific situations. The paper discusses the different functions that different types of figurines could have served. It also reflects on the connections between iconography and the role assigned to a figurine by the user, as well as on discrepancies in that matter. The border between *sacrum* and *profanum* was rather fluid in the Middle Ages and religious figurines could have been used in not religion-related situations and profane ones in religious activities.

KEY-WORDS: clay figurines, iconography, function, late medieval, toys

Late medieval mass-produced clay figurines are characteristic of the area of the German-speaking lands as well as the Netherlands, but a huge number of these were also discovered during archaeological excavations in other regions that were under strong influence of the culture of those lands, such as Bohemia, Moravia and Silesia (Borkowski 2004: 209). Most of the artifacts date back to the 15th and the early 16th century.

The Rhenish-Dutch borderland is considered to be the birthplace of the production of these so-called pipe-clay figurines, or *Pfeifentonfiguren* in German (Neu-Kock 1993: 28–29; Borkowski 1998a: 52, 2004: 207). They were pressed in two-piece moulds, which indicates that it was a serial production (for the technology, see also, e.g., Neu--Kock 1988, 1993; Richter, Standke 1991: 43; Borkowski 1998, 2004; Hermann 2004; Kowalczyk 2012, 2013a; Kowalczyk and Siemianowska 2014). They were so popular at

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that time that they were sometimes exported far beyond the borders of the Holy Roman Empire. Finds of such figurines, proved to be of Dutch or Rhenish origin, were reported even in England (Ward-Perkins 1967: 293), Finland and Iceland (Mehler 2009: 99, 103). There are numerous figurines in museum collections in those countries, e.g. in the Museum of London or Turku Castle (Finland). They are mostly unpublished, but may be seen on permanent or temporary exhibitions.

The existence of specialised craftsmen responsible for the production of such items was confirmed by both literary and archaeological sources. In Dutch and Rhenish documents, dated to the 15th and 16th century they are referred to as *Bilderbäcker*, *Bildermacher*, *Bilddrucker*, *hillegenbakker* or *Beeldedrucker*. Their workshops were supposedly located in Cologne, Utrecht, Kampen, Liège, Worms and a few other cities of present-day Germany (e.g., Leeuwenberg 1965: 151–166; Neu-Kock 1988: 6, 1993: 4, 12–13; Borkowski 1998a: 51, 2004: 207). These locations still need confirmation for the most part. The most important archaeological find is a pit filled with hundreds of fragments of broken clay figurines, discovered adjacent to relics of a furnace in Cologne, in the area of Breslauer Platz. The figurines are claimed to be the production waste from a *Bilderbäcker*'s workshop (Neu-Kock 1988, 1993).

The local production of ceramic statuettes was also confirmed recently in Silesia. Even though this production was rather peripheral and not fully specialised as in Rhineland and the Low Countries, it contributes importantly to research on clay figurines, Silesia being the easternmost region where local workshops were identified in the archaeological record (Borkowski 2004; Kowalczyk 2012, 2013a: 78–83). There is no historical record, however, to support the archaeological finds (Borkowski 1998: 51). The workshops were located probably in Wrocław, Dzierżoniów and Głogów (Kowalczyk 2012: 26–101, 2013a: 78–83, 90) and ongoing and future archaeological excavations in Silesian towns may surely bring new discoveries.

The variety of iconographic motifs represented by the figurines is considerable. They can be divided into two basic categories: religious and profane (or secular). Traditionally, the religious figurines are interpreted as devotional objects and the profane ones as toys or decoration (see, e.g., Borkowski 1998a, 1998b; Neu-Kock 1988, 1993; Hoffmann 1996), but this somewhat simplified approach requires revision. Researchers increasingly point to the need of making a distinction between an object's religious or profane iconography and its religious or profane function. It is emphasized that the one making a decision about how an item was to be used in a given situation was the owner (e.g., Hoffmann 1996: 136; Grönke and Weinlich 1998: 15; Hermann 2004: 38; Měchurová 2009: 181–182). This approach sounds obvious, but even so it is mature and insightful. Religious figurines may well have been used accidentally as toys while profane statuettes could have played a part in religious scenes.

Different depictions could have been used in different ways (see also: Kowalczyk 2012: 88–98, 2013a: 78, 2013b: 18–19; Kowalczyk and Siemianowska 2014: 86–87),

in some cases proved by archaeological and historical sources or works of art, in others, purely hypothetical. The relation between their iconography and function should be considered on the grounds of a few examples, keeping in mind that new data may be forthcoming from the extensive archaeological investigations being conducted in many European cities.

Sacred motifs are much more differentiated as a group compared to the profane ones. Their function appears to have varied depending on the iconography, but it is assumed that they were mostly used for religious purposes, generally as devotional figures used in private worship (Richter and Standke 1991: 42; Neu-Kock 1993: 25; Grönke and Weinlich 1998: 16; Borkowski 2004: 212). This assumption derives from the close relation to iconographic motifs, especially devotional ones, that had become widespread in Gothic art of the late medieval period (see Marcinkowski 1994). Such themes as the Saints, Nativity Cycle, Passion, various renderings of the Virgin Mary and Child, and many others were introduced or became very popular as a result of the huge changes in religiosity that started in the 13th century (Eörsi 1984: 8–17; Huizinga 1987: 147–192; Swanson 2000; Szulc 2007; Bylina 2009). A new, individual model of devotion was established (Eörsi 1984: 13, 16–17; Huizinga 1987: 147–148; Borkowski 1998a: 53, 1998b: 14–16; Szulc 2007) and specific cults, like the Veneration of Saints, the Virgin Mary, Nativity and Passion developed (Huizinga 1987: 149, 159–171; Swanson 2000: 35–36; Richter and Standtke 1991: 42; Szulc 2007: 173–227; Bylina 2009: 74–90). Devotion concentrated on the human aspects of Christ and his earthly life (Borkowski 1998b: 14–15; Szulc 2007; Bylina 2009: 68). The activity of St. Francis of Assisi and St. Bernard of Clairvaux (Kłoczowski 1974; Chéllini 1996: 289–297; Szulc 2007: 171; Bylina 2009: 75), as well as the development of the *devotio moderna* movement in the Netherlands and Rhineland in the 14th century (Huizinga 1987: 156, 172, 185–186, 189, 192, 216, 248; Chéllini 1996: 391–395; Bielak 2002: 39–73; Bylina 2009: 68–69), were probably responsible for these processes. Local examples of unusual piety, like St. Hedwig in Silesia, were also significant in spreading the new trends. Moreover, St. Hedwig was supposed to have been buried with her beloved figurine of the Virgin Mary and Child, and it is thus that she is sometimes depicted in art (Dola 1995; Borkowski 1998a: 54). All these transformations are clearly visible in the world of medieval iconography as well.

Saints as well as the Virgin Mary and Christ were considered mediators between God and his followers, who fulfilled God's plans on Earth (Huizinga 1987: 161; Borkowski 1998a: 52, 2004: 212–213). And depictions were symbolic representations of their presence providing everyday contact with the sacred (Borkowski 2004: 212–213; Kapustka 2008: 14; Bylina 2009: 119). People in the Middle Ages tended to focus on images and gestures, which played an important role in communication, because they were usually illiterate. That is why the trend to depict ideas was so strong at that time (Huizinga 1987: 147). However, they seem to have distinguished intuitively between

cult miraculous paintings and devotional images which were based on the holy intervention of the depicted characters (Kapustka 2008: 10, 23, 50).

Saints were beseeched for assistance in difficult situations (Bylina 2009: 80) even in the 19th century (Stomma 2000: 140). Their depictions could have been stored in the household, for example, in the so-called *God's corners* (Neu-Kock 1993: 24; Borkowski 2004: 212), but they could also have been used as a kind of charm kept in the pocket, to ward off evil, dangers and woes. People would choose a saint appropriate to their problem (Borkowski 1998a: 53). It is logical that these sacred yet human characters were closer and more understandable to the faithful than the powerful and impersonal God, yet there is a pagan note in this attitude, underlining this Christian tradition (Borkowski 1998a: 53–54, 1998b: 19). In the Late Middle Ages, the specific central European cult of The Fourteen Holy Helpers was very popular (Neu-Kock 1993: 15–16; Wachowski 2013: 128–129). K. Wachowski points out that the popularity of some saints from this group, such as St. Catherine, St. Barbara or St. Margaret, could have been connected with the outbreak of the Black Death pandemic in Europe in 1348–1349 (Wachowski 2013: 128–129).

One aspect of the relation between the figurines and so-called fine art should be emphasized, namely, the connection with late medieval altarpieces. Having a set of figurines, including the Virgin Mary and Child, the Virgin Saints, male Saints and other motifs which were very popular among clay statuettes, gave the opportunity to reconstruct a typical Gothic altarpiece in the house, such as the type dedicated to the Four Virgin Saints, both in terms of iconography and ideological program (See also: Kowalczyk 2013b: 29–30). The liturgy became more accessible to ordinary people in the Late Middle Ages (Kłoczowski 1974: 168, 172; Borkowski 199a: 53), so they could see all the beautiful works of art inside the churches. They might have desired to transfer these images to their homes, as they were deeply settled in their imagination (Gabriel and Kracíková 2010: 2, 31). Some of the figurines, like the Virgin Saints, have flat backsides, just like the regular altarpiece sculptures very often. It might indicate that the figurines were intended to be set against a wall. Another interpretation has the figurines being put in the places endangered by epidemics, hence their flatness (Wachowski 2013: 129), but this has not been proven. This issue is closely interknit with devotional function, but it definitely merits noting as a separate research problem. Scholars generally agree that such home altars constructed with the use of clay figurines could have been popular in the Middle Ages (Richter and Standke 1991: 42; Neu-Kock 1993: 24; Borkowski 1998a: 52, 2004: 212; Grönke and Weinlich 1998: 15; Hermann 2004: 38).

The other important situation, in which people could have made use of clay figurines, were re-enactments and reconstructions of biblical, apocryphal and hagiographic scenes and cycles. This might have its roots in medieval art as well as in liturgical dramas and mystery or miracle plays that were very popular in the Middle Ages.

The plays took place in churches and the favoured themes were the Nativity cycles, the Passion cycles and the miraculous interventions of the Saints. Clay figurines enabled people to organise such ritual and non-ritual re-enactments at home, as the archaeological finds consist of the images of various Saints, the Virgin Mary and different depictions of Christ, both as a child and an adult in Passion-related iconographic themes, such as Crucifixion, *Ecce Homo* and *Vir Dolorum*.

Some of the motifs at least could have also been connected with pilgrimages, which were common in the Late Middle Ages. Many pilgrimage centres developed throughout Europe at the time. Each of them had its own characteristic tin alloy badges and other souvenirs that were sold to the pilgrims and regarded as a proof of a completed pilgrimage. The badges usually depicted patrons of the centres and therefore we have Virgin Mary and Child from Aachen, the Magi from Cologne or to mention a local Silesian example, St. Hedwig from Trzebnica (Wachowski 1998, 2005, 2011: 133–134). Some researchers claim that clay figurines could have also served as pilgrimage souvenirs (e.g., Neu-Kock 1993: 30; Grönke and Weinlich 1998: 16; Borkowski 1998a: 52, 2004: 212). A clay depiction of the Virgin Mary and Child was discovered in archaeological excavation at the famous Marian sanctuary of Einsiedeln in Switzerland. It is a 17th-century, baroque-style statuette, the dating and identification confirmed by an inscription on the figurine containing the words 'MARIA ENSIDLENSIS' and the date (Grönke and Weinlich 1998: 108, Fig. 27). The said Silesian place of pilgrimage in Trzebnica could have also offered clay depictions along with the tin alloy badges (Wachowski 1998: 72–73). A find of a clay image of St. Hedwig was discovered among almost two hundred fragments of broken figurines in a wood-lined pit during the excavation of Dominikański Square in Wrocław (Borkowski 2004). More importantly, figurines, like badges, were believed to gain special powers by contact with the actual relics of saints (Murray Jones 2007: 93).

Figurines could have served votive functions sporadically as well (Richter and Standke 1991: 42; Borkowski 1998a: 54). As recorded in the *Gesta principum Polonorum*, a chronicle ascribed to Gallus Anonymus, the Polish king Władysław I Herman was supposed to have sent a small golden figurine depicting a child to St. Gilles in France in order to ask the saint for help. St. Gilles was believed to have the power to heal infertility (Witkowska 1978: 98–99; Borkowski 1998a: 54). Poorer people might have used cheaper clay statuettes for such purposes. And these votive practices could have taken place at pilgrimage places as well.

Special attention must be paid to depictions of the Christ Child. One of the most typical motifs is the Nativity scene, or rather Jesus lying in a crib, which may have been part of a larger realisation. The Child is usually depicted with the cross-nimbus over the head and an apple in his hand. The apple should be interpreted as a symbol of the upcoming Passion, as well as a representation of royal power. Jesus is sometimes paired in the crib with John the Baptist, who holds a chalice in his hand. The custom

of setting such a crib, especially at Christmas time, originated in medieval convents where nuns gathered around the crib, prayed and sung religious hymns (Richter and Standke 1991: 42; Neu-Kock 1993: 26; Hoffmann 1996: 148; Měchurová 2010: 101–102). This custom may have also been cultivated by ordinary people in their houses and clay figurines would have been a useful, easily accessible and probably affordable accessory (Gabriel and Kracíková 2010: 229–230).

The other motif connected with the Child Jesus is the so-called New Year's Jesus. The image of the Child holding a goldfinch, cross or other symbols of the Passion was popular in late medieval graphic art (Heitz 1900; Neu-Kock 1993: 24). The figure was usually accompanied by banderols with New Year's wishes, to which the name of the motif refers. It is assumed that such clay statuettes might have been gifts, given for the New Year or on other occasions (Neu-Kock 1993: 24; Grönke and Weinlich 1998: 15; Borkowski 2004: 212).

Apart from all the described religious functions, religious figurines could have been used in everyday, not directly religion-related situations. The biblical re-enactments and reconstructions might have played an entertaining role for both children and adults (Gabriel and Kracíková 2010: 231). The distinction between a ritual and a play was not quite evident as most scholars would agree (Hoffmann 1996: 136; Hermann 2004: 38; Měchurová 2009: 181–182, 2010: 99; Gabriel and Kracíková 2010: 231). Rituals as well as other religious activities had generally a great deal in common with plays, transferring the participants temporarily into a different reality (Huizinga 2007: 37). People were familiar with biblical, apocryphal and hagiographic stories, so they could have reached for them while playing and having fun. The educational character of such plays should also be stressed. Sacred figures, such as the Virgin Mary, Christ and Saints, were regarded as good examples of morality for children to follow. Giovanni Dominici in a document from the year 1405 suggests that parents should keep holy images at home and use them as role models for their offspring of how to be good Christians (Hoffmann 1996: 136–137; Borkowski 1998: 29; Měchurová 2010: 99). This aspect definitely balances on the border between the religious and the profane.

It may seem slightly trivial that such religious statuettes served also as decoration in the household, place on shelves or on a mantelpiece. This apparently secondary function is definitely worth noting. As clay figurine production has been proved to be mass and serial, the figurines were not likely to be kept as a sign of high social status. They were not included in testaments or other documents (Borkowski 1998a: 51), which indicates that they did not have any special value. However, they differ among themselves in quality and some of them could have been valued higher than others and therefore more exclusive. Unfortunately, it cannot be said whether the statuettes were somehow fashionable. Some of the finds come from medieval castles, which might suggest that they were rather not considered as something disregarded or despised at that time.

The second iconographic group is made up of profane motifs. These are also fairly diversified and could have been used in countless ways. The decorative function appears as the most obvious one and might have been fulfilled by all the depictions from this range (Neu-Kock 1993: 23–25). As said earlier, they were often interpreted as children's toys. Each figurine could have been useful in many different plays and there are various detailed studies on this issue (e.g., Borkowski 1995; Hoffmann 1996; Měchurová 1994, 2009, 2010). Female depictions might have been considered as dolls, just like images of babies in cradles (e.g., Hoffmann 1996: 148), at least the ones that cannot be interpreted as depictions of the Child Jesus due to lack of characteristic attributes. Adults may have used the figurines for entertaining purposes as well.

One of the entertaining roles of clay statuettes should be discussed in more detail as it reflects the cultural background of late medieval Europe. This is the re-enactment of tournaments and other scenes from courtly life, including courtly love (Neu-Kock 1988: 26, 1993: 23; Borkowski 1995: 102, 104; Hoffmann 1996: 136). Today, we would call it a kind of a puppet show. Depictions of knights, horsemen, horses and ladies were useful in the matter. Some of them, those with holes, could have been put on a stick in order to make them easier to operate. Types of such figurines have even been distinguished, namely *Lanzenpferdchen* with a hole in the front and *Aufsteckpferdchen* with a hole in the bottom (Borkowski 1995: 103; Hoffmann 1996: 151; Měchurová 2010: 102). This assumption is supported by the fact that the depicted dresses are often related to medieval courtly fashion as well as by miniatures in medieval codices (Borkowski 1995: 104; Měchurová 2009: 182). In fact, tournaments were very popular in the Late Middle Ages and even ordinary townsmen participated as spectators in this form of mass entertainment (Borkowski 1995: 104; Piwowarczyk 2000). Courtly life had a huge influence on people's imagination. Moreover, it created a typical situation in which the poorer looked up to those of higher social status and patterned their life on theirs, even if only for fun (Hoffmann 1996: 136). Other scenes that may have been reenacted were taken from the townsmen's everyday life, from hunting, popular legends and fairytales (Hoffmann 1996: 136; Měchurová 2010: 99). It may be assumed that images of knights, ladies, peasants, craftsmen, animals and centaurs among many others were used in such scenes. A huge number of figurines depicting everyday activities was discovered, for example, in Augsburg (Hermann 2004: 138–139).

There are figurines that obviously served symbolic functions, such as depictions of couples holding a chalice or wreath, as well as men with rings in their hands (Neu-Kock 1988: 32, 1993: 18–19, 56–57). These figurines referred directly to love and wedding symbolism, which is a separate issue (Wachowski 2011: 129–130, 2013: 11–83). Interestingly, a wedding-related figurine found in Cologne has a satirical, or rather moralising character at the same time. The couple is dressed in late medieval costume and holds a wreath but from the back, the lady is seen reaching for the man's pouch.

This might be interpreted as a warning not to trust all women, as they can be interested only in a man's wealth (Neu-Kock 1993: 18–19, 56–57).

There are many other satirical depictions among the clay figurines, especially those from the Rhineland. There are examples of monkeys playing musical instruments and jesters in their characteristic costumes, supposedly connected with the theme of the Garden of Love (Neu-Kock 1993: 19–20, 64). This would refer to courtly life as well. One of the most interesting humorous motifs is the so-called *Goldscheisser*, known from finds from Germany, Bohemia and Silesia, and generally dated to the 16th or early 17th century (Pazda 2002; Sedláčková 2003). It depicts a man with lowered pants, sitting on a pot or simply defecating. It surprisingly resembles the figure of a *Caganer* which is typical of Catalonia and neighbouring areas since at least the 18th century. It is still used in Nativity scenes there. These few topics are related to the idea of the carnivalesque and the reversed world, which was popular in late medieval and early renaissance literature.

Among the profane motifs there are also images that can be referred to as pornographic, as they depict naked couples in explicit poses (Neu-Kock 1988: 27, 1993: 19, 58). However, a simply erotic meaning may not be that obvious once insight is gained into the matter. There is a large number of obscene tin alloy badges known from Europe (see www.medievalbadges.org) and they were sold in pilgrimage places alongside the pilgrim badges. Their obscene character, seen with our modern sensibilities, could have involved magical connotations connected with fertility. There are some records suggesting that badges were believed to help with impotence and infertility (Murray Jones 2000). This might have been the case with the figurines as well. Christian and pagan beliefs and rites were mixed together for a very long time after the conversion to Christianity and in some ways they still are (Borkowski 1998a: 54).

Profane figurines could have also fulfilled strictly religious functions. They could have built the background for biblical and hagiographic scenes and re-enactments (Hoffmann 1966: 136–137), e.g., in the Nativity or the Passion. Similar solution are to be noted in medieval paintings and other works of art. People in contemporary dresses filled the composition when needed.

The wealth of representations among the late medieval clay figurines is fairly rich and provides numerous interpretations. The possibilities discussed in the paper are not the only valid ones and only some of them are confirmed by archaeological or historical sources. Moreover, both religious and profane functions can sometimes be assigned to a single motif, depending on the situation. As said above, it was the owner who decided on a specific use.

Nevertheless, as the presented review demonstrates, in most cases the iconography could have determined the intended function, or at least the spectrum of possible functions. The connections between iconography and function are more obvious than the discrepancies. The owners made use of the religious figurines in many

religion-related activities and the profane motifs were more likely to be used as toys or decoration. And they were probably designed and produced having these purposes in mind. However, we need to remember that in the Middle Ages, the border between the *sacrum* and *profanum* was rather fluid (Huizinga 1987: 147). Sometimes it is even hard to categorize the function.

Studies on the function of different groups of archaeological sources give countless possibilities of interpretations. Additionally, these are everyday items that show us a kind of life in past époques that was not recorded in other types of sources, including documents.

Studies of the iconography of archaeological artifacts is not a popular research subject, as it requires a combination of methodological approaches from two disciplines, archaeology and art history. It is important, however, to conduct such interdisciplinary studies in view of the broader context that they afford and the deeper insight into a matter that they allow. This is especially vital in medieval studies and archaeology of historical periods.

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Symbolism, aesthetics, faith – a few words about religious decoration on tile stoves

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Selected examples of stove tiles are presented in this article in the context of an iconographic analysis of their relief decoration, which included Biblical symbols and scenes as a reflection of the people's need to surround themselves with religious motifs that expressed their spiritual beliefs. Stove tiles were decorated with motifs that were widely recognized and important in the lives of ordinary people. These images of Christ, the Virgin Mary, saints and scenes from the Scripture helped individuals to keep and defend the faith, especially in times of need. They gave people the much needed feeling of God's presence in their lives and at the same time allowed them to express their religious beliefs by decorating furnaces with this type of motifs.

KEY-WORDS: stove tiles, iconography, decoration, religious motifs, saints and martyrs

Man has always needed images and symbols to understand the spiritual world, to get closer to and to be able to commune with God. Art served this role, as did the more mundane objects, crafted by anonymous potters, that are found in archeological excavations after many centuries. Decorated with religious motifs, they are a reflection of a longtime desire that people have to be surrounded with Biblical scenes and symbols, helping them to keep and defend their faith, especially in times of need. Tiled stoves decorated with religious motifs of the Christian faith – images of Christ, the Virgin Mary, saints and scenes from the Scripture, narrative, moralistic, didactic, hagiographic and symbolic – expressed individual religious beliefs and ensured God's presence in the lives of ordinary people. Thus the stove tiles presented in this article are a source of information on the level of religious awareness of the inhabitants of central and eastern Europe in the Middle Ages and early modern times.

The presentation of selected themes from the Old and New Testaments, and the lives of the saints and martyrs visualizes the range of religious motifs present on tiled stoves. Images were well recognized, interpreted and understood. They included characteristics and/or attributes that were like a code, permitting communication and

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transmission of the content, especially when the vast majority of the population was illiterate. Today, they illustrate aspects of life in the past. Differences in the way certain scenes were represented can also be demonstrated depending on time and place.

One of the most popular themes from the Old Testament since medieval times is the Temptation of Adam and Eve in Paradise – the Sin of Adam from the Book of Genesis. The images on tiles depict the Tree of Knowledge of Good and Evil in the center with the serpent entwined around it, symbolizing Satan, embodying evil that leads man to destruction and to hell. Adam and Eve are shown on either side, covering their naked bodies, an explicit indication of sin having been committed and evil beginning to rule. Adam appears mostly on the right side of the tree, Eve as the source of sin being shown on the left, traditionally considered as the 'wrong' side. The occasional reversal of the composition is difficult to explain at this stage of the research. Was it a deliberate act or simply ignorance or error on the part of the craftsmen making the mold?

Execution is realistic, even if schematic. Examples from the region of Poland are known from Gniezno (15th century; Janiak 2003: 85, fig. 144), Babice (15th–16th century; Dąbrowska 1987: 125, fig. 16: 4–6), Wleń (15th–16th century; Buśko and Dymek 1995: 20, fig. 11f), Jarocin (beginning of the 16th century; Grygiel 2001: fig. 10: 2). An interesting example from Bolesławiec (15th century; Żemigała 1987: fig. 93) compiles scenes from both the Old and New Testaments. It was common practice and often appeared in typological sets. In this case, a pelican at the top of the tree is a symbol of Christ's sacrifice; the reading is that the Original Sin led to the death of Christ on the Cross.

Tiles decorated with the Temptation of Adam and Eve in Paradise motif are also known from Brno (15th century; Nekuda and Reichertová 1968: Tr. XCVIII: 5) and Kroměřiž (15th century; Nekuda and Reichertová 1968: Tr. XC) in the Czech Republic and from Kaunas in Lithuania (first half of the 16th century; Žalnierius and Balčiūnas 2007: 246). The tree in the Lithuanian example is schematic and Adam seems to be shown on the left. An ornamental arcade is characteristic of this and other tiles from this city, and there is an evident difference in the manner of representation between medieval and renaissance images.

The Original Sin resulted in the expulsion of the first people from Paradise. Adam and Eve are shown covering their nakedness (Ge 3: 7–11). Representations of this kind are known from Kraków (16th century; Lichończak-Nurek (ed.) 2011: 410–411), Nové Strašecí (middle of the 15th century; Hazlbauer 1998: 48) and Brno (15th century; Loskotová *et al.* 2008: 17, fig. 6). The message is the same, but the rendering is different. A guardian angel at the gates to Paradise is depicted with a sword. This scene reveals and emphasizes the drama of the moment.

Another example from the Old Testament is a scene of Samson fighting the lion, also quite popular, referring to the Book of Judges. Typically, it shows a man holding a lion 's jaw. Examples from the territory of Poland are known from Gniezno (first

half of the 15th century; Janiak 2003: 80, fig. 127) and Jarocin (beginning of the 16th century; Grygiel 2001: fig. 13:2). Parallels from the Czech Republic come from Brno (end of the 15th century; Loskotová *et al.* 2008: 18, fig. 11), Bouzov (end of the 15th century; Hazlbauer 1996: 66–67, fig. 32), Pisek (15 h; Brych 2004: fig. 81) and Olomouc (middle of the 16th century; Loskotová *et al.* 2008: 18, fig. 13).

The next scene is the prophet Jonah spat out by the whale. He was a prefiguration of Christ in religion and art and references to Jonah are a preview of Christ's death and resurrection. The New Testament is thus hidden in the Old Testament and the Old Testament is explained in the New Testament. Abel and Isaac were also a prefiguration of Christ and the Crucifixion was compared to the copper serpent that Moses used to treat humans. Fragments of a tile have been preserved from Gniezno (first half of the 15th century; Janiak 2003: 80, fig. 126) and parallels come from the Czech Republic, from Lipnice (second half of the 15th century; Hazlbauer 1998: 68) and Praha (15th and 16th centuries; Hazlbauer 1998: 69).

Scene from the New Testament include the very popular Annunciation, connected with the Marian cult. The Virgin Mary as the Mother of God was exemplary testimony of a noble mission contributing to universal salvation. The message was that people should not give up, that they should trust and live in accordance with the divine laws. In Annunciation scenes, she is often shown as the Queen Mother holding her son and as a compassionate mother standing below the cross. This theme decorated heating stoves from Jankowo Dolne (first half of the 15th century; Janiak 2003: 81, fig. 128), Czersk (second half of the 15th century; Dąbrowska 1987: 125, fig. 16: 1–2) and Jarocin (beginning of the 16th century; Grygiel 2001: 238, fig. 11: 1); in the lattermost one, the Virgin Mary is placed in the center with an angel on the left giving her a lily as a symbol of purity, innocence and virginity. Tiles from the beginning of the 16th century from Grodno (Archeologia 2012: 151) show typical motifs: a kneeling Mary, an Angel and a dove as a symbol of the Holy Spirit. On a tile from Malbork (Pospieszna 2013: 60–61) there is a fragment of an Annunciation scene with Mary shown kneeling. In these examples the Virgin is depicted in the typical gesture of consent and submission. There is also a wrapper with the words: *ecce ancilla,* translated here as servant, which refers to the words from the Gospel: And Mary said: '*I am the servant of the Lord*'. Representations from Germany (Geslingen, end of the 15th century; Stuttgard, 15th century; Ulm, end of the 15th century; and Lörrach, second half of the 15th century) (Furnologia 2015) constitute an interesting parallel, showing a realism and precision in the execution of detail that allows even architectural elements, such as windows, to be reconstructed. In these examples, the gesture of consent and submission of the Virgin and a dove as a symbol of the Holy Spirit may be observed.

St. Veronica holding a scarf was a common motif. The *veraicon* theme presents Christ's suffering and his tormented face reflected on Veronica's scarf when she wiped sweat from his face on the way to Golgotha. The image was supposed to be created

without the participation of the human hand, in a miraculous and supernatural way. In Western art Christ is often represented as suffering, with closed eyes, a crown of thorns and a martyred expression. The theme of wiping the face with a cloth comes from the Middle Ages; it is the Sixth Station of the Cross and it was widespread in the art of the 15th century. Saint Veronica may have never existed. There is no mention of her in the Gospel. The fact that Christ was given a scarf to wipe his face is mentioned only in the apocrypha and the letter is not recognized by the Church as reliable. Nevertheless, Veronica and her scarf were one of the most popular themes in art. Veronica is known from Kętrzyn (beginning of the 16th century; B. Pospieszna (ed.) 2010: 317), Kowno (16th century; Žalnierius and Balčiūnas 2007: 242, fig. 1: 1), Rožnov (end of the 15th century; Loskotová *et al.* 2008: 24, fig. 44) and Dambořice (end of the 15th century; Loskotová *et al.* 2008: 24, fig. 43).

The culmination of the Passion is the Crucifixion. Golgotha is the place from which Christ's authority as King of the Universe, based on love and suffering, was exercised. The throne manifested in the cross is a symbol of his suffering and his reign, reminding Man that God has not left him, that he loves Man. In scenes of the Crucifixion, Christ's Cross is typically shown in the center. On the right, honorable side of the cross there is Mary and on the left side, John the Evangelist, Christ's favorite disciple (Starowieyski 2011: 77–80). The preserved tile fragments come from Bestwina (15th century; Dymek 1995: 30, Tr. XVI: d), Martinice u Votic (15th century) (Nekuda and Reichertova 1968: 342, Tr. XXXVIII: 2) and Heflenburk (15th century; Hazlbauer and Gabriel 1998: 384, fig. 1). An interesting example from Jankowo Dolne (first half of the 15th century; Janiak 2003: 29, 86, fig. 148) shows the Mother of Sorrows (*Mater Dolorosa*), the sword of sorrow next to her. It is a symbol of suffering, which was foretold during the Presentation in the Temple (Lk 2:34).

The sun and moon on both sides of the cross, the Moon on the left and the Sun on the right, are interesting motifs as cosmic bodies with advanced symbolism and meaning. They could personify, among others, the masculine and the feminine (Kobielus 2000: 84). The sun was identified with the person of Christ, on the grounds of the prophecy of Malachi, the Sun of Justice, and combined with Jesus's Passion (Mal 4:2). Examples from the Czech Republic include tiles from Praha (second half of the 15th century; Brych 2004: fig. 122).

The preserved tile fragments from Kołbacz (16th century; Kamiński 1997: 237, fig. 8:5) deserve mention. They show a set identical with the earlier system, but differing in the workshop style and richness of the ornament. The skull placed at the foot of the cross is an interesting feature. According to the Evangelists, Christ died in 'a place called Golgotha, which means, The Place of the Skull.'(Mt 27:33), symbolizing, according to tradition, the burial place of Adam's skull. The dying king on the cross was to wash the skull with his blood as a sign of redemption of the Original Sin and a symbol of control over the world. The Tree of the Cross was often compared to the Tree in

Paradise, the latter carrying the message of death and sin, the former of life and salvation (Starowieyski 2011: 339).

The next motif is a pelican feeding its young with blood. It is present on tiles from Bestwina (15th century; Dymek 1995: 32, Tr. XIII:a), Czudec (15th/16th century; Lubelczyk 2008: 255), Gniezno (15th century; Janiak 2003: 98, fig. 199), Jankowo Dolne (15th century; Janiak 2003: 182, fig. 181), Kostelec nad Černymi Lesy (second half of 15th century; Durdik and Hazlbauer 1993: 298–299, fig. 7: 1) and Mohelnice (second half of 15th century; Loskotová *et al.* 2008: 26, fig. 52). In Christian art, the pelican was a symbol of generosity and sacrifice, love and mercy, an emblem of the Eucharist and Christ. In most depictions, the pelican is shown in a nest or on branches symbolizing this nest, its beak at its breast to feed the young with its own blood (Kopaliński 1985: 847; Forstner 1990: 847).

Images of saints and martyrs were also very popular. Representations on tiles reflect the existence of a cult of patron saints in the region and demonstrate the richness of manifestations of religious life in medieval Europe. Figures of holy martyrs refer to life according to the Scripture: 'We are often troubled, but not crushed; sometimes in doubt, but never in despair; there are many enemies, but we are never without a friend; and though badly hurt at times, we are not destroyed. At all times we carry in our mortal bodies the death of Jesus, so that his life also may be seen in our bodies. Throughout our lives we are always in danger of death for Jesus' sake, in order that his life may be seen in this mortal body of ours. This means that death is at work in us, but life is at work in you. The scripture says, "I spoke because I believed." In the same spirit of faith, we also speak because we believe. We know that God, who raised the Lord Jesus to life, will also raise us up with Jesus and take us, together with you, into his presence. All this is for your sake; and as God's grace reaches more and more people, they will offer to the glory of God more prayers of thanksgiving. Living by Faith. For this reason we never become discouraged. Even though our physical being is gradually decaying, yet our spiritual being is renewed day after day. And this small and temporary trouble we suffer will bring us a tremendous and eternal glory, much greater than the trouble. For we fix our attention, not on things that are seen, but on things that are unseen. What can be seen lasts only for a time, but what cannot be seen lasts forever.' (Online Bible Edition, 4.31: 2 Co 4: 8–18).

In the Bible there are many passages about the life that Christians should lead and what the followers of Jesus will come up against, e.g.: '… Then Jesus said to his disciples, "If any of you want to come with me, you must forget yourself, carry your cross, and follow me. For if you want to save your own life, you will lose it; but if you lose your life for my sake, you will find it. Will you gain anything, if you win the whole world but lose your life? Of course not! There is nothing you can give to regain your life. For the Son of Man is about to come in the glory of his Father with his angels, and then he will reward each one according to his deeds. I assure you that there are

some here who will not die until they have seen the Son of Man come as King."' (Online Bible Edition, 4.31: Mt 16:24–28).

While it is not possible here to list all the saints depicted on the tiles and to present the tiles with their depictions, we should mention a few. First there is St. Andrew. A tile from Wrocław (second half of 15th century) (Lisowa and Lasota 1989: 90–92, fig. 5: b), made up of faces and a three-dimensional figure on a stand, shows the saint modeled on a sculpture from a portal (Lisowa and Lasota 1989: 100–102).

Saint Barbara was a very popular motif on tiles. She had been locked up in a tower by her father for defending Christianity and then beheaded with a sword. She was considered a patron saint of good death or eternal life. Her attribute is always a tower with three windows symbolizing the Holy Trinity and the sword. Her images were often accompanied by a crown of Martyrdom or crown of eternal glory, and the palm of martyrdom, which symbolizes the death of Barbara, and a lily as a symbol of innocence and virginity. Tiles decorated with the motif of St. Barbara are known from Kąty Wrocławskie (15th century; Gündel 1934: 289, Tr. XXII: 5), Bytom (15th century; Andrzejewska 2004: 125, fig. 10), uknown city in Silesia (second half of 15th century; Smoleńska 1975: 274, fig. 15), Gniezno (beginning of 16th century; Janiak 2003: 87, fig. 153), Kaunas (15th century; Žalnierius and Balčiūnas 2007: 242, fig. 1: 1), Olomouc (about 1500; Loskotová *et al.* 2008: 27, fig. 59) and Banska Bystryca (15th century; Holčík 1978: fig. 75; Mácelová 2009: 273, fig. 8.1).

The theme of St. George killing the dragon was highly popular on tiles in the 15th and 16th centuries. St George was a Roman legionary in the 4th century, sentenced to death for refusing to worship pagan gods. Tiles are known from Bolesławiec on the Prosna river (15th century; Żemigała 1987:15, 18–21, fig. 1,7), Jankowo Dolne (15th century; Strzyżewski 1993: 38, 132, figs 64–65; Janiak 2003: 82, 87, figs 134, 154, 157), Gniezno (15th century; Janiak 2003: 41, 87–88, figs 155–156), Strzyżewo Paczkowe (15th century) (Janiak 2003: 41, 88, fig. 158), Wenecja (15th century; Świechowska 1949: 100–101), Ciechanów (beginning of the 16th century; Dąbrowska 1987: fig. 81), Oświęcim (15th century; Moskal 2012: 78–79), Babice (15th century; Dąbrowska 1987: 125–125, fig. 17), Golesz Castle in Krajowice (15th century; Muzeum 2015), unknown location near Radomsko (15th century; Kopera and Pagaczewski 1909: 7), Wrocław (Dymek 1995: 30, 254; Fekacz-Tomaszewska 2010: 195, fig. 4), Chudów (beginning of the 16th century; Nocuń 2010: 23; Tarasiński 2010: 127, fig. 3), Wleń (15th/16th century; Buśko and Dymek 1995: 23, fig. 11: h–i), Namysłów (15th century; Gündel 1934: 291, Tr. XXIII: 6), Legnica (15th century; Strauss 1928: 72; Czechowicz 1993: 24) and in the Czech Republic from Chrudim (15th century; Frolik 2003: 52, 55), Cineves (15th century; Ławrynowicz and Nowakowski 2009: 120, 131, fig. 18), Hrobce (15th century; Ławrynowicz and Nowakowski 2009: 120–121, 130, fig. 12), Hoješin (15th century; Frolik 2003: fig. 54), Heflenburk (15th century; Smetana and Gabriel 1988: fig. 1: 5), Kostelec and Černymi Lesy (15th century; Durdik and Hazlbauer

1993: fig. 6: 5), Kralštejn (14th–15th century: Nekuda and Reichertová 1968, Tr. XLI: 6), Lipnice nad Sázavou (15th–16th century; Ławrynowicz and Nowakowski 2008: 307–308, fig. 8). Sites from Romania include Suceava (15th century; Batariuc 1999: 259–260), Vaslui (15th century; Batariuc 1999: 259–260; Gruia 2006: 30–31), Făgăraș (15th century; Gruia 2006: 27, 35), Feldioara (15th century; Gruia 2006: 24, 37). The depictions differ in composition, detail, presence of princesses or items such as a building or the royal couple in a window.

Numerous finds of tiles decorated with images of saints are a valuable source for the conversion to Christianity and the development of the new faith in Poland and central and eastern Europe. The iconography on tiles is one of the manifestations of the phenomenon during the Middle Ages. The Christian community believed in the intercession of saints in prayers addressed to God and often kept relics or images of saints. Items, like the stove tiles, expressed respect for defenders of the Christian faith and were treated at the same time as a kind of amulet or talisman. This religious attitude coupled with numerous pictures of saints, visible symbols of faith, spread the cult of the saints to distant sites.

Analysis of selected iconography images brings us to the spiritual sphere of man and his needs, allowing an exploration of religious life and cultural space. Stove tiles and their decorations are an important historical source which facilitates us to know past culture and society.

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The symbolism of the Lycurgus Cup[1]

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The Rothschild Lycurgus Cup from the 4th c. AD is one of the most renowned masterpieces of late Roman glass workmanship. It represents a type referred to as 'cage cups' (*diatreta*) and belongs to a rare group of dichroic glass. It depicts the punishment of king Lycurgus for his *hubris* against Dionysus. The focus of the paper is on the iconography of the decoration and its symbolism. The frieze on the Lycurgus Cup is compared to other representations of the myth on ancient vases and mosaics in order to get a broader view of the theme. Moreover, the paper introduces a different interpretation related to a possible other usage of the cup.

KEY-WORDS: Lycurgus, Dionysus, vase painting, mosaics, glass

The Rothschild Lycurgus Cup from the 4th century AD is one of the most renowned masterpieces of late Roman glass workmanship. The frieze is preserved in excellent condition, but the cup bears modern 'repairs', which have obscured the original shape of the vase: the rim and the stemmed base imitating vine-leaves are 19th-century additions (Harden 1987: 245). The cup represents a specific glass type, *vasa diatreta*, which are openwork vessels made in a technique of cutting and grinding out of a thick blank of cast or blown glass (Koster and Whitehouse 1989: 25; Harden and Toynbee 1959: 182; Stern 2011). The decorative frieze of the cup is made in such high relief that it creates the impression of a vessel enclosed in a relief cage – another justification for its name, that is, *diatreta* or cage cups. Most of the examples of this genre were produced in the 3rd and 4th centuries AD. The Lycurgus Cup represents another rare group, which is called dichroic glass. It displays two different colours depending on the source of the light. Both these glass types are very rare: about 50 late Roman cage cups are known (adorned mostly with geometric patterns) and less than 10 dichroic objects (Whitehouse 1989: 119). The Lycurgus Cup is therefore a unique example of these two groups, presenting an excellently preserved figured frieze which has given it its name.

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The cup is an opaque jade-green when seen in reflected light (Fig. 1). In transmitted light, it turns a translucent wine-red (Fig. 2; Elsner 2013: 103). This dichroic feature of the cup is caused by highly specific chemical glass composition. It is the usual variety of Roman soda-lime-silica glass, but with about half a percent of minor additions (such as colloidal gold and silver) which determine the unusual optical properties of the cup

Fig. 1. Lycurgus cup: Dionysus, British Museum, Photo: © Trustees of the British Museum

(Harden 1987: 246; Quinten 2010: 406–407; Chirnside 1965). It is not my purpose here, however, to discuss the technical factors of the cup. Instead, I will focus on the iconographical aspects of the vase, and the symbolism of the frieze.

Depicted on the cup is the punishment of king Lycurgus for his *hubris* against Dionysus. The 4th-century date of the cup is relatively close to the creation of a great

Fig. 2. Lycurgus cup: Lycurgus, British Museum, Photo: © Trustees of the British Museum

epic poem, *Dionysiaca* by Nonnos of Panopolis (4th/5th century AD), which tells the story of a conflict between king Lycurgus and the god Dionysus. Although there are several versions of the myth, the story of Nonnos is the closest literary parallel for the story depicted on the frieze.

THE STORY AND THE CHARACTERS

Lycurgus was an evil king of Arabia who killed innocent strangers coming to his country by cutting off their heads and adorning his palace with these trophies (Nonn. *Dionys*. 20.149ff.). Upon hearing one day that Dionysus with his retinue was to pass through his land on the way to the East, Lycurgus set upon the Bacchic *thiasos* with an axe, his hatred fuelled by the goddess Hera. Dionysus sought refuge in the sea and Lycurgus turned on the nymphs. One of them, Ambrosia, hurled a stone at him, knocking off his helmet. Lycurgus hit her with an even bigger stone and seized her, but Ambrosia prayed to the Mother Earth and with her help managed to escape. The nymph disappeared into the ground, reappearing as a grapevine. In her altered form Ambrosia immobilized Lycurgus to make him an easy target for the other nymphs. The Bacchantes would have taken their revenge were it not for Zeus who saved the king, but punished him by turning him into a blind wanderer (Nonn. *Dionys.* 21.166).

This story is the closest literary parallel to the frieze, but there are certain differences. A closer look at the cup distinguishes the following figures:

1) Lycurgus in the centre, naked except for the boots (Fig. 2), entangled by growing vines. An expression of extreme fear on his face, he stretches his left hand toward the god in a gesture (the thumb, the index and middle fingers extended and the others bent) that seems to be the Roman imperial gesture.
2) To the left there is Ambrosia before her transformation into a grapevine (Fig. 3). Her right hand is touching the ground and the left is slightly raised in a praying gesture. She is asking Mother Earth for help.
3) Standing behind Ambrosia is a Satyr (Fig. 4), a *pedum* or shepherd's crook in his left hand, a stone in his right, which he is hurling at the king (this figure is not present in the poem of Nonnos, hence the myth behind this depiction must be different in the details from the story given in *Dionysiaca*).
4) Pan is depicted to the right side of Lycurgus (Fig. 5).
5) An attacking panther faces the punished king (Fig. 1).
6) Dionysus appears opposite the figure of Lycurgus (Fig. 1). He wears a *mitra* ribbon in his hair, a himation thrown over his shoulders like a shawl, a tunic and boots. In his left hand the god holds a *thyrsus,* which was used when an adolescent was initiated into the sacred mysteries. He extends his right hand in a commanding gesture, bestowing punishment upon Lycurgus.

COMPOSITION OF THE FRIEZE

The composition of the frieze demonstrates a certain symmetry: The figures of Satyr, Pan, Lycurgus and Ambrosia are facing right, opposite Dionysus and the panther, both facing left (Fig. 5). The figures of Satyr and Pan are similar in their arrangement:

Fig. 3. Lycurgus cup: Satyr and Ambrosia, Photo: © Trustees of the British Museum

their right legs are bent and raised (their right hands as well), their left hands lowered and the scarf on Pan's arm copies the shape of the Satyr's staff. Dionysus mirrors the figure of Lycurgus. Even their footwear, high-laced boots is similar. Ambrosia and the panther are placed symmetrically on the lower level, on each side of Lycurgus' feet. Moreover, their presence divides the composition into two 'triples': the first one

Fig. 4. Lycurgus cup: Satyr, Photo: © Trustees of the British Museum

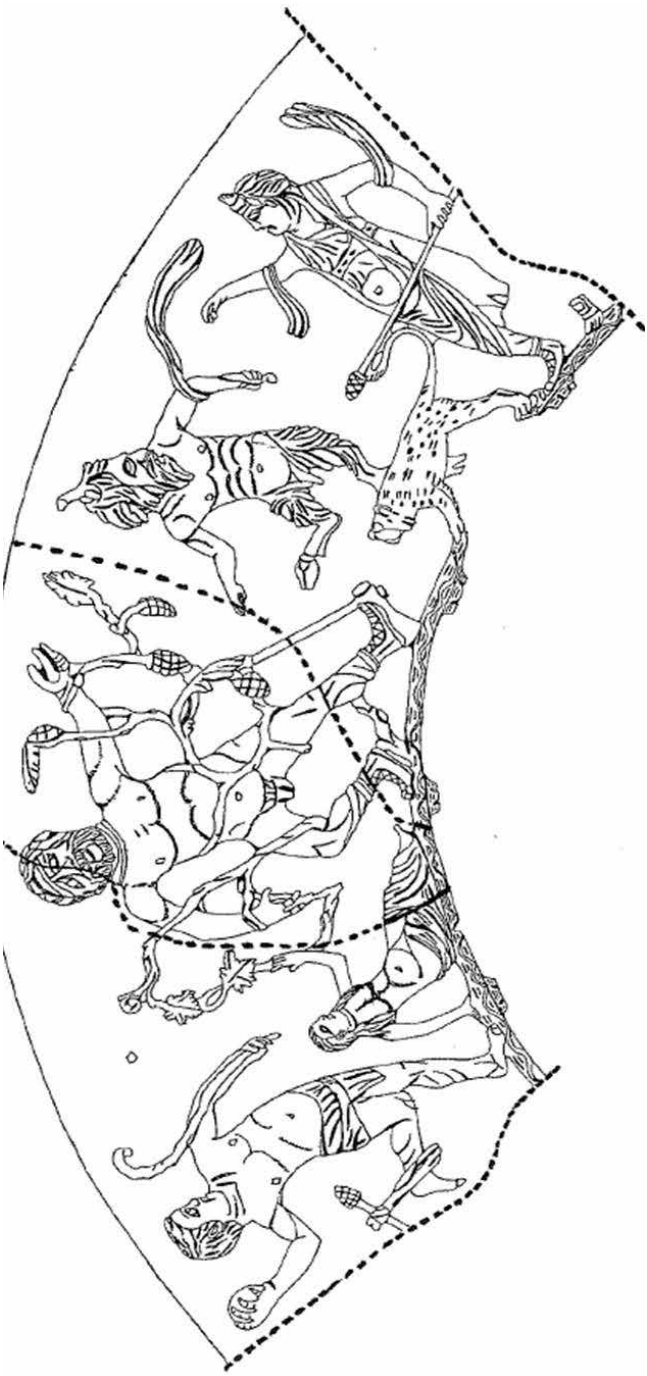

Fig. 5. Lycurgus cup: drawing of the composition (after Scott 1995: 54, Fig. 8).

composed of Satyr, Ambrosia and Lycurgus, and the second one of Pan, panther and Dionysus. There is also a technical symmetry paralleling the iconographical one: the profiles of all of the four standing figures were hollowed out and polished from the inside of the cup, but the two small ones, Ambrosia and the panther, were hollowed out only on the exterior of the vessel by grinding (Scott 1995: 53). This technical feature creates an effect when the cup is illuminated by transmitted light: the corpuses and faces of the four figures are more transparent than the remaining parts of their bodies, which produces a more spectacular visual impression.

ICONOGRAPHY

The Lycurgus Cup does not have exact iconographical parallels, but the theme of the punishment of Lycurgus was rather popular, enabling some of the motifs from the freeze to be traced in other works of art. Visual representations of this story began to appear on Greek vases already in the 5th century BC. The eldest is an Attic hydria from the Czartoryski Museum in Kraków (Griffith 1983, red-figure hydria, Kraków Museum: 1225, LIMC Lykourgos I 26, Beazley Archive vase no. 214835). They were, however, based on different versions of the myth: punished by madness Lycurgus kills his son, instead of the vine he wants to cut. A similar composition occurs on a 4th century BC Apulian vase (red-figure lutrophoros, *c.* 320 BC, Antikensammlungen, Munich, Germany, AS 3300, LIMC Lycourgos I 9). Dionysus gestures with authority, punishing the king. This punishment is symbolized by the presence of the panther, which is shown on the Apulian vase standing by the legs of a Fury and on the Lycurgus cup directly beside Dionysus. In the Roman world, the myth with Ambrosia as Lycurgus' victim gained greater popularity. The earliest representations of this story are dated to the 2nd century BC, such as the mosaic on Delos (Delos Archaeological Museum, LIMC Lykourgos I 33), depicting Lycurgus and Ambrosia. However, Lycurgus here has not been entangled by the vine entirely, but is aiming at Ambrosia who is making a gesture of invocation (Bruneau 1966: 401). A closer parallel to the Lycurgus cup is provided by a mosaic from Herculaneum (1st century AD, Archaeological Museum in Naples, inv. no. 9988). Here also Ambrosia invokes Gaia (Mother Earth), praying to be rescued from Lycurgus, who is trying to kill her with his double-axe. Added to the scene is the god Dionysus, dressed as on the Lycurgus cup in a tunic, cloak and a mitra on his forehead, stretching his right hand towards Lycurgus in a gesture imposing his revenge which is symbolized by the vine behind them and a panther leaping towards Lycurgus. This scheme is repeated also on a mosaic from the triclinium in a Roman villa in Sicily (LIMC Lykourgos I 42). The theme reached as far as Roman Britain. At the Brading Villa (room 12), one of the discovered mosaics dated to about the 4th century AD, depicts Lycurgus, identified by his double-axe, making an attempt to kill

a praying Ambrosia (Beeson 1997; LIMC Lykourgos I 41). Judging by the themes of the surrounding mosaics, this representation refers to the Dionysian sacred rites (Henig 2002: 153), but the rendering is schematic and it lacks the artistry of the Lycurgus cup.

J. van de Grift noted a depiction of the myth of Lycurgus on a silver kantharos from the 1st century AD in the Walters Art Museum in Baltimore (silver kantharos, Dionysus in a Centaur Biga, Baltimore, The Walters Art Museum, no. 57.929.). Although the object is damaged, a representation of a man struggling with a vine is distinguishable with a male figure holding a thyrsus and a panther standing on his left. The other figures depicted on this frieze, without parallel in other works of art repeating this theme, indicate that despite the huge similarity with the Lycurgus Cup in the composition style, the artist drew upon yet another version of the myth (Grift 1984: esp. 12).

The symbolism of the myth made it a popular theme also on Roman sarcophagi. Lycurgus can be found also on incense-burners, capitals and gems. From the romance of Longus we learn that a relief with Lycurgus entangled by a vine adorned a Dionysian altar (Daphnis and Chloe 4.3). The context of the story was usually depicted on sarcophagi (see Matz 1968; Harden and Toynbee 1959: 203). Other objects bear representations only of the king and the vine, this because of a lack of space.

It is not possible to discuss in this article all of the examples of objects with the Lycurgus theme (for a broader discussion, see Grassigli 1995; Griffith 1983; LIMC, s.v. Lykourgos), but in most of them Lycurgus is depicted pursuing his victim (regardless of the version of the myth). Usually, even if a vine is shown, Lycurgus is depicted clasping an axe or his sword firmly in his hands. The moment of the narrative depicted on the Lycurgus cup is different compared to other known representations, since the Dionysian revenge has already begun. Lycurgus is without his weapon, entangled by the vine, close to being suffocated.

INTERPRETATION OF THE FRIEZE

The symbolism of the Attic vases where Lycurgus kills his son stresses the rejection of Dionysus and his worship, and in consequence the god's punishment. The mosaics and vessels relating to the myth of Ambrosia being a victim of Lycurgus emphasize in turn the invention of wine by Dionysus. In the context of Roman Imperial poetry and the banqueting tradition, it could be a warning for the banqueters not to spoil the drinking, but not to drink too much (Grift 1984: 13). When we consider the theme in the context of Dionysian sacred rites, the meaning of the nymph's name is also significant, since *ambrosia* (gr. *ἀμβροσία*) means immortality. Ambrosia was also one of the nymphs who nursed the baby Dionysus (Pseudo-Hyginus, Astronomica 2. 21). Here, the vine and its product – wine – become the source of eternal life, achieved through the cult of Dionysus.

The Lycurgus frieze and the symbolism of the cup should be considered in a banqueting or even ritual context, due to its Dionysian connotations. It was obviously a wine cup, a drinking vessel, but even more likely, it could be a libation bowl. As D. Whitehouse has noted (Whitehouse 1989: 120), there is a description of a similar vessel in a 2nd century AD Greek romance of *Leukippe and Cleitophon* by Achilles Tatius. The main character, Cleitophon, attends a banquet celebrating a feast day of Dionysus, during which libations to the god are made from a very unique vessel. As the description goes, the vessel was made of crystal with carved clusters of grapes in relief. Those bunches were green and unripe when the cup was empty, but when the cup was filled with wine, the grapes turned a dark red [II.3.1–2]. A similar account, this time historical, of the 3rd or 4th century AD, is found in a letter of Hadrian Augustus to Servianus (SHA Firmus Saturninus Proculus et Bonosus 8.10; Whitehouse 1989: 119–20): 'I am sending you over some cups, changing colour and variegated, presented to me by the priest of a temple and now dedicated particularly to you and my sister. I should like you to use them at banquets on feast-days' (Trans. Magie 1932).

Therefore, not only does this fragment suggest the existence of dichroic glass already in the 2nd century AD, but it also leads us to see it as a libation bowl. This is suggested by the special use of dichroic cups during feasts and by the fact that such cups were special gifts among the Roman elites. The characteristics of the Lycurgus cup are described also in the epigrams of Posidippus and it also seems that the cup was seen as a kind of precious gem rather than glass (Elsner 2013: 108–110).

Moreover, *diatreta* such as the Lycurgus cup were used occasionally also as lamps (Elsner 2013: 107). A cup from the Corning Museum of Glass is formed like a bowl with the rim shaped to hold a metal fitting for suspension of the cup (CMOG, accession no. 87.1.1, *c.* 300 AD, see CMOG webpage: http://www.cmog.org/artwork/cage-cup?image=5). The unique dichroic features of the glass would have fitted here perfectly. Had the Lycurgus cup been used as a lamp, it would have been admired in all its splendour. Dionysian themes often adorned lamps and the use of light in many ancient festivals, those of Dionysus as well, played a significant role (cf. Zografou 2010).

Elsner favours the assumption that the cup served as a drinking vessel because of a residual part suggesting an ancient base in place of the modern one (Elsner 2013: 107). However, he does not exclude its functioning as a lamp as well, although as he rightly stresses, no scientific research has been conducted on the colour effects caused by filling the cup with wine or by lighting it with the use of oil (Elsner 2013: 107).

The meaning of the story of the punishment of Lycurgus was clear for the ancients. In a banqueting context, it signified rejection of the god Dionysus and his gift for humanity, which is wine. Those who surrendered themselves to the god's power were bestowed with feelings of joy, ecstasy and luxury. Those who demurred the god were punished (Zanker and Ewald 2012: 130). The punishment was madness, as suggested by the narratives of the myth of Lycurgus, a madness symbolized not without

coincidence by an image of Lycurgus entangled by a vine. Wine is naturally a product made from grapes – vine fruits. Wine is a Dionysian gift, but when overdosed, it causes madness. A poem by Eubulos writing in the 4th century BC was probably still remembered, since it was quoted by Athenaeus (2.36) in his book on banqueting written in the 2nd century AD. In this poem, Dionysus himself describes the effects of drinking wine, cup by cup. When he speaks of the tenth cup, he says (Eubulus fr. 93 K–A = Olson 2007 no. H18 = Ath. *Deipnos.* 2.36): 'and the tenth [cup belongs] to madness extreme enough to make people throw stones' (Trans. Olson 2007).

So the story of Lycurgus is a story of a gift, but also a double warning – be aware of the god, if you reject his gift; be aware of the gift, if you overdose it. The wine-madness symbolism of the cup is strengthened by its dichroic feature (Elsner 2013: 107). The transition from green to red may symbolize ripening of grapes and through this it can be related to the life-cycle and the death and rebirth of Dionysus and also the idea of *aeternitas* important for the late Roman religion (Grassigli 1995: 247). Naturally, the green and red colours reflect also white and red wine. Although in Italy it was the white wine that was more commonly drank (Tchernia and Brun 1999: 65), it was the red wine that was sacred to Dionysus since it symbolizes also blood and refers to the bloodthirsty rituals of the god (Stuligrosz 2011: 404). Moreover, in *Dionysiaca*, the chapters in which the story of Lycurgus is described are full of references to the red colour. And it is not a coincidence that Dionysus seeks refuge in the Red Sea. A poet, Timotheus of Miletus, wrote of Dionysus' gift of red wine mixed with water in the following metaphor [Timoth. *PMG* fr. 780.4–5]: 'and [he] mixed the blood of Bacchus with the fresh-flowing tears of the Nymphs (…)' (Trans. Hordern 2002).

Euripides writing in the 5th century BC attributed another symbolism to pale green/white (*chloros*) and red colours in Dionysian context. They relate to two classical elements: water and fire. Dionysus, like the water gives life, but like the fire brutally takes it away (Eurip. *Bacch.* 141–142, 704–711, 594–599, 624–625; Segal 1982: 149–150).

The conflict between Lycurgus and Dionysus is also a story of a conflict between the good represented by the wine-god and the evil symbolized by the Arabian (or Thracian in versions of the myth different from that given by Nonnos) king. If the Lycurgus cup served also as a lamp, this symbolism would be strengthened by the topical light and darkness conflict (visible in *Bacchae*: Segal 1982: 165).

Some scholars, however, go further, and suggest that the cup may be a luxurious symbol of victory of the emperor Constantine over Licinius in Thrace in AD 324. Although the co-emperors established the Edict of Milan stopping the persecution of Christians, Licinius, according to the image created by the letters of Constantine after his victory, persecuted Christians and confiscated their property. So, the story of Lycurgus would thus serve as a parallel for these historic events: Licinius being the evil Lycurgus and Constantine the victor and the saviour (Harden 1987: 249). A small detail suggests a specific relation between Dionysus and Lycurgus. If the gesture made

by Lycurgus is indeed a Roman imperial gesture, than both the figures make gestures characteristic of Roman emperors. In the parallel visualizations of the Lycurgus myth, this gesture was often made by Dionysus, but never by Lycurgus. Moreover, Constantine in his imperial propaganda applied images of pagan gods. In 325, a year after the victory over Licinius, a coin depicting Constantine as Jupiter was minted. The same coin due to the presence of a panther relates him to Dionysus and the god's eastern victories and through this symbol Constantine extends his power to the east (Key Fowden 2005: 390f). Therefore, a political symbolism of the cup is not impossible.

CONCLUSIONS

The interpretation of the symbolism of the Lycurgus cup depends highly on its original application: as a cup, libation bowl, lamp or even allegorical representation of Constantine's victory. All the theories presented above must remain merely hypothetical. The cup belonged to the Rothschild family from the middle of the 19th century. Shortly before it was acquired by Lord Rothschild, it was mentioned in a French article, but nothing is known of the cup's history before that (Harden and Toynbee 1959: 179). It is thus deprived of any archaeological context, which makes it impossible to understand fully the meaning of the Lycurgus cup. It is certain though that the Lycurgus cup was a very precious and unique object that could have belonged to an emperor or someone from the Roman upper class. The complexity of the Dionysian symbolism of the cup favours the theory that it was used in some kind of Dionysian rites at feasts. It is also certain that among the preserved renderings of the death of Lycurgus the iconography of the Rothschild cup is unparalleled.

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Selection of the ceramic collection from Jerusalem Hill

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Jerusalem Hill (Jeruzalemberg, Jeruzalemský Vrch) is an important archaeological site in Slovakia, lying in Kežmarok city in the Spiš region. It is mainly of Iron Age date, specifically, Púchov culture. The pottery assemblage from the site is particularly abundant. Remains from Jerusalem Hill include fragmentary jugs with handles decorated with one or two animal heads; parallels are known from several fortified settlements in the Spiš and neighbouring regions. Recently, Jerusalem Hill was excavated in 2013. The paper offers some preliminary results of the archaeological research, in particular selected ceramic shapes from Jerusalem Hill, coming from the different localities and different excavations (including an earlier salvage dig and the most recent, as yet unpublished project carried out in 2013). The site is placed in context with other Hallstatt and Pre-Púchov and Púchov culture hillforts in this region (Spiš), taking into account however the trans-regional nature as well.

KEY-WORDS: Jerusalem Hill, Pre-Púchov culture, Púchov culture, Kežmarok, pottery

THE SPIŠ REGION TOPOGRAPHY

Spiš lies in northeastern Slovakia with just a very small part of the region being located in southeastern Poland (Fig. 1). It is a district that is relatively closed in geographical terms, between the Vysoké Tatry and the Dunajec river in the north, the springs of the Váh river in the west (Liptov region), the Slovenské Rudohorie mountains and Hnilec river in the south and a line running from the town of Stará Ľubovňa via the Branisko Mountain to the town of Margecany in the east. The core of the Spiš region is formed by the basins of the rivers Hornád and Poprad, and the Vysoké Tatry mountains (Homza *et al.* 2003: 78).

Spiš was settled from the Pleistocene (Gánovce, for example), occupation continuing through the Neolithic, Bronze Age and Hallstatt periods (Novotná *et al.* 1991: 41). In the middle, late and final La Tène period, this region was intensively settled by the Púchov culture (including the so called Pre-Púchov horizon). The most intense

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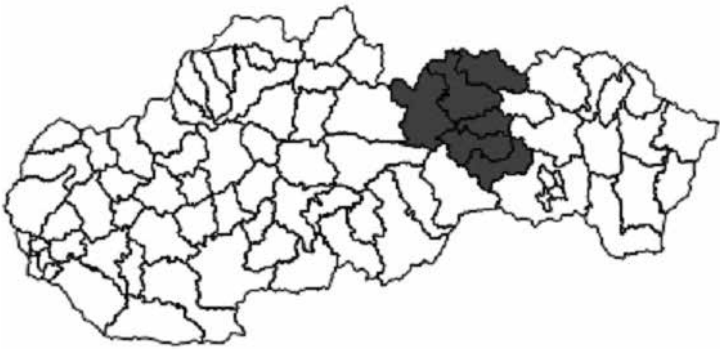


Fig. 1. Map of the Spiš region

settlement at Jerusalem Hill was from the late La Tène period. The most important archaeological sites are located near the modern cities of the Spiš region: Poprad, Kežmarok, Stará Ľubovňa, Spišská Nová Ves etc.

GEOGRAPHY OF KEŽMAROK AND JERUSALEM HILL

The city of Kežmarok is situated in the northeastern part of Poprad valley (Fig. 2). The site of Jerusalem Hill lies at the confluence of the water courses (the river Poprad and Ľubica brook) and on the southwestern slope of the Levočské hills (701.9 m a.s.l.) (Fig. 3). The site has several locations, the most important of which were surveyed and/or excavated (Fig. 4).

RESEARCH HISTORY AT JERUSALEM HILL

Archaeological research has a long tradition among the local intellectual elite in Kežmarok, going back to the Middle Ages and contributing quite probably to the survival of various antiquities in the city and region. Jerusalem Hill attracted G. Bohuš (1687–1722) because of the finds of old coins (Bohuš 1919: 105). He also described a formation of intersecting circles on the hill slope, the center of which was commonly referred to as *Unbezwinglich* or invincible. J.A. Hefty mentioned numerous prehistoric remains from Jerusalem Hill (Hefty 1925). According to I. Spöttl (1885) the name on contemporary military maps *Galgenberg* (Gallows) was commonly used for places where bones or other 'strange' things were found. Names like Jerusalem or Golgotha

Fig. 2. Map of Kežmarok with marked Jerusalem Hill. Second military mapping 1806–1869

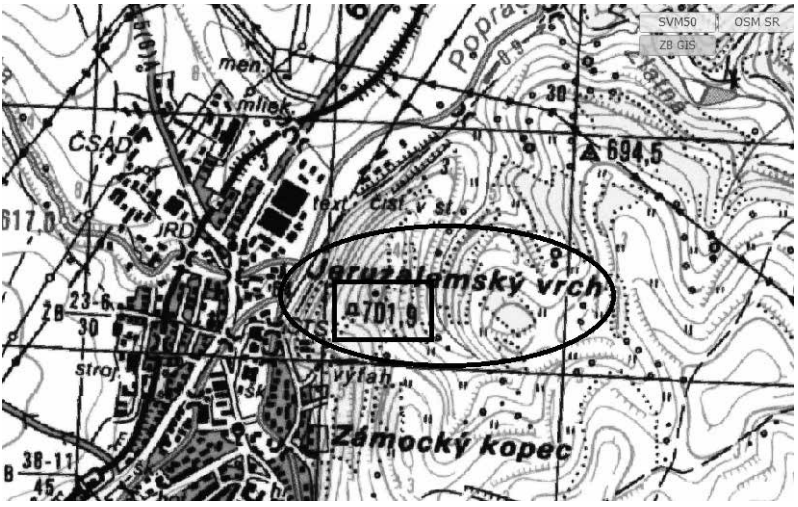


Fig. 3. Map of Kežmarok Jerusalem Hill with the top of the hill marked. Topographic map. www.geoportal.sazp.sk

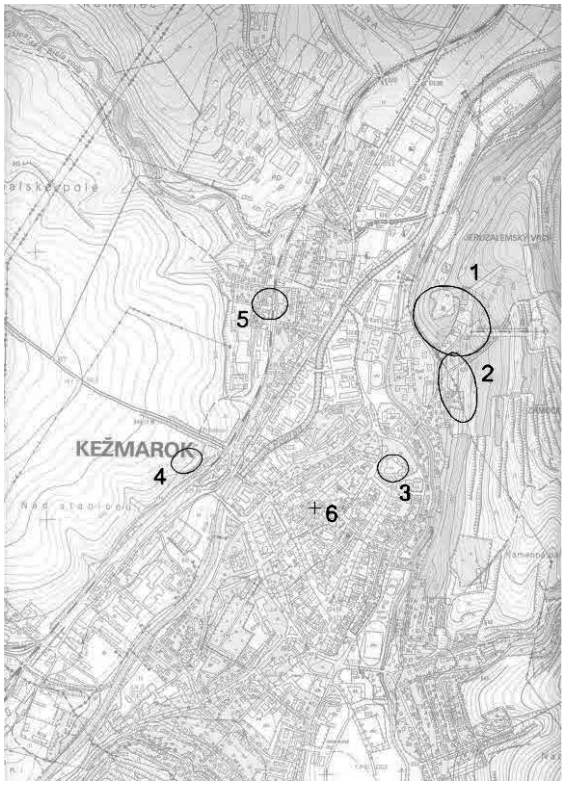


Fig. 4. Known sites with Puchov Culture finds. 1 – Jerusalem Hill and its locations (Amphitheater, Hotel Štart, tennis courts); 2 – hill site settlements related to Jerusalem Hill on Pod Lesom Street (Vartovníkovo pole or Pod Lesom site); 3 – Kežmarok Castle; 4 – Michalský vrch; 5 – Teheľňa (salvage work by Dr. Greisiger in the end of the 19th and early 20th century); 6 – isolated finds from the old town of Kežmarok (Starý trh, Nová ulica, Hlavné námestie)

were given in medieval times to localities with a chapel or cemetery. All are typical of sites with ancient remains.

The last third of the 19th and the first third of the 20th century witnessed extensive archaeological research by several scholars (I. Spöttl, M. Greisiger, B. Hajts, and J.A. Hefty) in Poprad valley and also on Jerusalem Hill. The results were published in several periodicals, e.g., *Zipser Bote*, *Karpathen-Post*, *Jahrbuch des Ungarichen Karpathenvereines*, or *Turistik, Wintersport und Alpinismus*. Jerusalem Hill was noted as a prehistoric hilltop site. Spöttl in particular made a detailed examination of Jerusalem Hill during his visit to Kežmarok in 1880, reporting a fortified acropolis protected by burned ramparts (Spöttl 1885: 42), a cult place and urn field on the eastern slope of

the hill. The prehistoric burial ground was mapped by M. Greisiger as a Columbarium (Greisiger 1890). This scholar observed the remains of the Jerusalem hillforts, destroyed because of quarrying in the 15th to 17th centuries, as well as the terraced slopes on Jerusalem Hill and other ancient localities in Kežmarok territory (Greisiger 1890).

B. Alexander noted in 1924 that deep subsoil ploughing on the southeastern side of Jerusalem Hill had unearthed numerous ancient potsherds. A ground survey by Prof. B. Hajts with his students yielded an abundant collection of La Tène period pottery and daub. Archaeological excavations by Hajts in 1925 recorded several cultural layers of prehistoric finds. Artifacts from both the walking survey and the digging are now in the Carpathian Museum in Poprad (Hefty 1925: 78, 161–162). Hefty also discovered pottery and charcoal deposits in association with remains of clay walls; his finds also ended up in the Poprad museum collection (Hefty 1925: 162).

Ladislav Kiefer (1912–2003), long-time member of the Slovak Archaeological Society (Baráthová 2009: 153), focused much of his historical and archaeological interests on the site on Jerusalem Hill. As a schoolboy he participated in Hajts's 1924–1926 excavations, then continued to monitor it, fieldwalking it every year. He was supported in this by the Kežmarok professors, J.A. Hefty and J. Lipták, In 1949, he carried out his own small excavation on Jerusalem hill. From the 1990s L. Kiefer cooperated with M. Soják and especially amateur archaeologist P. Wavrek. From the second half of the 1990s archaeological research has been carried out by M. Kučerová from the Museum in Kežmarok, fieldwalking archaeological sites in Kežmarok and conducting rescue digs in rural and urban areas, including Jerusalem Hill in 1998, 2000 and 2013 (Giertlová *et al.* 1998: 71–72; Giertlová and Mihok 2000: 75–76; the most recent project from 2013 has not been published yet).

JERUSALEM HILL AS AN ARCHAEOLOGICAL SITE

The oldest remains of human activity in this area, in the form of isolated finds with only a very general chronological attribution, are dated to the Paleolithic and Mesolithic (Hefty 1925: 78; Soják 2002: 265), as well as Neolithic and Bronze Age. Kiefer uncovered in 1949 a red layer 100–130 cm thick on the southwest spur of Jerusalem hill; the deposit contained Neolithic ceramics, which were later lost unfortunately. In 1972–1973, during a rescue dig he uncovered Neolithic pottery again (Kiefer 1974); these are attributed to the Baden culture based on their description. Some modest pottery finds attested to the presence of Piliny culture in Kežmarok (Eisner 1933: 145). Of greater interest is a bronze hammer-axe, today in the collection of the Museum in Kežmarok. Kiefer also noted several Bronze Age localities at the top of Jerusalem Hill when the cultural and sports complex Štart was being constructed; the assumption is that they represented the same Piliny culture known from other finds near Kežmarok.

In the Iron Age, however, the region was dominated by hillforts. Jerusalem Hill was one of several hillforts of this kind, situated in the basins of the Hornád and Poprad rivers (Fig. 5). The situation was similar in the neighbouring regions of Liptov and Orava, as well as the adjacent valley of the Dunajec river already in Polish territory. An ancient trail is assumed to have existed down the Dunajec river from the south along the Hornád flowing north in the Carpathian arc (Miroššayová 1992: 134).

Kiefer recorded pottery he believed to be of Halstatt date from the locality of Strielnica on Jerusalem Hill. This particular pottery features jugs decorated with one or two horn heads, vessels with graphitized surface or with graphite present in the fabric. The term 'horn-handled' bowl refers to a specific type of single-handled bowl

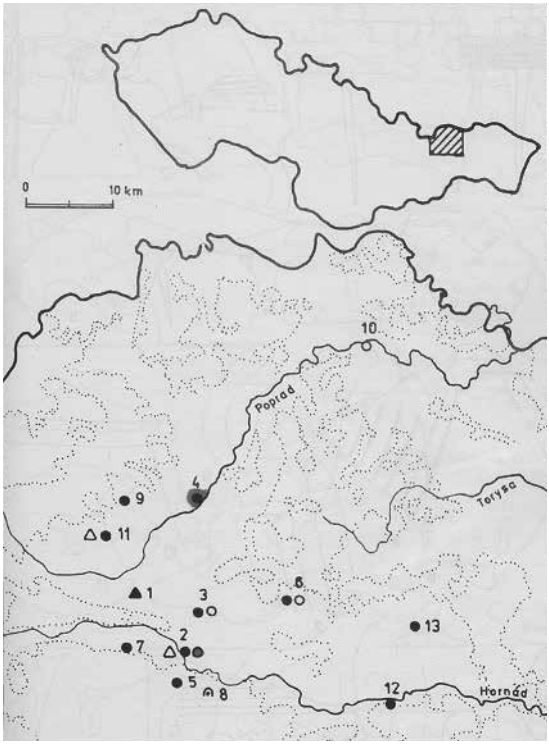


Fig. 5. Map of fortified and unfortified settlements, caves, depots and iron axes (black dot – fortified settlement; empty dot – unfortified settlement; black triangle – bronze depot; empty triangle – iron axes; number 8 – cave). 1 – Gánovce – Hrádok; 2 – Hrabušice – Zelena Hora, Pod Zelenou horou; 3 – Jánovce, časť Machalovce – Hradisko; 4 – Kežmarok – Jerusalem Hill; 5 – Letanovce – Kláštorisko; 6 – Levoča – Fitrift, Burg; 7 – Poprad, časť Kvetnica – Zámčisko; 8 – Letanovce – Čertová diera; 9 – Nová Lesná – Hliník; 10 – Stará Ľubovňa – okolie hradu; 11 – Veľký Slávkov; 12 – Vítkovce – Tureň; 13 – Žehra – Spišský hrad (after E. Miroššayová 1992: 135)

with handles in the form of stylized animal horns. It was restricted to the earlier part of the Central European Iron Age and, more specifically, to the late Halstatt and early La Tène periods, the chronological horizon still having to be clearly defined on archaeological grounds (Tankó 2005: 153). K. Tankó produced a typology and chronology based on finds of horn-handled bowls or jugs from the territory of their distribution (Tankó 2005: 153–163). Parallels from Slovakia were dated to the beginning of the La Tène Age (5th century BC) (Pieta 1982: 93–94; Novotná *et al.* 1991: 40–41). This type of horned decoration is find at other fortified sites in Spiš: Hrabušice – Zelená hora, Spišský Štvrtok etc. (Benediková 2007: 199) and recently in the settlement in Spišský Hrhov (Soják and Fecko 2012: 255).

Púchov culture formed on the Halstatt period base in Jerusalem Hill (Beninger 1937) and it is clear that a Pre-púchov phase was also present on the site and that Kežmarok belonged to the tribal region forming Púchov culture (Baráthová *et al* 2012: 83). Kiefer's finds of Hallstatt date could actually represent either the Pre-Púchov or Púchov phases, demonstrating the long survival of Hallstatt traditions in the region.

The most notable evidence from Kežmarok is for the existence of Púchov culture. A massive settlement developed with a centre at the top of Jerusalem Hill (the location of the modern amphitheatre). The culture is represented by thousands of potsherds, vitrified clay, iron (assuming advanced iron production and processing) and bronze objects, glass beads and coins minted in Slovakia (Baráthová *et al.* 2012: 83–84). Traces of Púchov culture settlements surrounding Jerusalem Hill occur on Michael's Hill, in the courtyard of the Kežmarok castle, as well as at the Teheľňa (*Ziegelei*) locality (Baráthová *et al.* 2012: 84). Spöttl and Greisiger described abundant pottery from cultural layers at the very top of the Jerusalem Hill and on the terraces. The collection of pottery from Jerusalem Hill obtained until 1925 was one of the most comprehensive in the Carpathian Museum according to Heft (it has yet to be processed and published). Kiefer contributed more than 1,800 sherds from his own collection and excavations carried out after 1925. In 1998 and 2000, the pottery count from layers 80 to 100 cm thick, no more than 2 x 1.5 m in area, exceeded 1500 (Baráthová *et al.* 2012: 85).

Prior to the building of the modern architectural complex on Jerusalem Hill, it was apparently a step-shaped hill, partly destroyed by quarrying (Spöttl 1880: 34–49), which however allowed the stratigraphy to be established. Spöttl, as well as Hajts, identified defence walls, which they both described as literally vitrified with sintered pieces of clay and stones.

The overall view is of a location that looked like an acropolis in ancient times (today the location of the amphitheatre), semi-destroyed by historical quarrying in the 14th–15th centuries that presumably uncovered the tumbled ancient fortifications (Púchov culture) made of stones and wooden stakes at least 10 cm thick and from 80 to 100 cm long, found charred in the layers which covered the entire hill with a mantle 80–100 cm thick. Theses accumulations contained an abundance of charcoal, large

amounts of pottery remains and burnt animal bones. A burned layer of clay approximately 10 cm deep overlay the north side of the hill and the southeast slope, covering a glassy layer of vitrified clay and stones. According to Greisiger, simple semi-sunken wooden dwellings had stood on the terraces whereas the top of Jerusalem Hill was occupied by a sort of fortified *lapis refugia* which he thought was a cult place or sacrificial ground (Greisiger 1890).

The existence of bounded areas of settlement in the Jerusalem Hill area, each presumably a separate economic unit, was confirmed by archaeological excavations and field walking by L. Kiefer, P. Wavrek, as well as Marta Kučerová. The location Strielnica––Oravcová lúka (also designated as 'Vartovníkovo pole'), examined by P. Wavrek and L. Kiefer in 1974, contained a 'burned building' described as 'Hallstatt and Púchov cultures' that was verified archaeologically and found to contain charcoal, daub clay, animal bones and pottery as expected, of the Púchov culture (Giertlová *et al*. 1998: 71).

Similar settlement units existed probably also on the opposite bank of the Poprad in the Kežmarok district. A settlement was also found in the courtyard of the Kežmarok castle (Polla 1971: 65–68).

CHARACTERISTIC OF THE CERAMICS FROM JERUSALEM HILL

The term ceramic is understood as various types of pottery, but also artifacts made of clay, such as spinning whorls, ceramic wheels, loom weights etc., considered a perfect source for deeper studies of the social and cultural situation. Ceramic material is prolific on almost all the sites within the Jerusalem Hill complex (Amphitheater, Strielnica, Hotel Štart etc.). Forms are extremely differentiated, but for the most par (80%) are made up of utility wares (transport amphoras, storage vessels with inverted rims = arrel form, jugs, vases etc.). The most common form are jars (storage vessels). Most of the pottery represented a coarse thick-walled ware; whole vessels were rare and the prevailing form were large fragments of pottery (handles, body sherds, rims and bottoms). Typically, the pottery was stained due to deposition in an iron oxides--rich soil. Much of the pottery is handmade and only a small part is thrown on the wheel. The color range is differentiated, presenting a whole range from black, graphite through very dark brown to light brown and red.

CHARACTERISTIC OF THE POTTERY FROM THE EXCAVATION IN 2013

As already mentioned the amount of finds of pottery from Jerusalem hill is abundant. This paper focuses on pottery findings from the excavation in 2013. The research in 2013 had a number of priorities, one of these being to ascertain how much of the

fortified settlement had been damaged by the construction of modern buildings and sports facilities. Four trenches with the total area up to 36 m² were opened at places suggested by the results of earlier amateur digging. During the excavation, remains of the stone oven have been found and the remains of a domestic house construction. Probably the corner of the frame house in depth of 1 m has been caught. This house was unfortunately not all examined, only a part of it with the oven (Fig. 8).

The pottery material from the trenches was abundant, representing mostly the Pre-Púchov and Púchov culture. Undiagnostic fragments amounted to more than 2000 sherds, as is typical of Jerusalem Hill as an archaeological site and attests to the high population density at this time, as indicated already in earlier studies (Mirrošayová 1992: 134; Homza *et al.* 2003: 152; Novotná *et al.* 1991: 41, etc.). Other finds included animal bones, daub, iron slag, semi-finished artifacts, domestic oven construction material and a bone needle (Fig. 6).

The pottery data has been entered in a database and a detailed study of some pieces is forthcoming. Here we present the results of a preliminary analysis of the material

Fig. 6. Bone needle, Jerusalem Hill site. Photo Marta Kučerová

in the context of the database construction strategy and method, as well as a selection of the more interesting finds, like horn handles, spindle whorls, and fragments of decorated pottery. The collection of diagnostic fragments consists of 537 pieces (vessel bottoms, rims, handles, and body sherds). Special categories include spindle whorls, strainers, crushers and other similar small objects. The material was divided into five groups based on the fabric as observed macroscopically. The method obviously narrowed the possibilities for identifying other distinctive characteristics of the fabric.

Five fabric groups were established as criteria for examining the pottery.

Fabric group 1: Soft material without identified impurities or with a minimum share of impurities. Not present in our material.

Fabric group 2: Fabric with slight impurities. Group 2a: fabric containing fine sand, polished surface. Group 2b: fabric with little sand and stones, polished surface. The group is not abundantly represented in the collection.

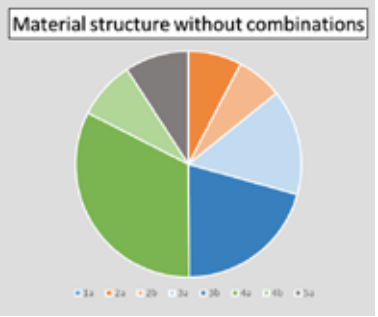
Fabric group 3: Coarse fabric. Group 3a: a coarse ware with a large sand fraction and small stones. Group 3b: sand and pebbles mixed into the fabric.

Fabric group 4: The most abundantly represented group (see Graphs 1–2). Group 4a: granular material with a heavy presence of gravel and sand, usually rough grainy surface. Group 4b: same as 4a plus traces of ferric impurities.

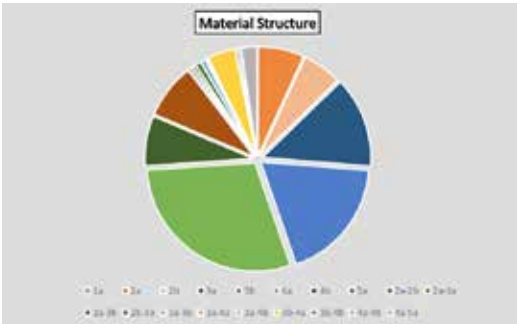
Fabric group 5: Coarse-grained fabric with abundant coarse sand and substantial share of stones, probably not floated. Represented about the same as group 2 in the collection.

Problems with assigning individual sherds to one of the above groups resulted in a series of combined identifications: 2a-2b, 2a-3a, 2a-3b, 2b-3a, 3a-3b, 3a-4a, 3a-4b, 3b-4a, 3b-4b, 4a-ab, 4a-5a, 4b-5a (see Graph 2).

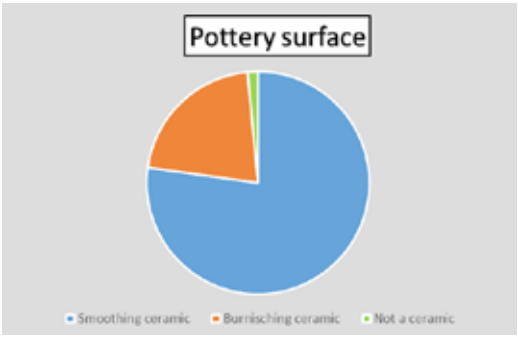
Two kinds of pottery surface were distinguished: burnished and smoothed, the latter being the prevailing form. More than half of the collection represented handmade



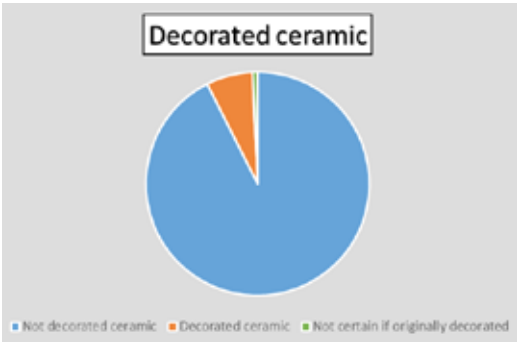
Graph 1. Material structure without combinations. Groups: 2a – material with poor composition usually fine sand, polished surface (35 pieces); 2b – material with low sand and stone content, polished surface (34 pieces); 3a – coarse pottery with big sand and small stone content (69 pieces); 3b – fabric mixed with sand and pebbles (96 pieces); 4a – granular material with heavy gravel and sand content, usually with rough grainy surface (148 pieces); 4b – same as 4a plus residual ferric impurities (41 pieces); 5a – coarse-grained material with much coarse sand and often a considerable share of stones, probably not floated (49 pieces)



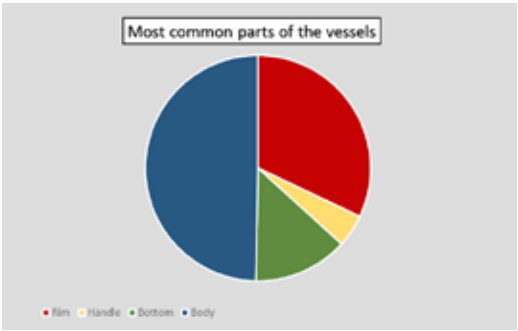
Graph 2. Combinations – 2a–2b, 2a–3a, 2a–3b, 2b–3a, 3a–3b, 3a–4a, 3a–4b, 3b–4a, 3b–4b, 4a–ab, 4a–5a, 4b–5a, in which case no clear attribution to a specific group could be made



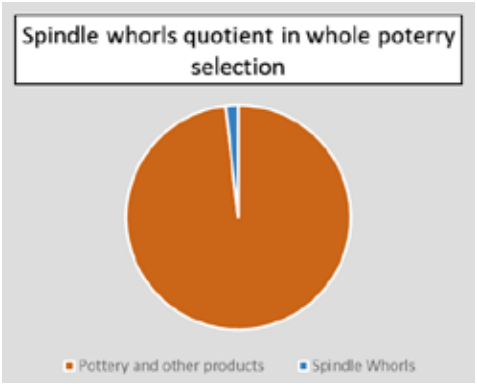
Graph 3. Pottery surface – smoothed pottery (410 pieces); burnished pottery (119 pieces), not pottery (8 pieces)



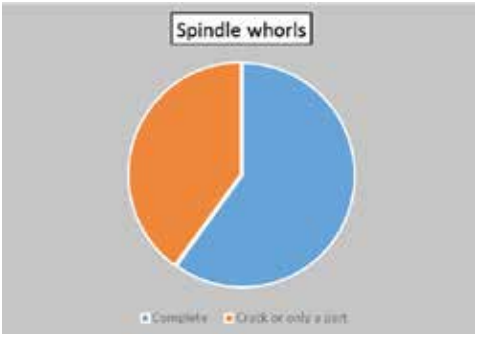
Graph 4. Total sherd count 537. Decorated – 36 pieces. Not decorated – 497 pieces. Not certain, if originally decorated – 4 pieces



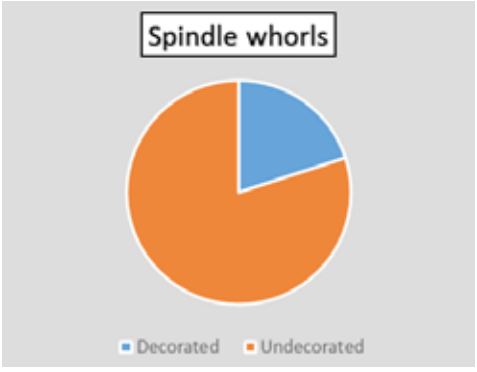
Graph 5. Most frequent vessel parts: body – 257 pieces; rims – 158 pieces; bottoms – 67 pieces; handles – 23 pieces



Graph 6. Spindle whorl quotient in the selection. Pottery – 527 pieces; spindle whorls – 10 pieces



Graph 7. Spindle whorls: complete – 4 pieces; cracked or only part of a spindle whorl – 6 pieces



Graph 8. Decorated spindle whorls – 2 pieces; undecorated spindle whorls – 8 pieces

wares. Quality is poor and firing mostly bad. Not one vessel was found complete. Rims, bottoms, part of bodies and handles were distinguished as diagnostic categories (see Graph 5). Rims were relatively varied: flaring, claviform, vertical, and bent being fairly common. The dominant category was utility pottery: big pots, storage vessels and amphoras. Vases, jugs, and bowls were fairly frequent. There were one-piece and biconic vessels. Body shape variability appears to have been substantial considering

the differentiated rims and bottom shapes. Frequent are barrel-shaped pots, also abundant egg-shaped, situlate, globular, piriform, sharply or ovally biconic, saccate. No one color predominated: dark brown, black, grey and milk coffee were quite common. Shades of red were present in a small quantity.

A preliminary examination of the pottery indicates that it is comparable with the finds from older excavations and from the archaeological field survey in terms of the range of shapes, colours, quality and other mentioned features (Giertlova *et al.* 1998: 71–72; Giertlova and Mihok 2000: 75). The collection serves the purpose of analyzing settlement density in different locations of Jerusalem Hill in the Púchov and Pre-Púchov culture horizon. A typological analysis can be proposed, but only if pottery from older excavations is taken into account. However, it is not possible on these grounds to go into deeper analyses of the economic and social relations, as well as ethnic issues. In any case, we are dealing here primarily with Pre-Púchov and Púchov culture (Giertlova *et al.* 1998: 71–72).

SPINDLE WHORLS

Spindle whorls, which document weaving activity, should be considered in terms of their shape, weight and dimensions, which have an impact on the function of the spindle when spinning. The decoration is also important as a cultural indicator for finds from a wider region of Hallstatt and La Tène Central Europe and a broader chronological range (Belanová *et al.* 2007: 419; Šalkovský 2009: 51). We don't have enough stratigraphy informations, which could prove with 100 percent their competence to be the certain archaeological culture and time (Hallstatt, La Tène, Early Roman time). Only possible but still not surefooted way could be trough the analogies of the forms and types characteristic for certain cultures and time horizons. Of the 10 spindle whorls excavated in 2013, six are intact and four are incomplete. Two of this set are decorated (Fig. 7: 1–3). The complete example is from topsoil. It is of biconical shape with rounded bulge, black in colour and decorated with three sets of dot impressions, each forming a triangle, placed on the upper surface. The decoration may have been damaged to some extent. A parallel spindle whorl was found at the fortified settlement of Detva-Kalamarka (Šalkovský 2009: 51). Two similarly decorated biconical and conical spindle whorls came from archaeological features of the Kalenderberg Group of Molpír in Smolenice, phase HC2 to beginning of HD1 (Dušek and Dusek 1984: Fig. 83: 8, 116: 16; Parzinger and Stegmann-Rajtár 1988: 167 ff.). A very similar spindle whorl was among the grave goods discovered with inhumation 76/62 IB from a bi-ritual burial ground of the Vekerzug culture from Chotín (Kozubová 2013: 127). The parallel all come from sites dated to the Hallstatt through La Tène period, but the chronological range spindle whorl types is very broad as stated above. Therefore, this particular spindle whorl from Jerusalem Hill can be dated from the Hallstatt to the La Tène (Púchov culture).

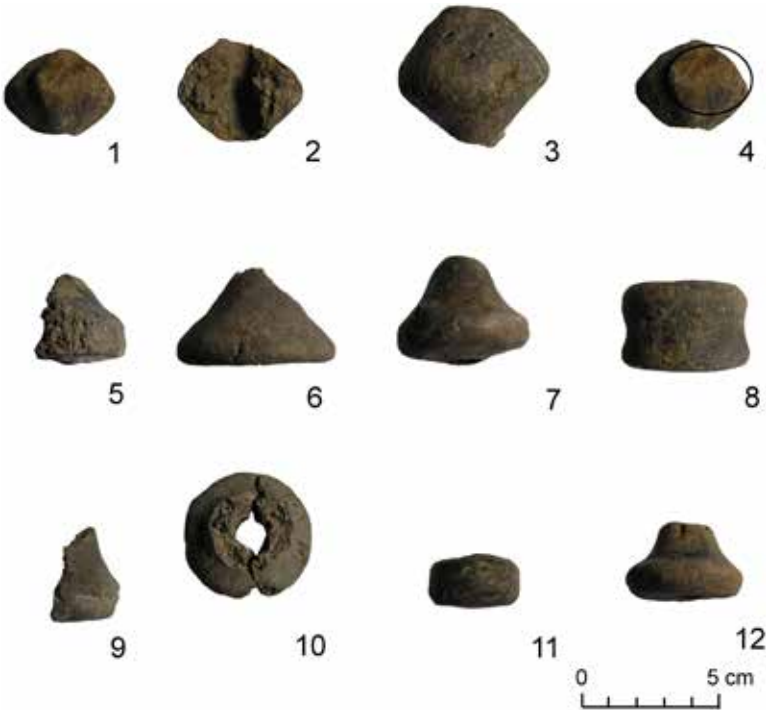


Fig. 7. 1 – decorated spindle whorl; 2 – decorated spindle whorl, view from the missing inside; 3 – decorated spindle whorl; 4 – decorated spindle whorl with cuts; 5 – preserved half of a spindle whorl; 6 – conic spindle whorl; 7 – spindle whorl, bulbous form; 8 – spindle whorl, ring shape form with cylindrical profile and flat surface on either side; 9 – spindle whorl, probably conical form; 10 – spindle whorl, circular with flat sides, broken; 11 – spindle whorl ,cylindrical form; 12 – spindle whorl, bulbous form

The second decorated spindle whorl is biconical, decorated with plastic ribbing and five oblique grooves (Fig. 7; 10: 4). It originates from the archaeological dump and is thus problematic, as the type of decoration is very specific and not usual for the Púchov culture. Some similarity of the decoration can be seen in finds from the late Hallstatt and early La Tène burial ground in Bučany, grave 29 (Bujna and Romsauer 1983: 289, Fig. VII). Nevertheless, the dating of this particular spindle whorl is questionable

The remaining eight spindle whorls are undecorated. Two are preserved in half, one is cracked into two pieces and five are preserved without bigger damage. Four of them come from different layers. Interestingly, the shape variation in this small set was

quite extensive (see Graphs 6–8). Starting with trench 1, the first to be discussed is a half preserved piece (topsoil layer) of bulbous or possibly conical form (Fig. 7: 5), black-coloured with sheets with rusty shade. A conical spindle whorl (Fig. 7: 6) (topsoil layer) is typical of the finds from Hallstatt period burial grounds and settlements in the northeastern Alps. Decorated and undecorated forms are known (Ranseder 2006: 321 f., figs 14: 10, 45: 10, 73: 5; Rebay 2006: 112–115; Romsauer 1993: 19; Stegmann-Rajtár 2009: 84f., fig. 4: 1, 15: 6; Čaplovič 1987: pl. LXXII: 1, 2). The spindle whorl from Jerusalem Hill could thus be dated to the Hallstatt or pre-Púchov stage. The third spindle whorl (topsoil layer) is of bulbous conical form, black in colour, its surface burnished with some small damages (Fig. 7: 7). Parallels are as above, falling in the late Hallstatt and early and middle La Tène period, discovered at different settlements and burials in Slovakia and elsewhere in the region.

The remaining spindle whorls were either not clearly of Púchov or late Hallstatt date or representing a very wide horizon. One of these (topsoil layer) is ring-shaped, mainly black, with a sintered crumbly surface (Fig. 7: 8). It is flat on either side and has rounded edges. A half of a spindle whorl from a cut in trench 3 was of a lighter black colour and featured probably secondary damages to its surface (Fig. 7: 9). It may have been conical, which could make it like the said parallels from the Hallstatt period. A whorl broken into two (trench 3, layer 6, 0.53–1.10 m) (Fig. 7: 10) is an atypical grey colour with small sinter and iron oxide marks. It is circular, flat on one side, but since the other side is damaged, the original shape cannot be identified with certainty. The next spindle whorl (trench 3, layer 14, depth 1.12–1.26 m) is black in colour with small secondary damages on the surface (Fig. 7: 11). It is the smallest in the present collection with uneven rims and ring-shaped form, much like the example from trench 1 but with different edges. The last spindle whorl (trench 3, layer 2, depth 0.30–0.50 m) is black and brown in colour, possibly burnished originally and with small secondary damages (Fig. 7: 12). It is of bulbous shape, very close to the whorl from trench 1.

DECORATED POTTERY

Of the pottery sherds recorded from the 2013 excavation, 40 pieces were decorated. We have included the horn-handled bowls and jugs, as well as pieces with decoration that could be secondary damage (see Graph 4) and the sole fragment of painted ware. Even so, it is comparably much less than on attested Púchov culture sites, such as Liptovská Mara (Pieta 1996: 52–57) in Liptov and Dolný Kubín in Orava (Čaplovič 1977).

The painted ware fragment (from trench 3, layer 3) is very small, too small to identify the vessel type (Fig. 8: 1). Several forms have been identified in the record, all wheelmade: vases, bottles, bowls etc. (see Pieta 1982: 119–122). It could be good evidence for the late Púchov culture horizon on Jerusalem Hill, because this type of ware

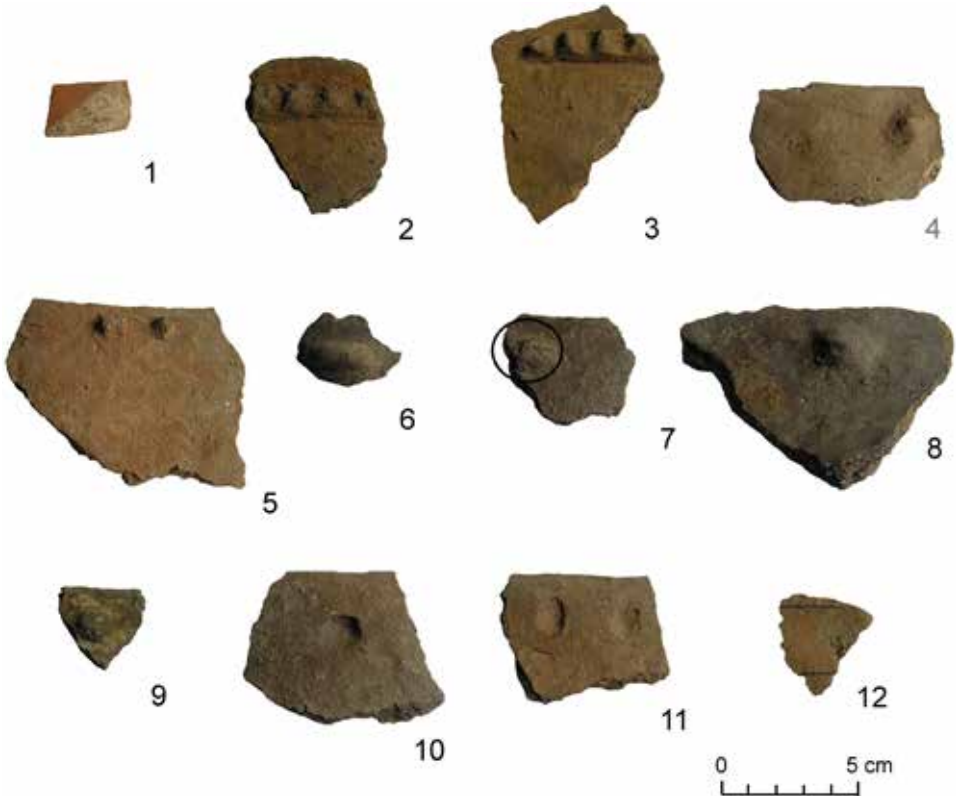


Fig. 8. 1 – painted ware sherd; 2–12: decorated ceramics

starts in phase LT C1–LT D1 (Pieta 1982: 118–119). A total of 13 Púchov culture sites has yielded this type of late La Tène pottery (see Pieta 1982: 120), Spiš included (Pieta 1982: 119). In Spiš territory, these are Jánovce-Machalovce (Novotná and Novotný 1971: 16) and Spišský hrad (Vallášek 1976: 6–9). One fragment comes from an earlier field survey on Jerusalem Hill (Pieta 1982, Pic. 11, no. 22) and the ware has also been found in Batizovce (Budínsky and Krička 1965: 168).

The rest of our decorated pottery is handmade. All the fragments from trench 1 feature a plastic cordon (Fig. 8: 2–8), whereas the pottery from trench 3 has finger-pressed decoration, one relief cordon and one piece with engraved decoration (Fig. 8: 9–12). The first two kinds of decoration are typical of the La Tène period (Púchov culture in the case of Jerusalem Hill) (Březinová 2001: 203–207), but also of an older, late Hallstatt tradition. The plastic cordon is also very close to decoration motifs on Dacian pottery (Luštíková 2007: tab. 4). Therefore, it is difficult to be

certain, whether the decorated pottery from Jerusalem Hill is connected with the late Hallstatt horizon or early and late Púchov culture horizon.

HORN-HANDLED BOWLS OR JUGS

The three horn handles from the excavation in 2013 are each seemingly different in Károly Tankó's typology (Tankó 2005: 154–155) and cannot be attributed with certainty to either jug or bowl (Fig. 9: 1–3). All three appear to have been made in Jerusalem Hill and were influenced by contemporary models from the Spiš region. In his key study of the Puchov culture, K. Pieta (1982) suggested that the horn-handles in pre-Púchov and Púchov horizons could have been imports (Pieta 1982: 95), but the assemblage from Jerusalem Hill includes no pottery or other artifacts that could be identified with certainty as imported.

The horn handle from trench 1 (topsoil layer) is the most interesting (Fig. 9: 2). It is an unusual light brown colour with orange tint. It has an atypical perforation in the middle (Fig. 9: 4) and the horns, both broken off, were obviously *irregula*; they may be classified among finds of the La Tène type D according to Tankó (2005: 155).

Fig. 9. 1–3: horn handles; 4 – perforation on one side of the horn handle; 5 – horn handle from the older excavation on Jerusalem Hill; 6 – horn handle from an earlier archaeological field survey (1892), now on exhibiton in the Poprad museum; 7 – horn handle from an earlier fied survey in 1895, now on exhibiton in the Poprad museum

It may have been a bowl (or jug), in secondary use in the Púchov horizon. The role of the perforation is not known. The possible analogy is subject of our later interpretation. Closest analogies from Spiš territory, or neighbouring regions (Liptov, Orava or Horehronie) we could not find yet and it is a subject of our research.

The second example (trench 3, layer 5, depth 0.49–0.96 cm) is of black colour, originally burnished on the surface presumably but the surface is very sintered (Fig. 9: 3). The handle is fully preserved and has one small stopper horn, the other missing. This type could correspond to Tankó's type B (Tanko 2005: 154). This type of horn-handled bowl is not very frequent. The closest parallels from Slovakia come from Ploštín, Liptovská Mara and Veľký Bysterec (Pieta 1982: 93). Chronologically, this type of horn handle may be classified in the late Hallstatt D period or pre-Púchov culture (La Tène B–C) (Tankó 2005: 157–158; Pieta 1982: 93).

The last horn handle (trench 3, layer 12, depth 1.2–1.8 m) is black in colour, the horns are handmade and are of unequal size and height (Fig. 9: 1). The vessel to which this handle belonged has not been preserved, but judging from the preserved rim thickness, it must have represented a finer ware than most of the assemblage. The form is common on several fortified settlement sites in Spiš and is also present in the material from earlier surveys and excavations on Jerusalem Hill (Fig. 9: 5). Many are on display at the Podtatranské Museum in Poprad (Fig. 9: 6, 7). Judging from their relative frequency in Spiš territory, mostly from the high hill settlements, they could represent a local fashion in pottery design, reflecting a regional artistic trend. The Spiš exemplars are less sophisticated in terms of their design than the southern and western counterparts. They can be find in several regions in Slovakia (Liptov, Detva, Orava, southwestern Slovakia etc.), in Hungary (Párducz 1966: 35–91; Patek 1983: 59–84) and even in the Balkan area (Gabrovec 1987; Teržan 1990). In the Tankó typology, this handle represents type C: Vekerzug type, dated to Halstatt D2–D3 or La Tène A1 (Tankó 2005: 156).

In conclusion, the horn handles from Jerusalem Hill represent the older, probably late Hallstatt horizon in this settlement; a more precise chronological differentiation is still not possible. They disappear at the end of La Tène B in central Europe, no later than La Tène C (Pieta 1982: 93; Tankó 2005: 156). However, their development in the Spiš region may have taken place with some delay and this should be taken into consideration in their dating.

CONCLUSION

The main aim of this study was to give an overview of the hillfort site on Jerusalem Hill in Kežmarok, an important archaeological site in the Slovakia Spiš region. We have looked briefly at the site topography, history of research, the nature of

archaeological remains, overall characteristic of the pottery, specific pottery remains (horn-handled jugs) and the finds from excavation in 2013. The conclusions are preliminary as the site merits further closer examination in the future. The pottery from Jerusalem Hill should be studied further in the context of other Púchov high hill settlements or lowland settlements from the Spiš region and then compared with Púchov culture settlements in Slovakia, Poland and the Czech Republic.

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Medieval mosque lamps from Ostrów Tumski (Cathedral Island) in Wrocław and Opole–Ostrówek[1]

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A fragment of a 13th–14th century painted mosque lamp was identified in the collection of archaeological glass from Ostrów Tumski in Wrocław, held by the Institute of Archaeology and Ethnology of the Polish Academy of Sciences (Research Centre on Late Antique Culture and the Early Middle Ages). An analysis of glass chemical composition as well as the decoration of this fragment showed that it was made of sodic-calcic-silica glass, and that part of the ornament covering it was finished with gold. A comparative study indicated that the artifact had been made in the Middle East, most likely in a glass workshop in Syria or Egypt. Another example of this type of Islamic glass was discovered in Poland during the excavation in the 1930s of Ostrówek in Opole. Large fragments of a painted glass bowl were found there and identified as a mosque lamp. Since then the object has been lost. The fragments of glass mosque lamps from Wrocław––Ostrów Tumski and Opole–Ostrówek will be discussed here in the context of basic raw material studies and chemical composition analyses.

KEY-WORDS**:** medieval glass, Islamic glass, mosque lamps, enamels, Wrocław–Ostrów Tumski, Opole–Ostrówek, residential centres, Silesia, Middle Ages

INTRODUCTION

Excavations of medieval towns and strongholds, and especially residential centres often unearth a significant number of artifacts of an elitist nature beside extensive bulk material and architectural remains. These include elements of weaponry, jewellery, figural art, exquisite clothes, ornate stove tiles, metal vessels, luxury pottery, game pieces and all kinds of other goods unavailable to the general population. Glass and

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glazed products, especially those decorated with enamel, from both the early and the late Middle Ages should also be placed in this group. Decorated glass artifacts were extremely luxurious and valuable commodities at that time in Central Europe[2]. Possession of such items signified a comfortable lifestyle, emphasizing the wealthy status of the individual (see Piekalski 2008; Piekalski and Wachowski 2009).

Medieval enamelled glass belongs to a class of exceptional and particularly rare finds in Poland. Islamic mosque lamps are special in this group. The article presents a comprehensive description of fragments of glass mosque lamps from Wrocław–Ostrów Tumski and Opole–Ostrówek, in terms of both basic raw material studies and chemical composition analyses.

WROCŁAW–OSTRÓW TUMSKI

A fragment of a vessel of undoubtedly elitist character was found in 1952 on Ostrów Tumski (Cathedral Island) in Wrocław, during excavations carried out by the former Institute of the History of Material Culture of the Polish Academy of Sciences (Kočka and Ostrowska, 1953; 1955), in trench VI located on Katedralna Street, in the late medieval layer No. 3. It was a small fragment of the body of a vessel crafted in the free blowing technique (?), made of transparent glass of a lemon–honey colour (Fig. 1). Air bubbles are to be observed within the wall, which is 2.7–3.6 mm thick. The outer side is decorated with motifs of circles and palmettes, rendered in brown-red, white and gold enamel.

This is not the only find of its kind from Wrocław's Cathedral Island. A team of researchers from the Chair of Archaeology, University of Wrocław, discovered in 1972, in the neighbouring trench I/72, in layer D dated to the mid-13th century, a fragment of a glass vessel, most likely a bowl, made of transparent glass of sapphire colour (Kaźmierczyk *et al.* 1974: 260–264). This fragment was painted with an ornamental pattern that was gilded, the bright gilding surviving on the surface in the form of small scales (Kaźmierczyk *et al.* 1974: 262, Fig. 9: e). The decoration of circles, floral motifs and possibly a fragment of an inscription (?) is consistent in terms of style with the decoration of the vessel from trench VI. Spectographic analyses[3] of the glass of this fragment carried out in the 1970s showed that it was made of sodic-lead glass (Kaźmierczyk *et al.* 1974: 264, 271).

Neither style nor type of glass matches these vessels to the production of medieval workshops in central Europe. However, this kind of decoration was widely used both on pottery vessels (see Nawrolska 2002: 272, Fig. 1; Miazga 2009: 254–256, Figs. 2 and 3)

[2] According to 10th-century Arab sources, a single glass bead of green colour bought by Rus' merchants had the value of one dirham (Lewicki 1953: 118). Early medieval glass beads, as well as rings made of this material could have functioned as a non-monetary currency (Kurasiński and Skóra 2012: 77).

[3] Carried out by Dr. A. Idzikowski from Wrocław University of Technology (Kaźmierczyk *et al.* 1974: 264).

Fig. 1. Fragment of a mosque lamp from Wrocław–Ostrów Tumski, Inv. No. 2779/52. Photo by S. Siemianowska

and on glass vessels (see Goldstein *et al*. 2005: exhibits 308 and 311–312; Jenkins 1986: 38–45; Carboni 2001: 232, 235), in Islamic countries, the Byzantine Empire and the Arab caliphates in Western Europe[4]. Taking into account the colour of the glass, the style of the decoration, and the wall thickness and profile, we are dealing here most likely with bowl-shaped or jug-shaped lamps, fragments of which are fairly frequent finds in museum collections and during excavations in Europe. Such vessels are known, among others, from Ulm in Baden-Württemberg, the monasteries Farfe in Italy and Perpignan in France (Gross 2012: 51), the Old Town in Kiel[5] and the stronghold in Opole–Ostrówek (Hołubowicz 1956: 251, Fig. 101).

OPOLE–OSTRÓWEK

The Wrocław artifacts are not the only examples of Islamic lamps discovered in Poland. Fragments of a glass bowl (Fig. 2), which may also be associated with this category of artifacts, were found during excavations of the Ostrówek in Opole in the 1930s. The bowl has been published, starting with the original report from G. Raschke's excavations in 1930–1931 (Raschke 1938), through W. Hołubowicz's works on the history of Opole from the 10th to the 12th century (Hołubowicz 1956: 251, Fig. 101), to M. Deka's publication (Dekówna 1962). Maria Deka in her article on glass imports in early medieval Poland noted that the stylized Arabic writing placed on the bowl is typical of 11th–13th-century pottery products from Muslim countries in the Middle East, while its decoration is typical of mosque lamps (Fig. 2: c, d) (Dekówna 1962: 242). The early publications did not contain a detailed description, while the artifact itself was lost, most probably during World War II. The inscription on the lamp was deciphered recently in part. Kadir Pektas-Medeniyet from the University of Istanbul pointed out that only part of the inscription is legible and that it means: 'Mewla is the sultan'. According to Turkish scholars, an analogous lamp dated to the 15th century is in collection of the Mevlana Museum of Konya. The inscription reads 'Izzunli Mevlana is the sultan of el Melik'[6].

CHEMICAL COMPOSITION

The chemical composition of the glass of the fragment from Wrocław–Ostrów Tumski (Fig. 1)[7] as well as the enamel adorning it was undertaken with X-ray analysis

[4] For enamelled Islamic glass, see, e.g., Carboni 2001.

[5] Personal communication of Dr. P. Steppuhn, to whom we are very grateful.

[6] I would like to thank the scholars for the opportunity to consult with them and for the translation.

[7] Analyses costs were covered from the funds of the grant *Adulescentia est tempus discendi*. ATD-Nr 9 /MNiSW/ATD/M/2012.

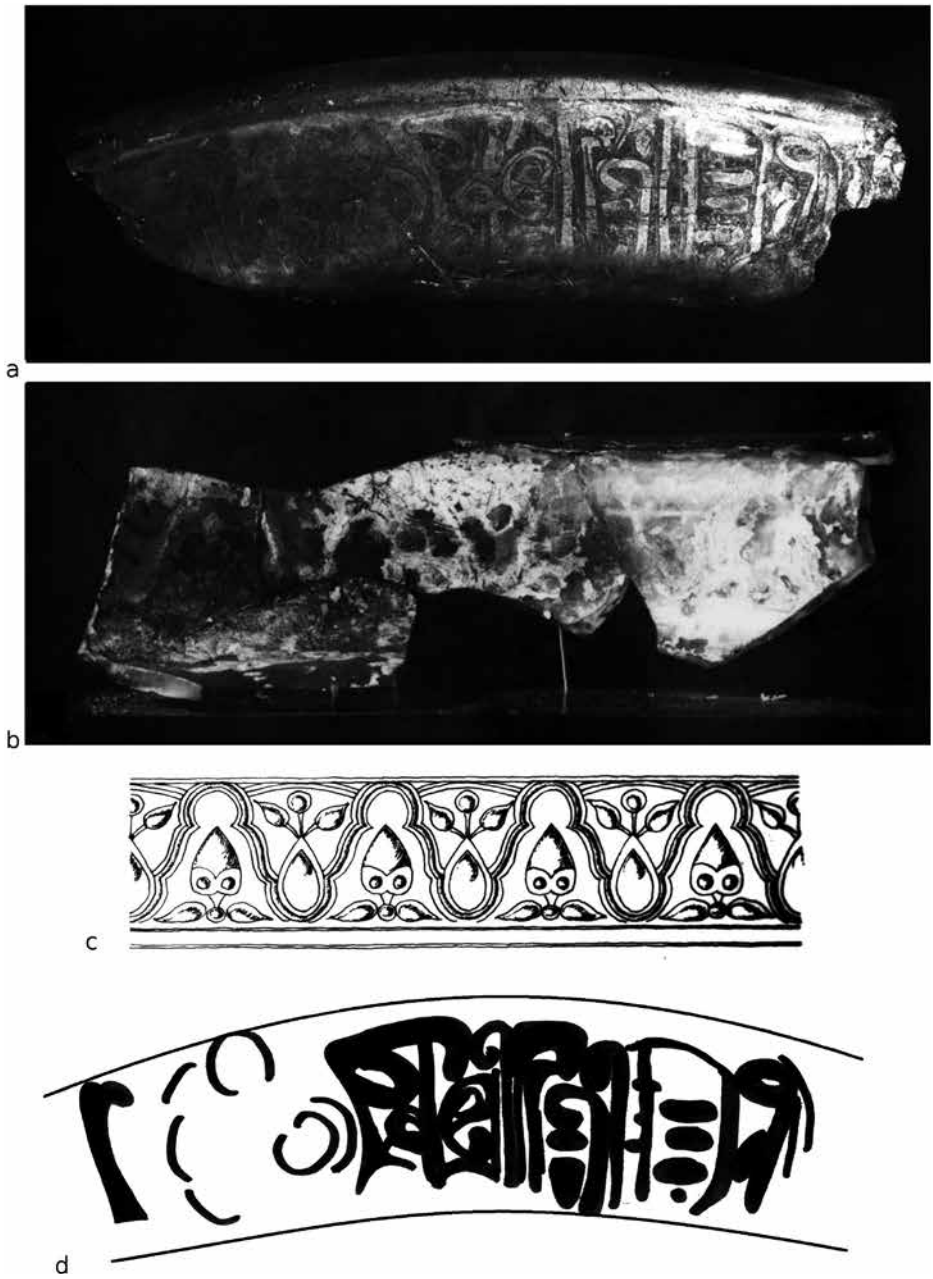

Fig. 2. Fragment of a mosque lamp from Opole–Ostrówek discovered in 1931; a – c archival photographs, Archive of the Institute of Archaeology and Ethnology, Polish Academy of Sciences, Research Centre on Late Antique Culture and the Early Middle Ages; d – the inscription redrawn based on photographs. Prepared by S. Siemianowska

(EPMA) using the CAMEC Sx 100 device. Conditions of the analysis included accelerating voltage of 15 kV (electron energy of 15 keV), beam current of 10 nA, and beam width on a sample (spot) of 15 microns. They were checked for various patterns of synthetic oxides and natural minerals and glasses (Purowski 2012: 47; Purowski *et al.* 2012). The basis of this method is gunning a sample placed in a vacuum with an electron beam, which as a result emits X-rays, the measurements of which (wavelength and intensity) define its chemical composition (Purowski 2012: 47; Wajda 2013: 93) (Tab. 1). The examination allowed us to prepare a detailed chemical characteristic of the glass and the enamel covering it, which contributed to determining its origins. A thin section from the artefact was examined macroscopically and using a binocular magnifying glass, determining general features of the glass such as glass colour, degree of weathering, compaction, structure and texture (Tab. 2). Microscopic examination of the glass material was performed using a polarizing microscope, a Zeiss 'Axiolab pol'. Then, drawing on existing studies and frequently discussed methods of interpretation of the results of chemical compositions of ancient glass (see Ščapova 1973, 1983: 29–30; Dekówna 1980: 31–32; Stawiarska 1991; Ciepiela-Kubalska and Stawiarska 2005; Černá *et al.* 2012; Dekówna and Purowski 2012; Purowski 2012: 45ff; Wajda 2013, 2014, and therein further references), the results of the chemical composition of the glass of the Wrocław mosque lamp were compared with results of similarly dated glass artifacts from Europe and the Middle East.

In terms of the chemical composition, the glass of which the artefact was made can be identified as sodic-calcic-silica (Na-Ca-SiO_2) glass (see Tab. 1). It is characterised by a high content of silica (SiO_2) – 69.05%, calcium oxides (CaO) – 8.89%, and sodium oxides (NaO) – 12.42%. The amount of iron oxides (FeO) in the glass is 0.52 % of the weight, chlorine (Cl) 0.68 % of the weight and manganese oxide (MnO) used for glass discolouration (Černá *et al.* 2009: 404) 0.71% of the weight. A considerable content of oxides: magnesium oxide (MgO) 3.75% and potassium oxide (K_2O) 2.83%, as well as the presence of aluminum oxide (Al_2O_3) 1.049%, indicates the use of ash from halophytes (salicornia and barilla), growing on soils with high salinity as well as in the steppe and desert regions (Stawiarska 1984: 35 and following; Freestone and Stapleton 1998: 122; Wedepohl *et al.* 2007: 266).

The paint decorating the vessel, recorded on BSE images, was also subjected to chemical composition analysis (Figs. 3 and 4). The EDS microanalysis showed that the main component of the decoration was gold (Au) (Fig. 5).

Richly enamelled and gilded sodic-calcic-silica glass with a raised percentage of the said elements is typical of Islamic products from Syrian and Egyptian workshops, which were controlled in the 13th–14th centuries by the Ayyubid and Mamluk dynasties (Freestone and Stapleton 1998: 122–124, Tab. I; Wedepohl 2003: 103–106; Wedepohl

Table 1. Chemical composition of the glass fragment from Ostrów Tumski in Wrocław, Inv. No. 2779/52. Prepared by K. Sadowski

Oxides	**Percentage of individual oxides in the analysed glass**
	# 5 Na-Ca-SiO_2
K_2O	2.832
CaO	8.893
BaO	0.058
P_2O_5	0.179
SO2	0.156
PbO	0.112
Cl	0.683
Ag_2O	0.000
SnO_2	0.000
Sb_2O_5	0.092
Fe_2O_3	0.516
MnO	0.709
TiO_2	0.052
CoO	0.057
NiO	0.033
CuO	0.000
ZnO	0.000
Na_2O	12.419
SiO_2	69.052
Al_2O_3	1.049
MgO	3.747
As_2O_5	0.000
total	100.638

Table 2. Macroscopic and microscopic description of the mosque lamp fragment from Ostrów Tumski in Wrocław, Inv. No. 2779/52. Prepared by K. Sadowski

No. of analysis/ thin section	**Site (trench)**	**Inv. No.**	**Artefact**	**Chronology**	**Colour**	**Transparency**	**Vesicles**	**Type of glass**	**Comments**
5.	Wrocław–Ostrów Tumski, trench VI	2799/52	Fragment of enamelled lamp	13th–14th century	Bright yellow	Transparent	Numerous about 0.5 – 1 mm	Glass Na-Ca- SiO_2	Paint – brown and white decoration; wall thickness about 3 mm

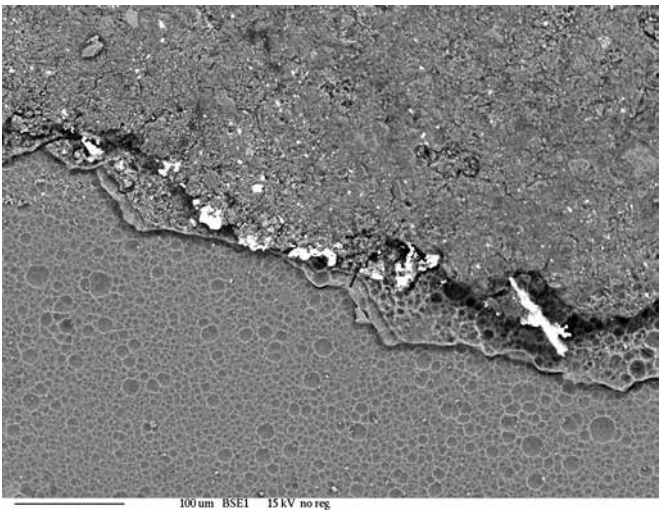

Fig. 3. BSE image of the painted surface of the mosque lamp from Wrocław–Ostrów Tumski. Photo by P. Dzierżanowski

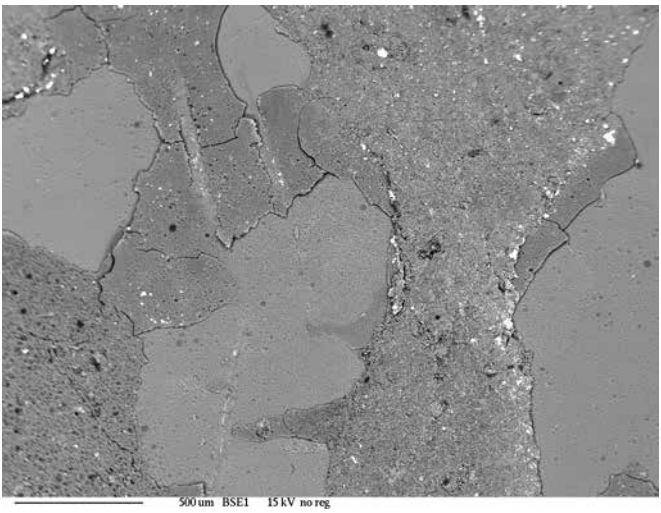

Fig. 4. BSE image of the painted surface of the mosque lamp from Wrocław–Ostrów Tumski. Photo by P. Dzierżanowski

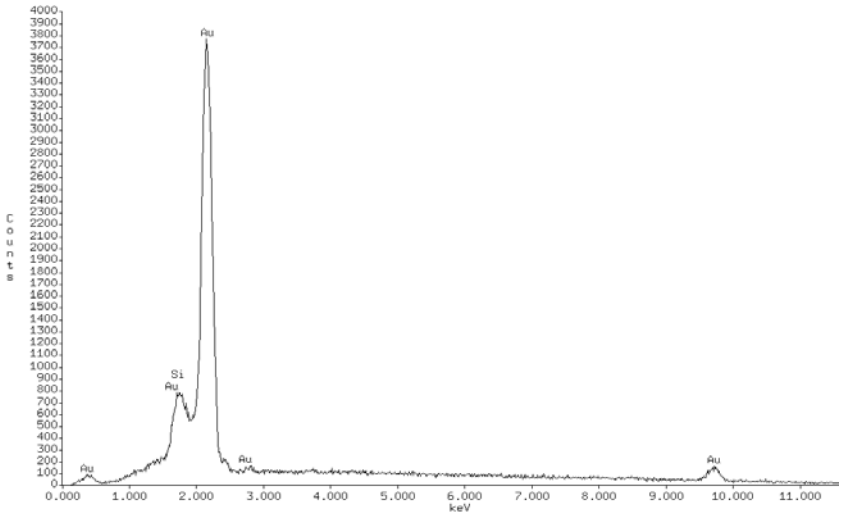

Fig. 5. EDS spectrum (elemental composition) of paint from the surface of the glass from Wrocław–Ostrów Tumski. Prepared by P. Dzierżanowski

et al. 2007, Tab. 1; Gueit *et al.* 2010: 1744, Tab. 1)[8]. The high level of chlorine and manganese oxides[9] in the glass (Gueit *et al.* 2010: 1744, Tab. 1) and the use of gold for decoration (Gueit *et al.* 2010: 1745–1746) also pointed to Middle Eastern workshops[10].

[8] Studies on sodic-calcic-silica glass of Islamic, North Italy and Byzantine origins were taken into account for comparative study (Brill 1999, Chapters VII, VIII; 2001; Wedepohl *et al.* 2007: Tab. 1; Černá *et al.* 2009: 406; Gueit *et al.* 2010: Tab. 1; therein further references).

[9] Most of the Islamic glass products contain above 0.3% MnO, used for glass discolouration (Wedepohl *et al.* 2007: 267).

[10] Venetian imitations of late medieval Islamic glass products must be considered in any study of glass finds from sites in the deep European interior, in areas outside the direct influence of the caliphates. In the late Middle Ages, after the fall of the great centres of glass production in Syria and Egypt, Venetian glass-makers began to produce copies of glass mosque lamps for Arab and Turkish clients (Gross 2012: 51). Imports from the mid-13th century of halophytic plant ash from the Middle East as well as of cullet, facilitated the production of sodic-calcic-silica glass following the Islamic recipe (Wedepohl *et al.* 2007: 267). Italian workshops produced both glass imitating Middle East designs and vessels in the European style.

CONCLUSIONS

The chemical composition of the 13th–14th-century fragment of a mosque lamp found on Ostrów Tumski in Wrocław clearly indicates that it was made of sodic-calcic-silica glass, based on an ash recipe. The specific chemical composition of the glass as well as very characteristic surface paint based on compounds of gold indicate that it is an import from the Middle East, most likely from the Syrian–Egyptian circle. The two other artifacts from Wrocław–Ostrów Tumski and Opole–Ostrówek are also of Middle Eastern origin.

The presence of such distant and culturally different imports in Poland is not uncommon. One should mention finds of Middle Eastern glass and Islamic glazed pottery in central as well as western Europe[11]. Fragments of mosque lamps are known from Ulm and Kiel, while fragments of enamelled glass are known from, among others, Kiel, Lübeck, Göttingen, Braunschweig, Maastricht, Prague, Tábor and Wrocław––Nowy Targ Square[12] (Baumgartner and Krueger 1988: 120–125; Černá *et al.* 2012, Tab. 1; Steppuhn 1996, 2014, 2016)[13]. The very important St Hedwig beakers, discovered in central Europe, should be mentioned here (Baumgartner and Krueger 1988: 86–105; Lierke, 2005; Wedepohl *et al.* 2007, therein further references). Glazed Middle Eastern pottery was discovered in the Fulda monastery, the Old Town in Erfurt, Prague Castle and Koválov near Žabčice, where it occurred in the context of a central mound located on the spot of a manor (Nováček 2011: 611–613). It is also known from late medieval layers in Elbląg and Wrocław (Nawrolska 2002; Miazga 2009).

Several issues related to glass mosque lamps from central European contexts still remain open. First is the function of these objects in a new, culturally foreign environment. Did they serve in their original role and light up monastery, palace or court interiors? Or were they prestigious decoration? Were they stored in treasuries as precious gifts? The second question is the how and from where did the glass mosque lamps come to Silesia. There are several possible routes and circumstances to be considered. Glass mosque lamps and other items of foreign, Islamic provenance could have been the object of long-distance trade, brought by migrating individuals and whole

[11] Finds of Islamic pottery outside the Italian Peninsula, Sicily and some regions of the Iberian Peninsula are extremely rare in Europe. In western and northern Europe, the occurrence of Islamic pottery from the Syrian–Egyptian and Iranian region overlaps the Mediterranean–Atlantic maritime trade routes. They have been discovered mainly at port sites and in the coastal zones of southern England, Belgium, the Netherlands, Norway and Sweden. Finds of Middle Eastern pottery, in comparison with glazed pottery from Valencia, Malaga and Seville, quite numerous in the Hanseatic–Atlantic areas, are extremely rare (Nováček 2011: 611–613).

[12] Unpublished material known to the author, S. Siemianowska.

[13] On other finds of Islamic glass from Europe, see, among others, Lamm 1941; Carmona *et al.* 2009.

communities, military expeditions, as a result of diplomatic and political contacts, Christianising missions, marriage and service in a foreign court (see Wołoszyn 2000, 2004, for more). According to some researchers, Middle Eastern imports, such as glass, could have been gifts from Middle Eastern rulers or souvenirs brought back from the Crusades (Dean 1927; Černá and Podliska 2006: 251), or from pilgrimages to holy places, very popular in the late Middle Ages. The presence of richly enamelled glass products and Islamic glazed pottery in the context of ecclesiastical estates, castles, aristocracy and wealthy burghers' estates, and plots belonging to town craftsmen suggests that these items could be a determinant of wealth and social status. It is possible that they were personal gifts rather than traded goods (see Haggrén and Sedláčková 2007: 192). Therefore, the glass mosque lamps discovered in Wrocław and Opole could have arrived from the Middle East first to Western Europe[14] and from the Byzantine Empire to eastern Europe, from where they may have been traded or travelled on the pilgrimage routes to Poland. It cannot be ruled out that they were brought directly from the production centres, as gifts from foreign rulers or as 'souvenirs' from a journey to the Middle East.

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[14] A significant amount of Islamic and Middle Eastern imports are known from urban centres and castles located in present-day Russia, Ukraine and Belarus. According to the already quoted researcher, the Volga and perhaps also the Dnieper most likely played a very important role in trade in the Middle Ages. A very large accumulation of 12th–13th-century imports of Eastern provenance is known from Navahrudak in Belarus. Excavations conducted there (1957–1960) yielded a significant number of finds of Islamic, Oriental and Byzantine origin, occurring together with imports from the Mediterranean, Poland and the Rhineland (Nováček 2011: 611–613).

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Middle Eastern painted glass vessels from Yaroslavl

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The paper studies fragments of gilded and enameled glass vessels of Middle Eastern origin from a building dated to the pre-Mongolian period, excavated in Yaroslavl in 2006 by researchers from the Institute of Archaeology, of the Russian Academy of Sciences. The fragments seem to be parts of three beakers. Two of them bear inscriptions in *Naskh* script and had a fragment showing a human face in three-quarter view. Parallels support the contextual dating. A fragment bearing the image of the lower part of a man standing on the bank of water probably belonged to the third beaker. Discrepancy between dating it to the third quarter of the 13th century based on parallels and archaeological context evidence enables dating the emergence of vessels of this kind to the first half of the 13th century instead of the mid-13th century.

KEY-WORDS: glass vessels, gold-painted, enameled, Middle Eastern origin, Yaroslavl, pre-Mongolian period

INTRODUCTION

Archaeological excavation in the city of Yaroslavl, by an expedition directed by A.V. Engovatova from the Department of Rescue Archaeology, Institute of Archeology, of the Russian Academy of Sciences, has been carried out since 2004 (Fig. 1), bringing to light a large number of finds. Not the least of these are glass objects – currently numbering more than 2,000. About 70% of these artifacts are bracelets – a common situation at Russian urban sites – whereas one-fourth are beads. The remaining items are vessels, stained glass and fine jewelry, such as buttons, rings and inserts.

Some of the most interesting finds from Yaroslavl are glassware items decorated with gold and enamel. These are Middle Eastern imports – recognized by Soviet historiography as Oriental and by Western science as Islamic in origin. In ancient Russia, such products were luxury items. The Yaroslavl collection of Middle Eastern vessel fragments decorated with painted enamel and gold is quite extensive and may be

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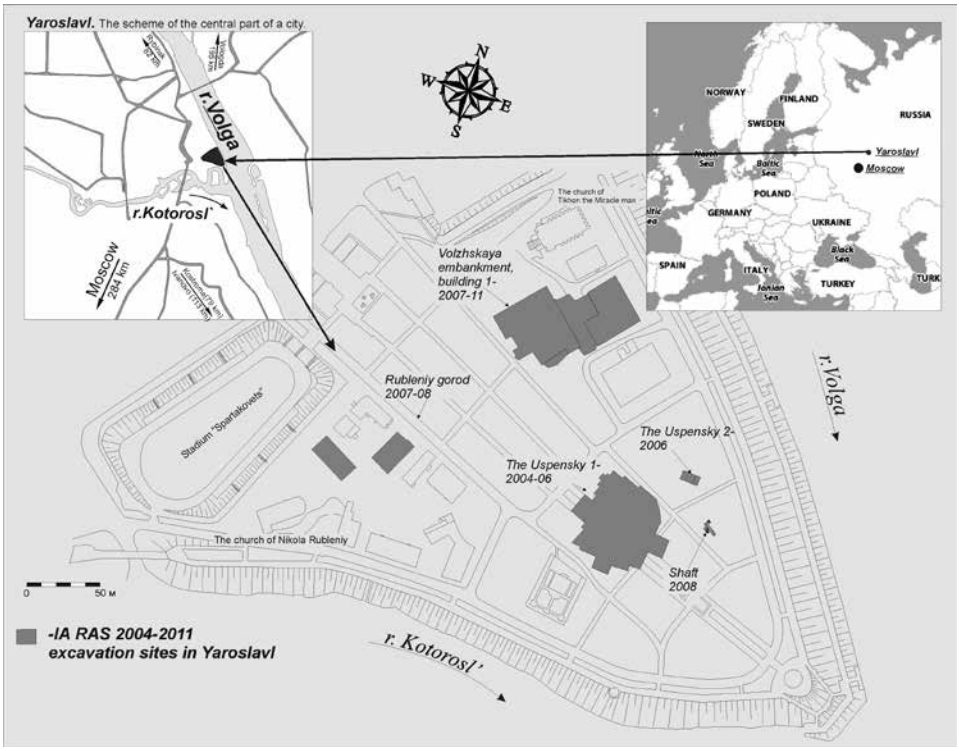

Fig. 1. Yaroslavl Kremlin (plan). Institute of Archaeology, Russian Academy of Sciences excavation sites in Yaroslavl (2004–2011)

compared to known finds from Novogrudok, where eight vessels with similar ornamentation were found (Gurevich *et al.* 1968).

The first discovery in 2006 comprised 35 gilded and enameled fragments (Fig. 1; 2) from building 36 at the Uspensky 1 site[1]. All of them appear to have been part of open vessels, such as beakers, which make up one of the largest groups of Middle Eastern painted glassware. Most fragments were from the upper part of vessels (Fig. 2, No. 1987), and only two pieces can be reliably attributed to middle and lower parts (Fig. 2: Nos 1989 and 1958).

Building 36, where these pieces were discovered, is located in squares 248, 249, 258, 259 (sections 12–13) from the 280 cm level (Figs 3; 4) (Osipov and Faradzheva 2006). It was a cellar buried 120 cm in the ground, the walls constructed of vertically

[1] The fieldwork was headed by N.N. Faradzheva and D.O. Osipov (2006).

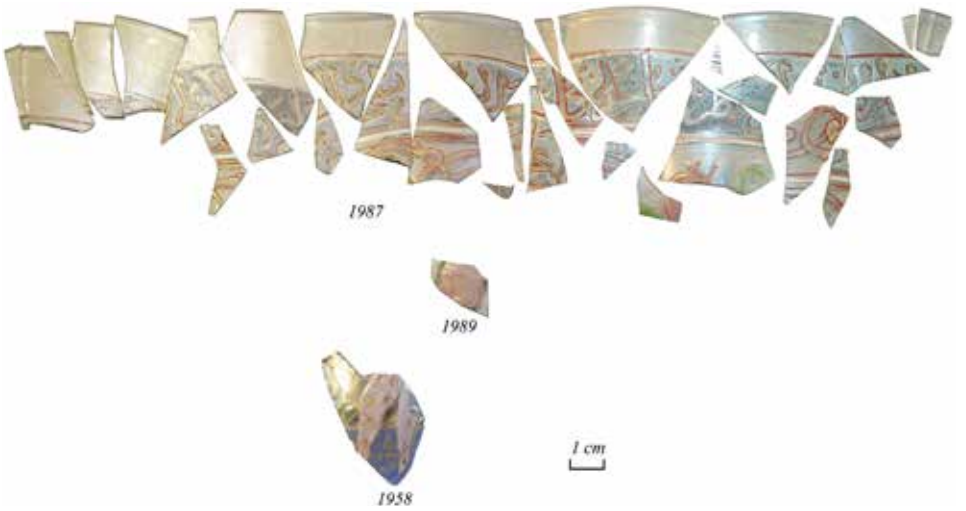

Fig. 2. Gilded and enameled glass fragments from residential building 36

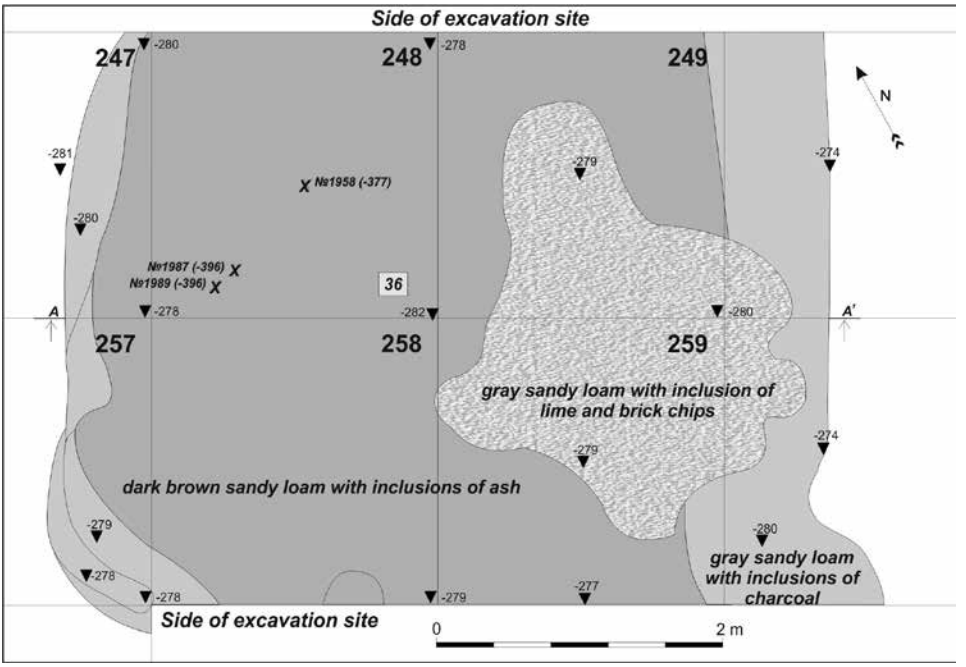

Fig. 3. Residential building 36. Plan × – find locations of enameled glass fragments

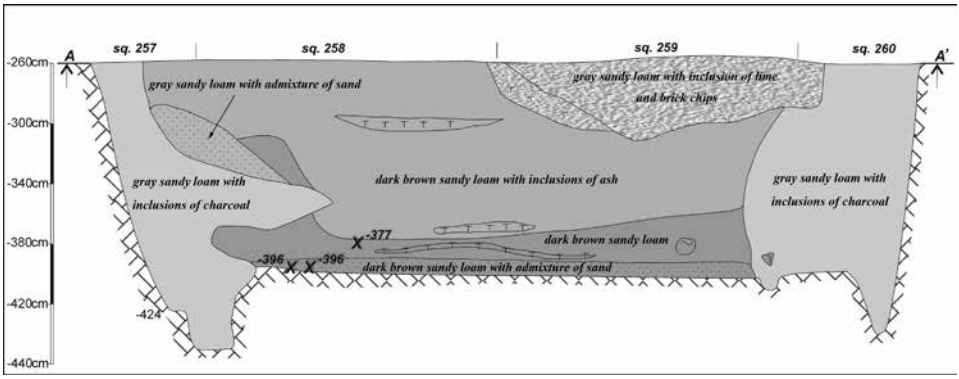

Fig. 4. Residential building 36. Cross-section A-A'. View from the West × – find locations of enameled glass fragments

embedded whole tree-trunk sections with filed lower ends recessed 30–40 cm into ground. Traces of larger support pillars can be seen in the corners and in the middle of the walls. The building measures 400×420 cm on the outside and 340×350 cm internally. The backfill of the walls (gray sandy loam with charcoal inclusions) was noted along the northern and southern limits of the building. A layer of dark brown sandy loam filled the interior. A pit in the southern part of the building contained gray sandy loam with lime and brick chips.

Fragments of painted glass vessels were found at the bottom part of the cellar fill, in a layer of dark brown sandy loam with extensive sand. The fragment considered as lower part of a vessel was found at a depth of 377 cm, while pieces from the upper and middle parts were found below that, at 396 cm. The bulk of the ceramics from the fill is composed of ancient Russian pottery of 12th and early 13th century date (Tab. 1). Overall, the assemblage of all finds and pottery dates building 36 to the second half of the 12th or the first half of the 13th century.

A study of the shapes and proportions of Islamic beakers has led researchers to distinguish five basic types (Fig. 5; Kenesson 1998: 46, Tab. I). In terms of shape there are two forms of beakers: cylindrical and conical. One theory is that both forms emerged simultaneously in the mid-12th century, their popularity waning towards the end of the 13th century (Carboni 2001: 329, 332, 334). A different view holds that the conical vessels should be attributed to the end of the Ayyubid period (1225–1250), whereas the cylindrical vessels are thought to pertain to 1250–1380 (Kenesson 1998: 46–48).

The fragments from Yaroslavl belonged most probably to the conical type, the shape being reconstructed based on fragments came from the upper part of the vessel. These fragments were decorated with a frieze consisting of an Arabic inscription in *Naskh*

Table 1. The collection of ceramics from the bottom fill of the building 36

Part of the vessel **Type of ceramics**	**Upper part**	**Body**	**Base**	**Total**	**%**
Ancient Russian circular (early 13th c.)	14	80	7	101	86.33
Ancient Russian circular (12th c.)	2	9	2	13	11.11
Molded		3		3	2.56
Total	16	92	9	117	100.00

script (only the word 'cup' could be distinguished)[2] (Fig. 2: No. 1987). The inscription was rendered with gold paint, contoured with red-brown, the interstitials filled with applied indigo enamel. The frame around the inscription is a simple red-brown line on top and a strip of yellow enamel sandwiched between red-brown paint below. Under the inscription there is another frieze with an interwoven pattern of arabesques. The ornament is wrought in gold outlined with red-brown.

The varying space between the frieze with the inscription and the vessel edge suggests that there were at least two beakers with the same ornament (Fig. 2: No. 1987). The rim diameter of one of them is 11 cm; the other one could not be determined due to the small size of the fragments. Both vessels were of conical type A with a rim diameter ranging from 9 to 14 cm, whereas in type B rim diameters ranged from 8.4 to 10.5 cm (Fig. 5; Kenesson 1998: 46, Tab. I).

The closest parallel to the Yaroslavl fragments with inscription is the Palmer Cup from the British Museum (Fig. 6). The Cup features an inscription near the top edge; it is in the same style and bordered by the same kind of frame. There is, however,

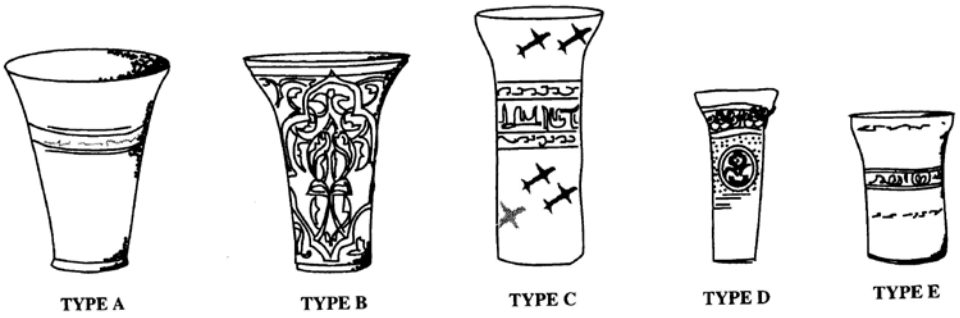

Fig. 5. Types of Islamic beakers (after Kenesson 1998: 46, Tab. I)

[2] Anatoly Ivanov, Head of Oriental Department, State Hermitage Museum

Fig. 6. The Palmer Cup. Syria, Raqqa, early 13th century. H. 13 cm. The British Museum, London (after Tait 1998: Col. pl. J. Fig. 13: 5)

no ornamental frieze like the one on the Yaroslavl pieces. The Cup's shape and proportions classify it as a type A conical vessel. According to C.J. Lamm, the Cup represents Raqqa-ware dated 1170–1270 (Lamm 1929–1930: Tab. 96: 6). Lamm attributed the Palmer Cup to the 1230s (Tait 1998: 51). Even though Lamm's chronology has been significantly revised, no new dating for the Palmer Cup has been proposed. Modern scholars of the Cup suggest that such inscriptions can be found in Arabic manuscripts of the 13th century, while inscriptions in gold outlined with black or red occur in manuscripts from the turn of that century (Contadini 1998: 56).

Fragments with a similar inscription on a indigo background and a gold ornament of arabesques encircled with a red-brown line have been found in the Rurik settlement excavations. Some were found during the dismantling of structures dated from the late 13th to the 15th century (Plokhov 2007: 167, 173, Tables 6, 10, 11, 18).

The fragment with an image of a human face in three-quarter view was located probably in the middle section of the beaker (Fig. 2: No. 1989). The silhouette is in gold-plated pale pink enamel, while facial features and the contour are rendered with a red-brown color. Pieces of clothing, that is, the headgear and outer garments (purportedly, a turban and a collar, respectively), are executed in indigo paint outlined with gold. The face is done in a manner characteristic of Islamic miniature painting, including features such as a rounded chin and a distinctive portrayal of the neck. Rounded eyes and arched eyebrows are similar to the features of individuals depicted on the Palmer Cup, the closest among which is the facial image of a musician standing to the right of the figure of the ruler on the throne (Fig. 7).

Fig. 7. Drawing of part of the decoration of the Palmer Cup (after Contadini 1998: Fig. 14: 3)

Another fragment comes from the lower part of the vessel to judge by its thickness (Fig. 2: No. 1958). One can see the legs of a standing man turned to the right, one of them is bent. The man is dressed in tight-fitting red-brown trousers decorated with gold flecks. In the background there is a pond outlined with a red-brown line and yellow-green grass. The pond is done in indigo enamel with lines representing the ripples in the water.

The fragment is paralleled by the decoration on a vessel from the National Museum in Kuwait City (Kuwait) (Fig. 8; Carboni 2001: 330–331, Cat. 86a). The vessel depicts two men surrounded by tall bushes: one is standing on the lakeshore and the other is knee-deep in water. With their raised right hands, the men point to birds (herons or cranes) flying above them. The images of birds girdle the cup's upper part. This story is interpreted by researchers as a hunting scene. One of the hunters is a man clad in

Fig. 8. Beaker, 1250–1275. H. 12 cm, max. D. 8 cm. The National Museum, Kuwait City (Kuwait; after Carboni 2001: 330, Cat. 86a)

the same kind of trousers, only with a golden cross-shaped pattern. His legs are bent at the knees and turned to the left. The man stands on the waterfront with characteristic ripples, outlined by yellow-green grass in the background. This part of the image is almost completely identical with that on our fragment.

In addition to the Kuwaiti Cup, birds of the same kind were depicted on the upper part of nine other whole and fragmented vessels (Carboni 2001: 332–333). Lamm dated them to the 13th century, placing them in the Aleppo group (Lamm 1929–1930: Taf. 120, 126, 127). Researchers have narrowed down the chronological range of these cups to the second half of the 13th century (Baumgartner and Krueger 1988: 121).

The nearest parallels to the Kuwaiti Cup are two vessels with an image of men at a waterfront (Carboni 2001: 331). One of them is a glass from the Grünes Gewölbe museum in Dresden. One side of the glass shows a male figure submerged in water; on the other there is a large spreading tree instead of a human figure. Cranes flying in two rows are placed above the figure of a man, who seems to be wanting to grab one of the birds by its wing. Two fragments of glass from the Berlin Museum of Islamic Art also feature a preserved image of one man sitting in water, while the other man is shown standing. The men do not point towards the birds; their hands are raised close to their faces. The images on these vessels are not identical, but they seem to be united by a single storyline. This suggests that they are illustrative of some unknown literary work. In the researchers' opinion, these cups should be considered together with the beaker from the Museum of Hessen History (Hessisches Landesmuseum) in Kassel, featuring an image of flying birds and two human figures sitting in a thicket of plants and playing musical instruments (Carboni 2001: 331). Unlike the scenes on the Dresden and Berlin beakers, the group of flying cranes encircling the upper part of the Kassel beaker is enclosed in a frame, as is the central composition, bounded by two thin enamel lines. Despite the scene depicted on this beaker being different (not a hunting scene), the similarity of some features (e.g., the shape of cranes and the drawing on the musician's garments) suggest that the Kassel beaker should be regarded in conjunction with the three other vessels and that they were manufactured in a single workshop during a short period of time. According to Stefano Carboni, cups with images of birds and human figures standing on the waterfront with characteristic ripples on the water were popular in the third quarter of the 13th century (Carboni 2001: 331). A fragment of a vessel with the same image unearthed in a Yaroslavl building dating from the pre-Mongolian period may suggest that such vessels existed at an earlier time. This in turn is supported by the wider dating proposed by Lamm.

Could the pieces from Yaroslavl be part of the same vessel? Presumably, fragments with the inscription and the face of a man may have been part of the same beaker. The lower part of a male figure is likely to belong to another vessel as demonstrated by the cited parallels and the fact that the fragment with the male figure was discovered separately from the rest of the fragments within the building.

Researchers have suggested that vessels of the same shape with similar painting but different dimensions (height and diameter) could have been placed one inside the other and thus be part of a set of nesting cups for different purposes (Fig. 9; Carboni 2001: 331, 334; Gibson 2005: 278–279). Such a set of cups was purportedly intended for different beverages to be consumed by one person during a meal, for example, wine, water, koumiss and others. In addition, cups nested one inside the other were easier to transport (Kenesson 1998: 47; Carboni 2001: 334). Several such sets are known. One set includes four cups with an ornamental image: three come from the collection of Nasser D. Khalili in London, while the fourth cup is from the National Museum in Kuwait City (collection of Sheikh Nasser Al-Sabah). Another set, according to Carboni, was made up of three vessels with images of birds and male figures standing on the waterfront: from Kuwait, Grünes Gewölbe museum in Dresden and the Museum of Islamic Art in Berlin (Carboni 2001: 331).

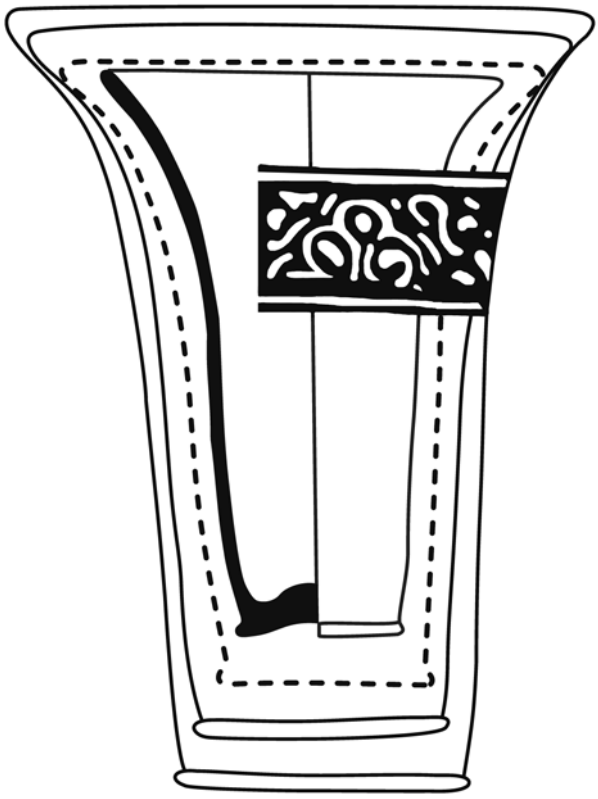

Fig. 9. Glass cups comprising a set (after Gibson 2005: 278)

The Yaroslavl vessels with an inscription made in the same style, of which there may have been at least two, presumably formed a set of beakers or part of such a set, brought in from the East as a gift or souvenir. Note that many of the finds of Middle Eastern glasses from the territory of Russia consist, as in our case, of at least two identical vessels. One example are the two beakers with ornamentation in the same style from Novogrudok (the publication unfortunately records the height of only one vessel) (Fig. 10, 11; Gurevich *et al.* 1968: 12); another are the two beakers from Vladimir (in this case, losses prevent the height and rim diameter from being identified) (Kuzina 2011: 92).

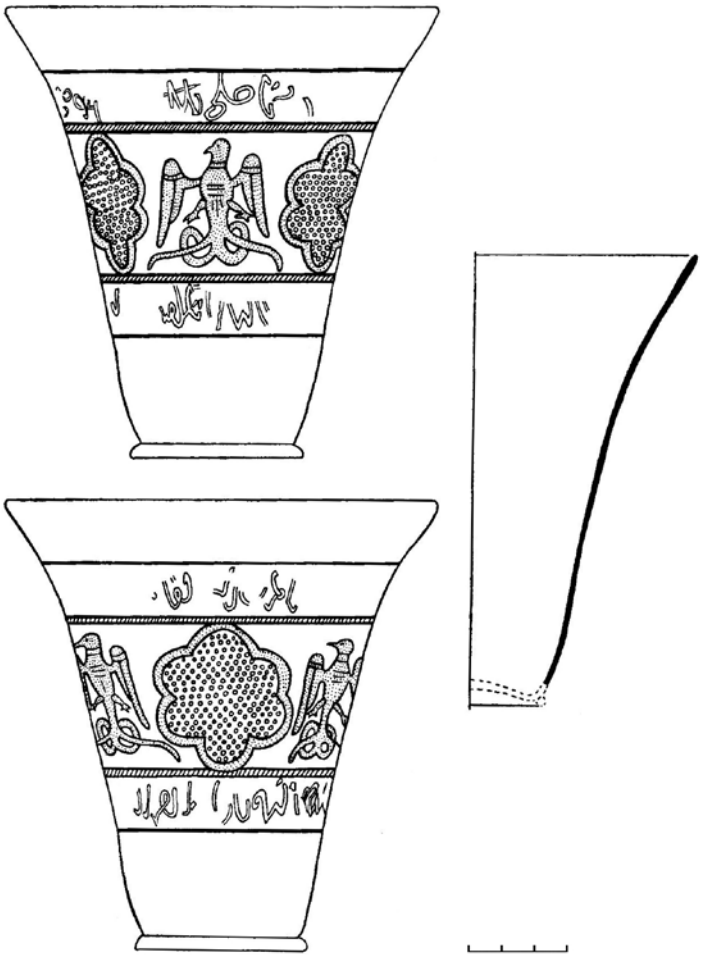

Fig. 10. One of two beakers with ornamentation in the same style from Novogrudok (after Gurevich *et al.* 1968: Tab. 8)

Fig. 11. One of two beakers with ornamentation in the same style from Novogrudok (after Gurevich *et al.* 1968: Tab. 9)

The chemical composition of two glass fragments from vessels with inscriptions was studied (Tab. 2). Both glasses were found to belong to the sodium-calcium-silicon (Na_2O–CaO–SiO_2) chemical class. The ratio of sodium and potassium (Na/K=6.1 and 6.3) in both instances suggest that they were melted of sodium raw materials with a small addition of potassium (3<Na/K≤13). The calculation of the potassium fraction in the alkaline raw material (C=100 × K_2O / Na_2O + K_2O = 13.7 and 14.1) shows that the ash of the air-borne parts of annual plants from the desert zone, *Kalidium caspicum*, were used as alkaline raw material (Stawiarska 1984: 24–27). Fusible fractions (R_2O = Na_2O + K_2O; RO = CaO + MgO) of Yaroslavl glass (test 839–1) are mixed according to recipe 3 (N = R_2O / RO). The second analysis (test 839–2) revealed that recipe 2.5 was used. A similar recipe was traditionally used in Middle Eastern glass-making from the first centuries of our era (Sčapova 1983: 127).

Table 2. Optical emission spectral analysis data for glass vessels from the city of Yaroslavl

Laboratory test code	**839–1**	**839–2**
Color	**colorless**	**colorless**
SiO_2	base	base
Na_2O	14	15
K_2O	2.3	2.4
CaO	4.3	5.8
MgO	1.0	1.2
Al_2O_3	0.3	0.4
Fe_2O_3	0.03	0.03
MnO	0.3	0.4
TiO_2	0.06	0.07
PbO	-	-
SnO_2	-	-
CuO	-	-
CoO	-	-
Sb_2O_5	-	-
Ag_2O	-	-
NiO	-	-

Thus we can assume that the fragments of painted glass of Middle Eastern origin from Yaroslavl belonged to three beakers, two of which, decorated with inscriptions, could have made up a set. Parallels for fragments with Arabic inscription and a fragment with the image of a human face confirm their dating to the pre-Mongol period, as determined from the archaeological context. Discrepancies in the dating of the fragment with the image of the lower part of a male figure derived from the archaeological context and the various parallels push back the first occurrence of vessels with similar paintings from the middle to the first half of the 13th century.

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Glass along the Silk Road in the first millennium AD[1]

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The so-called Silk Road routes of the 1st millennium AD promoted the spread of ideas and artistic trends, advanced technology, arms, horse harness etc. Glass had played an important role in the exchange network between the West and the East as well as South and North ever since antiquity. Most of the archaeological glass (vessels, personal ornaments) from the Eastern end of the Silk Road (China, Korea) comes from 'special' places, such as elite burials and Buddhist temples. Their importance for ancient Chinese and Korean societies, where precious stones, bronzes and porcelains played a significant role, remains an open issue. The origin of glass artifacts found along the Silk Road, particularly in China and Korea, is still debatable. Transparent glass vessels unearthed in China are rare, usually interpreted as Western imports, proving trade relations along the so-called Silk Roads. Most of them come from elite graves, while others were deposited in temple treasuries, like the famous treasure from Famen Si (Shaanxi province). In both instances, the suggestion is that objects of this kind were valuable and highly appreciated, thus probably quite rare in China. The latest studies, especially laboratory analyses, have thrown new light on the origin of the glass finds from China, raising at the same time multiple issues concerning their cultural and social context. The aim of the present paper is to analyse the chronological and geographical distribution of Western-related glass vessels within the present territory of the Peoples Republic of China, as well as Korea and Japan, and to discuss social interactions and processes which caused these goods to reach Chinese territory and beyond. The final goal is to understand the reception of these exotic goods by the local population in terms of their meaning and value.

KEY–WORDS**:** Silk Road, glass, imports, cultural exchange

Research on the Silk Road inevitably opens multiple questions concerning traded goods, their nature and value. Glass vessels are usually considered as Western products exported from the Mediterranean region and valued in distant countries, even in China. This paper presents observations on glasses from the West found in archaeological contexts in Eastern Asia: China, Korea and Japan, and their possible interpretation.

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Early research on the contacts between Western and Eastern Asia hypothesised that glass was among the most important goods exported to the East because the technology of producing multicoloured, transparent glass was unknown in China. This was based initially on the reading of ancient Chinese texts where glass is mentioned as one of the 'Roman products' (Hirth 1975: 230–234) and on the fact that most ancient Chinese glasses produced locally were of an opaque, usually greenish glass with high lead content (Pb and Pb–Ba glass systems). In default of persuasive evidence of local production of transparent glass, this hypothesis seemed plausible, especially in the light of the modest presence of objects of western provenience found in Xinjiang by Aurel Stein at the beginning of the 20th century. These finds were the essential proof of glass being imported from the West to China via the so-called Silk Road, leading from the Eastern Mediterranean through Mesopotamia, Iran, Central Asia and the Tarim basin, as proposed by Ferdinand von Richthofen in his famous work entitled *China, Ergebnisse eigener Reisen und darauf gegründeter Studien* (Richthofen 1877: 499–500).

Years of excavations in China and scientific laboratory analyses of glass objects from archaeological contexts have changed this picture dramatically. It is currently assumed that starting from the beginning of the 1st millennium AD glass vessels were imported to the Far East from different regions of Western and Central Asia along different maritime and land routes. Perhaps the most spectacular proof of long distance trade are the Persian glass vessels which became part of the Shōsō-in[正倉院], the treasury of the Tōdai-ji [東大寺] temple in Nara city [奈良市] in the 8th century AD and which reached Japan from Iran through China. At the same time, however, transparent glass was being produced locally in some regions of China, although the technology did not spread to other areas and appears to have been abandoned in the end. Long exposure to imported objects and probably also to foreign craftsmen prompted a development of local technologies and the emergence of various types of locally produced glass in the second half of the 1st millennium AD. Moreover, the scarcity of imported glass finds from the 1st millennium AD speaks out against a regular trade, indicating rather that these items were individual imports, rare and precious objects, explaining why the only archaeological contexts in which they are found are aristocratic graves and temple treasuries.

GLASS FINDS FROM CHINA

Han dynasty period

Recent research on a small group of glass objects from Han dynasty graves in the Guangxi Zhuang Autonomous Region [廣西壯族自治區] has shown that contrary to the earlier hypotheses the technology of producing transparent and semitransparent glass may have been known in China as early as at the end of the 1st millennium BC.

Several vessels, mainly bowls and cups, were found in tombs in Hepu [合浦] county and Guigang municipality [貴港][2] (Huang 1988, 1991, 2006; Guangxi 2006; Xiong and Li 2011) (Fig. 1). They find parallels among unprovenanced objects of similar shape and size, including two pieces from the Musée Guimet and one cup from the private collection of W.H. Shorenstein in San Francisco, the latter having undergone chemical analyses (Brill 1995: 271–274; Borell 2010: 131). At first glance these forms are quite like the Hellenistic moulded bowls produced in the Eastern Mediterranean, but their chemical composition differs remarkably from Western glass. While the Mediterranean glass was made of so-called soda–lime glass with high Na_2O content (usually between 10% and 20%) and a fairly high percentage of CaO, the Guangxi glass contained K_2O instead of Na_2O and is characterized usually by CaO below 1% and moderate Al_2O_3 (above 3%) (Xiong and Li 2011: 71–98) Although potash glass was found in multiple areas extending from Central Asia through South and Southeast Asia up to Korea and Japan, some local variations in the CaO and Al_2O_3 percentages can be observed (Dussubieux and Gratuze 2013: 404–406). Lankton and Dussubieux (2006: 135–136) distinguished three categories of potash glass: the most popular moderate CaO and Al_2O_3, low Al_2O_3 (most samples of such glass come from the late 1st millennium BC sites in Southeast Asia, mainly from Ban Don Ta Phet in Thailand as well as from Sa Huinh culture sites in south and central Vietnam and Lang Vac, the southernmost site of Dong Son culture in northern Vietnam) and low CaO (most of the samples come from Dong Son sites in northern Vietnam, China, Korea and Japan). The Guangxi finds naturally fall within the last group.

The origin of this type of glass is still not definitely proved. To date, there are no workshop sites producing such glass known from the area of Eastern or Southeast Asia. Lankton and Dussubieux suggested the production of raw material for low CaO potash glass in Southeast Asia or China (Lankton and Dussubieux 2006: 136). Huang (1991) proposed that at least some of these vessels could have been produced locally (Huang 1991: 192), while Borell argued that vessels found in Guangxi had to be produced locally and were even exported as far as the Indian Subcontinent (Borell 2010: 134–138). The most recent study by Xiong and Li (2011), which includes a comparison of the chemical composition of samples from China, India and Southeast Asia, as well as additional research on the Rb/Sr ratio, seem to prove the local origin of Guangxi glass. A lead isotope analysis demonstrated parallels in the typically local production of Pb and Pb–Ba Chinese glasses (Xiong and Li 2011: 158).

The issue of glass from Guangxi opens multiple questions that extend beyond the scope of this paper, such as the cultural association of vessel forms which hardly find

2 Guigang [貴港] is now a prefecture-level city. Before 1988 it was known as Gui county (貴縣 Guixian), thus objects found and published in earlier publications may be described as found in Gui county.

parallels in the local production, the location of workshop centres and distribution patterns. However, one thing is clear: the technology of transparent glass production was known in southern China already in the 1st century BC.

In this context the issue of glass vessel imports from the West and their value on the Chinese market takes on added interest. Glass vessels of Western origin found in Han dynasty contexts in China are particularly rare. To date, only three examples are known. Small fragments of a moulded ribbed bowl made of purple and white mosaic glass were found in tomb no. 2 from AD 67, located at Ganquan [甘泉], Hanjiang [邗江] county, Jiangsu [江蘇] province (Nanjing Bowuyuan 1981: 1–10). A fragmentary green cup with convex bottom comes from the tomb at Laohudun [老虎墩] in the same area, dated roughly to the Han dynasty (Changzhou Bowuguan 1991: 62–70), while a green and white mosaic glass bottle was found in a tomb at Luoyang [洛陽] from the 3rd century AD (Watt *et al.* 2004: 113).

The ribbed bowl is a typical example of late Hellenistic – early Roman Eastern Mediterranean production and is represented in many regions of the Roman Empire; multiple parallels of Eastern Mediterranean origin populate museum collections around the world (Matheson 1980: 14; Auth 1976: 50; *Ancient Glass* 2013: 370; 373). Chemical analysis have identified the cup from Laohudun as made of soda–lime glass probably in the same region (Changzhou Bowuguan 1991: 70). And the mosaic glass bottle from Luoyang is a typical example of a Roman *unguentarium*, which was also often produced in the Eastern Mediterranean.

The extremely rare occurrence of glass finds from the early centuries of the 1st millennium AD in central and eastern China is significant in this context. Taking into consideration the scope of archaeological research all over China, this scarcity is not due to the casual nature of such finds, but reflects the actual scale of imports from the Western countries. During the Han dynasty reign, contacts between the extremes of eastern and western Asia were usually indirect and items from the more distant countries were obviously rare in China. They must have been perceived as exotic curiosities and included in the funerary inventories of the highest aristocracy as rare and valuable goods.

Finds from Xinjiang dated to the period of Han–Jin dynasties

A few finds from the area of Xinjiang Uyghur Autonomous Region [新疆維吾爾自治區] could probably be added to the above group, although the chronology in their case is not definitely clear, since they were found in cemeteries that are dated generally to the period between the 1st and 5th century AD.

Let us first mention cups with cut decoration found on two sites in the south-eastern part of Xinjiang. Two small flat-bottomed cups with slightly opening out walls were found in the Yingpan [營盤] necropolis, Yuli [尉犁] county, one by Stein (Stein 1928, vol. II: 756, vol. III: plate CX), the other during Chinese excavations conducted in 1995 (Xinjiang Wenwu Kaogu Yanjiusuo 2002: 41; Li W. 2007: 139–140, Fig. 1) (Fig. 2). A third vessel of similar shape was found in Zagunluk [扎滾鲁克], Qiemo

Fig. 1. Glass cup from Tomb no. 1 at Huangnigang, Hepu county, Guangxi province (after Wu and Lü 2006: Colour Fig. 8)

Fig. 2. Glass cup with cut decoration from Yingpan necropolis, Yuli county (after Xinjiang 2002: Fig. 59)

[且末] county (Wang and Lu 2007: 127, Fig. 1). The tentatively late date of these vessels and their decoration, similar to Sassanid glass production, led them to be considered as Iranian imports. Recent physico-chemical analyses have demonstrated, however, that the cup from Zagunluq is made of soda–lime glass with a very small content of K_2O and MgO (less than 2%), which is a typical composition for Eastern Mediterranean glass (Cheng *et al.* 2011: 89–91). Two other finds are similar in shape and decoration, but differ in details. It seems thus that all three cups could be considered as produced in the Roman Empire, but further analyses are needed.

A small piece of glass vessel with two grooved lines under the mouth and traces of cut facets on the walls was found during excavations conducted at the Loulan [樓蘭] site in the eastern part of Xinjiang. Again, the dating of this object is broad: 1st–4th century AD (Yu 2010: 191). No results of physico-chemical analyses have been published to date, but it seems that it could be a fragment of a Roman cup or beaker with faceted decoration. A similar vessel was found at Nijmegen in Holland (Olivier 1984: 35–58), but other examples with the rim divided into two parts by a horizontal line and decoration of oval facets cut on the lower part of the vessel, dated to the 2nd–3rd century AD, have been found at other sites, such as Dura-Europos for example (Clairmont 1963: 68–71).

Recent laboratory analyses of the chemical composition of a small group of glass shards collected by early researchers, principally Aurel Stein and Sven Hedin, at diverse sites in Xinjiang, have shown that most of these glass vessels were of Central Asiatic origin, while Western Asian objects were definitely rare (Brill 2009: 109–148).

The states of the so-called Western Regions were only intermittently subjected to Chinese control and some of them enjoyed relative independence. Here crossed communication routes from all directions and it was only natural that objects from diverse regions flowed in and out of this region. Even so, glass vessels of Western provenance dated to the Han and Jin dynasties were relatively rare, suggesting that they were highly valued objects of a luxurious nature.

Six dynasties

The situation started to change in the 3rd–4th century AD. The fall of the Han dynasty at the beginning of the 3rd century AD began a long period of political destabilisation and disintegration of Chinese territory into smaller states, often governed by dynasties of non-Chinese origin. By paradox this period opened a new chapter in the development of Chinese culture, influenced by foreign ideas and cultural patterns on a large scale. One of the most important factors stimulating the process was the development of Buddhism in China and, in consequence, pilgrim movement and the mobility of monks, transmitting not only religious ideas but also knowledge about distant countries, their people, art and crafts. Moreover, foreign goods were often carried as gifts for the temples (Lewis 2009: 157–162). After the fall of the Han dynasty

the rules regulating trade with the non-Chinese became less strict and gradually more and more foreigners travelled to China and even settled in cities like Dunhuang [燉煌] in Gansu [甘肅] province and further east, up to the Central Plains. Letters written in the early years of the 4th century AD by the members of the Sogdian community of merchants settled in China, discovered by Aurel Stein in the ruins of an ancient beacon tower, 55 km west of Dunhuang [燉煌], give precious evidence of the everyday tribulations and business troubles of the foreign traders (de la Vaissière 2002: 48–65; 2004: 19–23). The development of trade and pilgrim mobility both resulted in a growing number of imported objects being accessible on the market, increasing the awareness of their existence and origin at least among the higher classes of society.

One of the most spectacular discoveries of Western glass vessels in China was made in the family tomb of Wang Li (tomb no. 70) at Xiangshan [象山], close to Nanjing [南京] city in Jiangsu [江蘇] province. The tomb, which is dated to AD 322, yielded two beautiful Roman cups with cut decoration, reflecting the high skills of the craftsmen and their unquestionable artistic value. One of these glasses, almost intact, was placed in front of the coffin of the male deceased, the other, very fragmented, in front of that of his consort (Nanjing Shi Bowuguan 1972). The preserved vessel is 10.4 cm high, has thick walls and a deep-cut decoration consisting of horizontal lines, a row of small vertical ovals in the upper part and a row of big, vertical oval facets covering the lower part of the body. It was made of transparent yellow soda–lime glass (Gan 2009: 93, Table 2.8), undoubtedly in one of the workshops located in the Roman Empire (Fig. 3).

A few other glass vessels made of soda–lime glass, probably imported from the Eastern Mediterranean, were found in Nanjing, which was the capital of the Jin dynasty [晉朝 AD 265–420] between AD 317 and 420 and then of the succeeding Southern dynasties [南朝 AD 420–589]. These include small fragments of the upper part of a translucent, colourless bowl with two horizontal lines below the rim and diagonally organized cut petals (Nanjing Daxue 1973: 36–50) and fragments of a transparent yellow vessel with traces of cut decoration excavated in the northern suburbs of Nanjing (Nanjing Shi Bowuguan 1983: 315–321). These finds come from aristocratic tombs and are proof of a high concentration of luxurious goods in one of the political centres of China in this period.

Definitely in this period glass imported from the closer area of the Sasanian Empire was more common. Vessels of this kind were found also in the area of Nanjing as well as in other areas of China. We could mention here a transparent, light green bowl with slightly narrowing neck, decoration of a row of knobs in the middle of the body and small knobs on the bottom. This vessel was found in 1965 during excavation at the Hua Fang [華芳] tomb in Beijing [北京], which is dated to the reign of the Western Jin dynasty [西晉朝 AD 265–316] (An 1986: 173–174) (Fig. 4). It was made of plant ash glass (Na_2O–CaO glass, K_2O and MgO >2%) (Gan 2009: 93, Table 2.8).

Fig. 3. Glass cup with cut decoration from the Wang Li tomb at Xiangshan, Nanjing, Jiangsu province (courtesy of The Oriental Metropolitan Museum at Nanjing). Photo by M. Żuchowska

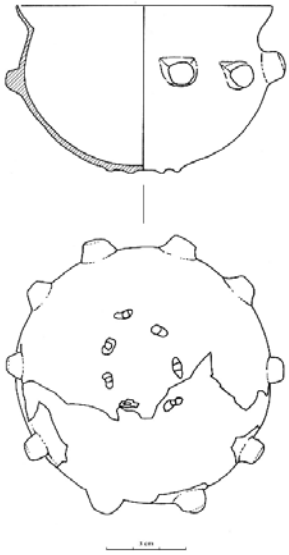

Fig. 4. Glass bowl from the tomb of Hua Fang in Beijing. (after An 1986: Fig 2). Drawing by J. Ożóg

A group of five transparent glass vessels was found in the tomb of Feng Sufu [馮素弗], younger brother of Feng Ba [馮跋], known as the emperor Wencheng [文成] of the Northern Yan dynasty [北燕朝], discovered in Beipiao [北票], Liaoning [遼寧] province, dated to AD 415. There was an intact shallow bowl with inward-folded rim and ring foot, a fragment of the foot of a cup, a bowl with convex bottom, a duck-shaped *unguentarium* and a cup with open mouth and concave bottom. The latter was made of deep green transparent glass, the others of transparent greenish glass (Li Y. 1973: 6–7). The shallow bowl was made of a plant-ash type of glass, but with a high content of K2O, over 4% suggesting its Central Asian origin (Gan 2009: 93, Table 2.8; Brill 2009: 122) (Fig. 5). The duck-shaped *unguentarium,* however, fails to have close

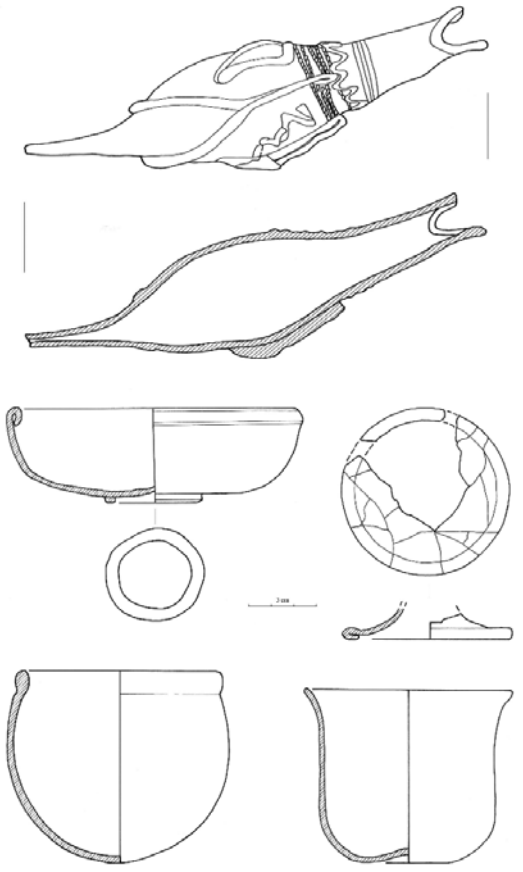

Fig. 5. Glass vessels from the Tomb of Feng Sufu at Beipiao, Liaoning province (after Li 1973: Fig. 9, 10). Drawing by J. Ożóg

parallels in glass from this area. Result of chemical composition analyses of the other vessels could answer the question whether all the vessels from this group came from one source or were they perhaps collected over a longer period of time and ended up in a single funerary deposit by chance.

Sasanian cut glass with faceted decoration and, less commonly, relief cut decoration became quite popular about the 5th century. One of the best preserved examples is a colourless bowl with cut decoration in the form of vertical petals on the body and seven large round facets on the bottom, found in tomb no. 107 in a necropolis in the southern suburbs of Datong [大同], Shanxi [山西] province, dated to the reign of the Northern Wei dynasty [北魏朝 386–535] (Shanxi Sheng 1992: 10) (Fig. 6). Another interesting example is a bowl made of green glass with cut decoration of convex circular elements, found in the tomb of Li Xian [李賢] in Guyuan [固原], Ningxia Hui Autonomous Region [寧夏回族自治區], dated to the Northern Zhou dynasty [北周朝 AD 557–581] (Ningxia 1985: 14) (Fig. 7).

Before the unification of Chinese territory by the Sui dynasty [隋朝 AD 581–618], western glass was imported in larger numbers than under the Han dynasty, but still remained a rare and luxurious type of goods. Although in the southern provinces the production of transparent glass based on silica was known, it did not spread to other regions of China and most people believed that glass was a natural raw material, similar to crystal. In his famous text *Bao Puzi* [抱樸子 *The Master who embraces simplicity*], in the chapter Lun Xian [論仙 *About Immortals*], Ge Hong [葛洪], a Daoist writer born at the end of the 3rd century AD, writes of popular beliefs concerning glass production in China during his lifetime:

外國作水精碗，實是合五種灰以作之。今交廣多有得其法而鑄作之者。今以此語俗人，俗人殊不肯信。乃云水精本自然之物，玉石之類。

In foreign countries water essence[3] *bowls are produced, which in reality are made by mixing five types of powdered components. Nowadays there are many [of those] who possess this method and produce them* [bowls] *in Jiao and Guang*[4]*. Now, if we talk about the simple people, they are not willing to believe it. They say that the water essence is natural, like jade* (Ge Hong, *Bao Puzi 2, Lun Xian.* Transl. M. Żuchowska).

The demand for glass vessels was relatively high due to their unique features and luxurious character. In the *Beishi* [北史 *History of the Northern Dynasties*] we can read about people from Dayuezhi [大月氏, probably Bactria], who came to trade in the capital city of Pingcheng [平城], modern Datong [大同] in Shanxi [山西] province:

[3] *Shuijing* [水精] means literally 'water essence'. It is sometimes mistakenly translated as 'crystal', which is also pronounced *shuijing,* but written with another character [水晶]. It seems that it could be interpreted as 'transparent glass'.

[4] *Jiao and Guang* [交廣] correspond to the ancient Jiaozhi [交趾] Prefecture covering the northern part of Vietnam and Guang [廣] Province covering the area of present-day Guangdong [廣東] and Guangxi [廣西] provinces (Vu 2007).

Fig. 6. Sasanian bowl with cut decoration found in a tomb in the southern suburbs of Datong, Shanxi province (after Shanxi Sheng 1992: Plate 1)

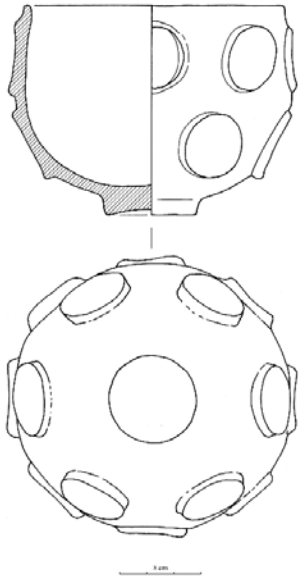

Fig. 7. Sasanian bowl with cut decoration from the Li Xian tomb at Guyuan, Ningxia province (after Ningxia 1985: Fig. 26)

太武時，其國人商販京師，自云能鑄石為五色琉璃。於是採礦山中，於京師鑄之，既成，光澤乃美於西方來者。乃詔為行殿，容百餘人，光色映徹，觀者見之，莫不驚駭，以為神明所作。自此，國中琉璃遂賤，人不復珍之。(北史 97， 列传85： 西域)

During the reign of Taiwu[5]*, people from this country* [Dayuezhi or Bactria] *arrived in the capital to peddle. They said they can cast stone to make five-colour glass. They mined* [stones] *in the mountains,* [brought] *them to the capital and cast them, when it was finished it was beautifully shining like this which comes from the West. Thus, on the emperor's order they built a pavilion that could house more than one hundred people. It was translucent and had bright colours. Among those who came to see it, everyone was astonished, they thought it was made by the demons. From that time on, glass became cheap in China and people stopped to treasure it* (*History of the Northern Dynasties* 97(85): *Western Regions.* Transl. M. Żuchowska).

This account must not be interpreted literally, but it reflects the high value of rare imported glass vessels and attests not only to foreign traders, but also apparently glassmakers travelling to China, who could supply the local market by producing glass according to their own technologies, possibly from imported raw materials.

Archaeological evidence of such production, intended for the Chinese market, but using foreign technology, comes with a small vase of an opaque deep blue that was found in tomb no.16 in the Eastern suburbs of Datong, Shanxi province (Datong 2006: 50–71). The chemical composition of this glass is typical of Central Asian production (Central Asian high Al_2O_3 type: Na_2O–CaO–SiO_2 with K_2O>4,5% and Al_2O_3>5%), but the form is analogical to ceramic vessels popular in this region and represented also among the funerary items in the same grave (Datong 2006: 50–71; An 2009: 384; Brill 2009: 122) (Figs 8, 9).

Sui and Tang dynasties

During the reign of the Sui and Tang dynasties [隋朝 AD 581–618; 唐朝 AD 618–907] the demand for glass objects of Western origin did not diminish. Typical examples of early Islamic vessels flowed to China in a wide stream and while the vessels were still precious luxury items, the consumer had changed. Before the Sui dynasty glass vessels were found in elite graves; later, singular examples were also placed in graves, but most of the finds occurred as offerings made to the Buddhist temples and preserved in their treasuries. Optimal storage conditions away from the impact of destructive environmental factors have left these glasses in a perfect state without any trace of oxidation or other kinds of damage. These vessels often constitute the best preserved examples of glass of this period. A similar pattern of glassware finds in tombs and temples can be observed in Korea (cf. Lee 2010) and Japan (cf. Taniichi 2010).

[5] Posthumous name of Tuoba Tao [拓拔燾], emperor of the Northern Wei dynasty [北魏朝, AD 386–535], reigning from AD 408 until 452.

Fig. 8. Small vase from a tomb in the eastern suburbs of Datong, Shanxi province (after Datong 2006: Fig. 26)

Fig. 9. Pottery jar from a tomb in the eastern suburbs of Datong, Shanxi province (Datong 2006: Fig. 42).

In the times of the Sui and Tang dynasties glassware reached China proper in one of two ways. Either by the land trails which were a continuation of the earlier trade routes from the west, unchanged until the rebellion of An Lushan [安祿山], and conducive to Arab expansion into Central Asia or by the maritime routes which gained importance during the turbulent middle years of the 8th century, reaching areas located in Southern China, around present-day Guangzhou [廣州]. Glass production also developed rapidly during this period, introducing soda–lime–silicate glass (also in the form of vessels imitating indigenous pottery models, Gan 2009: 92–94) next to the local types of high lead–silicate and potash–lead–silicate glass developed in the technical experiments of an earlier age (Gan 2009a: 26–30) under the influence of blown glass imported from the West.

The demand for cut Sassanian glass did not diminish during the times of the Sui dynasty. A fine example of a small bottle with relief cut decoration was found in the tomb of She Li [舍利] on the eastern outskirts of Xi'an [西安], Shaanxi [陕西] province (Zheng 1988: 62) (Fig. 10), but the local production also became popular. Locally

Fig. 10. Bottle with cut relief decoration found in the tomb of She Li on the eastern outskirts of Xi'an, Shaanxi province (after Zheng 1988: Plate 2)

produced soda–lime–silica glass vessels have been found in the tomb of Li Jingxun [李靜訓], Xi'an [西安], Shaanxi [陝西] province (Gan 2009: 92).

Glassware was discovered in large numbers in the burials of Tang aristocracy in Shaanxii [陝西] province around the capital city of Chang'an [長安] (present-day Xi'an [西安]) (Wang 2010). In 2010, glass objects were known from 18 graves, allowing Wang to distinguish three chronological phases during the Tang period based on the identified types of vessels and their frequency in the burials (cf. Wang 2010: 167–174 and Table 1). It should be noted that only two of the 18 burials belonged to the middle class and not the aristocracy (Wang 2010: 172, Table 1). 'Early Tang glass' comes from the first phase dated to the 7th century AD. Eight of the elite burials could be assigned to this phase: 1) tomb of Li Shou [李壽] at Sanyuan [三原] county; 2–3) tombs of the princesses Changle [長樂] and Xincheng [新城], attendant tombs at Zhaoling [昭陵] in Liquan [禮泉] county, Xianyang [咸陽] municipality; 4) tomb of Li Shuang [李爽] in Yangtou [羊頭] village; 5) tomb of Wen Chuo [溫綽] at Xi'an [西安]; 6) tomb of Yuan Shijiang [元師奬] at Zhengjiacun [鄭家村], Qishan [岐山], Baoji [寶雞]; 7) tomb of princess Da Chang [大長] at Fangling房陵 in Fuping [富平] county; and 8) tomb of Li Feng [李風] in Fuping [富平] county (Shaanxi Sheng Wenwu 1959: 43, Shaanxi Sheng Bowuguan 1974: 77, Fuping 1977: 321, Wang 2010: 172). Mainly personal ornaments were discovered in these graves: flower beads, strung beads, beads of a trumpet flower shape, and a flower-like fluted bowl (Wang 2010: Figs 8, 9). Similar objects have been found in 7th century tombs located in other areas of China, such as the Guyuan [固原], Ningxia Hui Autonomous Region [宁夏回族自治区]. Chemical analyses show that they were probably made locally as most of them are of lead glass (Ningxia 1996: 61, 236). Unusual thin-walled or spherical beads, approximately 2 cm to 5 cm in diameter are also known from this period from the Shaanxi region. Their function as harness ornaments has been suggested by their presence under a wooden statue of a horse from the tomb of Li Feng (Fuping 1977: 321). Three egg-shaped glass objects were found in the grave of Li Jingxun [李靜訓] from the Sui dynasty, interpreted as 'a kind of toy… rather than the ball-like ornament' (Wang 2010: 173). The glass vessels from the first phase included mainly bottles (Li Shou), bowls (Princess Xincheng, Li Shuang and Wen Chuo) and a goblet (Princess Changle) (Wang 2010: 172, Table 1).

The second phase, referred to as 'Prosperous Tang glass', dated from the late 7th to mid 8th century AD, encompasses eight burials with glass finds. Two of these are middle class interments. Glass as personal adornments was just as usual as in the earlier stage: strung beads and beads for inlays, as well as hairpins, round, oblate, and tubular in form (Wang 2010: Figs 10, 11 and 13). A few items are shaped resembling a flower knot (Wang 2010: 173, Fig. 12). A necklace of glass beads in the form of flowers knots is preserved in the Shōsō-in treasury in Japan (Wang 2010: Fig. 14).

The third phase, 'Middle to Late Tang glass', is dated from the mid 8th to the early 10th century AD and coincided with turbulent times for the Tang empire when the old

trade routes in Central Asia were lost. Two burials with glass are known, one being an emperor's mausoleum yielding two glass disks with images of the dragon and the phoenix, typical Chinese ornamental patterns reserved for the emperor. The other burials were a small or middle-sized tombs and contained two green and yellow discs of glass (Wang 2010: 174, Table 1).

Only a small group of objects from the tombs in the Chang'an area have been analysed, but most of them appear to represent local production. Items of personal adornment have parallels among the Guyuan finds made of lead silicate glass (Ningxia 1996: 236); also a bottle from the Li Shou [李壽] tomb was made of high lead silicate glass, while the bottle from the Li Jingxun [李靜訓] tomb is a typical example of locally produced soda–lime silicate glass (An 1984: 18, Table 2; Gan 2009: 94). The glass that came to southern China under the Sui and Tang dynasties and the successive age of the Five Dynasties and Ten Kingdoms [五代十國, AD 907–960] reached the region through the commercial port of Guangzhou which developed during the Tang Dynasty and played a key role in glass distribution. From the 7th to the 9th century it was the main port of the Tang empire and of the Song dynasty [宋朝, AD 960–1279] from the 10th to the 13th century. Glass was imported primarily from the Arab world (An 2009a and 2010). Fragments of vessels made of soda–lime glass of a chemical composition characteristic of the Arab zone were discovered in archaeological levels at the Nanyue [南越] King's palace (An 2009a: 392, Photo 20.4) and in the Kang Mausoleum [康陵], the tomb of Liu Yan [劉岩], usurpatory emperor of Guangzhou [廣州] (d. AD 942) (Guangzhou 2006: 22–23; An 2009a: 388–391, Photo 20.1., 20.2) (Fig. 11). A good example of early Islamic glass from the palace is a cylindrical bowl with vertical walls and a kick-base with a pontil mark (An 2009a: Photo 20.6 and 2010: 178, Fig. 1, 2); from the Kang Mausoleum it is a greenish transparent glass bottle with mould-blown decoration, short neck and reverted rim (An 2009a: Photo 20.3 and 2010: 181, Fig. 3).

The similar popularity of imported and locally-produced glass is well attested in the tomb of Litai [李泰] in Yun [鄖] county, Hubei [湖北] province, dated to the Tang dynasty, where Islamic glass vessels of both kinds have been found (An 1984: Table 1,2; Gan 2009, Table 2.8).

Offerings made to the Buddhist temples represent today a very important source of information on the types of imported glass products and their value in Chinese society. The most spectacular example is the discovery made in the crypt of the Famen [法門] temple in Fufeng [扶風] county, Shaanxi[陝西] province, sealed in AD 874. Eight emperors of the Tang Dynasty sending gifts every year had gradually filled the temple treasury (Figs 12, 13: A–B). After more than 1100 years, the crypt was unveiled and its interior revealed an extraordinary collection of articles of gold, silver, and other precious materials, including 20 items of glass (Famen 1988: 105; cf. Jiang 2010). The glass vessels can be divided into six categories: 1) bottle; 2) cups; 3) blue plates with scratch-engraved designs; 4) stained plate; 5) undecorated glassware; 6) glassware of

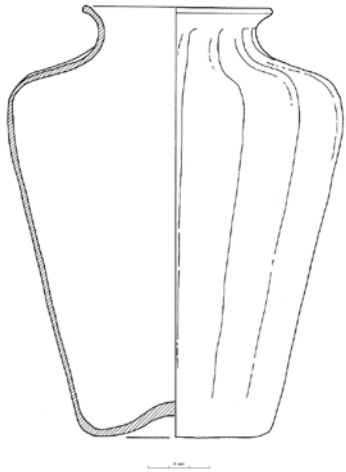

Fig. 11. Bottle from the Kang Mausoleum, Guangzhou (after Guangzhou 2006: Fig. 37). Drawing by J. Ożóg

Fig. 12. Bottle from the Famen temple, Fufeng county, Shaanxi province. Photo by B.Sz. Szmoniewski

Fig. 13. A, B – plates from the Famen temple, Fufeng county, Shaanxi province. Photo by R. Żukowski and B.Sz. Szmoniewski

domestic origin. Of importance is a pear-shaped glass bottle with circular foot and decorative appliqué on the surface (Jiang 2010: 184) (Fig. 12), which appears to be of Sasanian or early Islamic origin (Brill and Fenn 1992: 255). Another glass object is a cup formed by blowing, the body decorated with a zigzag pattern and circular ornament (Jiang 2010: 184). The set of six blue glass plates with elaborate scratch-engraved designs, decorated with branches and plant leaves, are also of high importance (Jiang 2010: 185–186) (Figs 13: A, B). The similarity to Islamic dishes is clearly evident, e.g., a plate from Nishapur in Iran (Brill and Fenn 1992: 255). According to Jiang Jie, most of the Famen Temple glasses were of Islamic origin, very close to glass vessels produced in Nishapur in Iran (Jiang 2010: 188). Two objects, a teacup and a teacup holder, may be of local make in view of an absence of parallels in the Western glass (Jiang 2010: 188). This diversity of origin of the glass objects from the Famen Temple, pointed out already by Brill and Fenn (1992: 256), reflects well the changing tastes in China for imported vessels and the main directions of glass imports over a longer period of time.

GLASS FINDS FROM KOREA

The presence of glass products is not limited to China proper. Almost 40 pieces, a large number by any standards, have been discovered in Korea (cf. Lankton *et al.* 2010: 222) (Fig. 14). Glass vessels were discovered mainly in the tombs of the Three Kingdoms period [삼국시대/三國時代, 57 BC–AD 668], especially in the ancient Silla [신라/新羅] Kingdom burials (Lee 2010). The largest number (about 25) came from the royal burials of Gyeongju [경주시/慶州市]; they represent different shapes, colours and ornament patterns (cf. Lee 2010: Figs 1a, 1b, 2a, 2b, 3, 4, 5, 6, 7, 8; Lankton *et al.* 2010: 222). Considering the similarity of the glass vessels from Korea to a familiar type of eastern Rome glass, some researchers have specified this assemblage as 'romanizing glass from Korea' (cf. Lee 2010: 214). This approach reflected the assumption that glass production in the Korean peninsula during the Three Kingdom age showed a strong influence of Western models, especially Roman glass vessels and Roman technology (cf. Lee 2010; Lankton *et al.* 2010: 222). However, new results of chemical composition analyses have demonstrated that at least some of the glass vessels may have been made in Central Asian workshops (Lee 2010: 216). Some glasses from the south mound of Hwangnamdaechong [황남대총 북분 금관/皇南大塚北墳金冠], the great double-mounded Silla Kingdom tomb in central Gyeongju, dated from the late 4th to mid-5th century AD, were made of plant-ash soda–lime glass, with magnesium oxide (MgO) at more than 1.5%, CaO up from 5–7% and Al_2O_3 between 1 and 3% (Lankton *et al.* 2010: 222). This chemical composition is not typical of either Roman or Eastern Mediterranean glass (Nenne and Gratuze 2009; Lankton *et al.* 2010: 222). The Korean glass composition most resembled the chemical composition of glass from northern

Fig. 14. Glass vessels from Korea
(after http://www.mei.edu/content/1500-years-contact-between-korea-and-middle-east)

Afghanistan, the ancient territory of Bactria and Tokharistan (Lankton *et al.* 2010: 222). New studies on the glass objects from Korea have suggested three or more types of glass being used in their production (Lankton *et al.* 2010).

GLASS FINDS FROM JAPAN

The small glass collection of western glass, either Sasanian or post-Sasanian in origin, is known from Japan (Fig. 15). As in China and Korea, glass vessels were found in burials and in Buddhist temples. Analyzing the chemical composition of the glass of the finds recently, Takashi Taniichi (2010) discovered the important role played by China in their delivery to the islands. Of greatest interest are three facet-cut bowls and fragments of relief-cut bowls. An unusual facet-cut bowl was found in the Niizawa-Senzuka [新沢千塚] Tomb no. 126 in Nara [奈良] prefecture, dated to the Kofun [古墳] period, that is, 5th century AD (Tōyō 1980: 144). The bowl is hemispherical with very thin walls and a delicate facet-cut decoration on the surface of the body and on the bottom. The glass is almost transparent with a pale greenish yellow tone. Chemical analysis identified it as plant ash glass (4.81% MgO and 3.10% K_2O) typical of Sasanian products (Taniichi 2010: 240). Similar glass vessels have been discovered on the northern coast of the Black Sea, e.g., Olbia, Tanais, Pantikapaion (Sorokina 1965: 204–215).

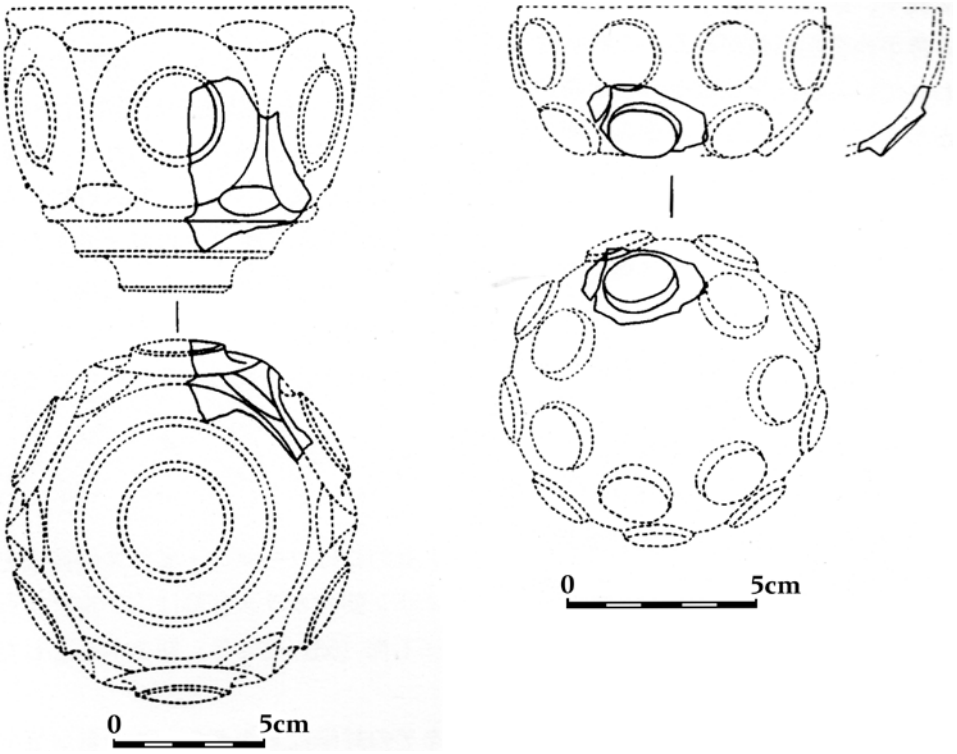

Fig. 15. Fragments of glass bowls from the Kamigamo shrine in Kyoto (left) and the Munakata shrine, Okinoshima (right) (after Okayama 1999: 98)

Two other facet-cut bowls, probably from the same workshop, are known from Shōsō-in [正倉院], from the treasury of Tōdai-ji [東大寺], Nara [奈良] prefecture (Hayashi 1975: 89, Fig. 91; Tōyō 1980: 144; Taniichi 2010: 240–242, Fig. 2) and from the grave mound of Emperor Ankan [安閑] in Habikino [(羽曳野) city, Osaka [大阪] prefecture (Hayashi 1975: 89, Fig. 91; Tōyō 1980: 135; Taniichi 2010: 242, Fig. 3). They are of a different type than the one described above, featuring thick walls and hexagonal facets covering the whole surface. The dimensions are almost identical (height 8.5 cm and 8.6 cm respectively, rim diameter 12 cm and 11.9 cm), as is the number of facets and the colour (transparent, slightly brownish). Chemical analyses of the bowls revealed that they belonged to the NaO–CaO–SiO system with 4.7% MgO and 2.3% K_2O, which is a typical composition of Sasanian plant ash glass (Taniichi 2010: 240–241). According to Takashi Taniichi, these bowls reached Japan via China as a set and then were separated. Interestingly enough, one of the bowls was used in AD 752 during the

Eye-Opening ceremony of the great image of Buddha in Nara and then was deposited in 756 in the Shoso-in treasury (cf. Taniichi 2010: 242).

Facet-cut bowls of Sasanian origin were discovered distributed over large areas of Eurasia. A large number comes from the territory of the Sasanian Empire, today in Iran and Iraq (Tōyō 1980: 135; cf. Whitehouse 2005: 43; Taniichi 2010: 241). Items exported outside the Sasanian domain have been found in Caucasus (Armenia, Georgia, Azerbajian) (cf. Whitehouse 2005: 43), the steppes of eastern European (Ukraine and Russia) (cf. Whitehouse 2005: 43; Komar 2008: 296, Fig. 4: 14) and China.

Two fragments of relief cut bowl came from site no. 8 of the Munakata [宗像] shrine on Okinoshima [沖ノ島], Fukuoka [福岡] Prefecture (Laing 1991: 118, Fig. 29; Taniichi 2010: 242–243, Fig. 4) (Fig.15). The fragments are from the lower part of a bowl made of pale green transparent glass. Cups of this type are typical examples of Sasanian glasses (Whitehouse 2005: 45–46). Parallel vessels were discovered in Iran (Whitehouse 2005: 45) as well as China (see above). One fragment of a circular facet-cut bowl was found in a backyard tomb at the Kamigamo [上賀茂] shrine, Kyoto [京都] (Laing 1991: 118, Fig. 28; Taniichi 2010: 244; Fig. 5). Bowls of this type were excavated in Kish in Iraq and in Hunzak in Dagestan (Whitehouse 2005: 48; Taniichi 2010: 244).

According to David Whitehouse, facet-cut cups can be dated from the 3rd to the 7th century AD and relief cut cups from the 6th to the 7th century AD (Whitehouse 2005: 42–48).

Of special interest is another glass object from the Shōsō-in collection, a cobalt-blue cup with 22 small rings of similar glass applied on its exterior walls, fixed in a silver stand (Harada *et al*. 1965: iii). The original stand was decorated with a dragon ornament and was probably made in Korea (Nishikawa Akihiko, Masakazu Naruse and Kiyohide Saito, personal communication), but was replaced with the new one during the early Meiji [明治] period. The similarity of its decoration to the green vessel found inside the *sarira* case in the pagoda of the Songrim-sa [松林寺] temple in Chilgok county [칠곡군/漆谷郡], North Gyeongsang province [경상북도/慶尙北道] in Korea, dated to the 7th–8th century AD (National Kyongyu Museum 1984: 39) and the presumed origin of the silver stand suggest that this object could have been imported to Japan via Korea and analogically might be of Central Asian origin.

A cobalt-blue vessel was found also in Tomb no. 126 at Niizawa Senzuka [川西町新沢千塚] in Nara [奈良] prefecture, together with the cut glass described above. It was an intact small, shallow dish made of blue glass, possibly of Mediterranean origin (Yamasaki 1965: xvi)

Another interesting object is an oblate spheroid bottle from Toshodaiji [唐招提寺] Temple in Nara [奈良] (cf. Taniichi 2010: 244–245, Fig. 6). This small bottle made of pale greenish yellow transparent glass now is used as a reliquary. Parallel finds from Egypt and Syria suggest that it may have been produced in the first half of the 8th

century AD. Chemical analysis results revealed post-Sasanian plant ash glass (5.9% MgO and 2.2% K_2O) (cf. Taniichi 2010: 245). The bottle was used for a long time, having been sealed with a metallic lid by the Japanese Emperor Go-Komatsu [後小松] in AD 1392 (Taniichi 2010: 245).

CONCLUSIONS

This short review shows that during the 1st millennium AD imported glass vessels in the East Asian context were considered as highly luxurious objects, valued for their beauty as well as mysterious character, and placed in the burials of members of the ruling families and high aristocracy. The scarcity of finds and their individual character (one vessel per type) suggest that they were curiosities rather than goods in regular trade exchange. Based on this material one can hypothesize about the directions of exchange that led to Western glass vessels being spread through China, Korea and Japan, leading eventually to their use as models for the local glass industry. There is no doubt that China was the main consumer of imported glass and at the same time played an important role in distributing objects of this kind to the more distant regions of Korea and Japan.

During the long history of Chinese civilisation different aesthetic preferences may be observed, dependent mostly on personal tastes and current fashion trends. In the first half of the 1st millennium AD, the Chinese believed that Western glass was made of a natural material (precious stone) and was very valuable. Uncommon and unfamiliar vessel shapes would have been an added value, emphasizing exotic foreign origin and, in consequence, the precious nature of these items.

About the middle of the 1st millennium AD, local glass technologies developed and diverse types of glassware started to be produced in China. Locally produced glass vessels appeared in elite graves during the Sui dynasty. Interestingly, these objects did not imitate imported glassware shapes, but followed local ceramic traditions, using popular and well recognized forms. This could reflect a switch from visually attractive objects of prestige to goods of an utilitarian nature.

In cosmopolitan Tang times (618–907), especially at the zenith of Tang power in the political and cultural centre of China, a domination of glass products in the form of personal adornments, particularly head ornaments, can be observed. These ornaments were probably produced locally and reflected local tastes. The absence of glass vessels from prosperous Tang graves and the occurrence of glass objects in middle class burials might indicate that the market was overflowing. Having become relatively easily accessible to the middle classes, the glass not surprisingly could have lost its specific 'luxurious and mysterious charm'. It is possible that glassware was replaced in part with gold and silver wares. However, the imported glass vessels never lost their

attractiveness in the more remote provincial centres, which probably did not follow capital trends and where local production was not developed to a similar degree.

Starting from the beginning of the second half of the 1st millennium AD a new trend may be observed with glass objects of high quality, mostly imported, being offered to the Buddhist temples.

In Korea, glass vessels are dated from the 4th to the 9th century AD. A large number of the imports is dated between the 4th and 5th centuries AD. Glass vessels were deposited mostly as grave goods in royal tombs. An earlier interpretation of some vessels as being of Roman origin has been refuted by the results of chemical compositional analysis which pointed to a Central Asian origin (Bactria/Tokharistan). However, Bactrian and Tokharistan craft work, not only in glass but also in gold and silver, was under a strong influence of the Greco-Roman cultural tradition.

In Japan, the end point of the Silk Road in the East, the few glass vessels discovered came through China. Most are typical examples of the Sasanian and post-Sasanian workshops and, analogically to the other East Asian regions, they were deposited in the highest elite burials and temple treasuries. It cannot be excluded, however, that some objects were imported via the Korean peninsula from Central Asia.

Most of the vessels were imported between the 5th and 7th century AD. The only late example is the bottle from the Toshodaiji temple. This item is also interesting for its long usage after it reached Japan, from the 8th to the 14th century AD. This confirms its special value. Having only a small group of imported glass vessels found in archaeological contexts in Japan, it is difficult to understand why Islamic glass lost popularity on the islands, while still being imported to China and offered to the Buddhist temples on the continent.

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On the road from the Early to High Middle Ages: Glass of the 9th–13th centuries in Bohemia

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The paper discusses the main changes in the glass and glass artefacts in Bohemia in the Early and at the beginning of the High Middle Ages (AD 850–1300) from an archaeological and archaeometric point of view. The results of chemical analyses (SEM-EDS) presented in the VITREA database identify the different chemical types of glass used for personal glass ornaments (beads and rings), glass windowpanes, vessels and other products. A major complex change, both in the type of artefacts and sites, and in the chemical composition of glass, occurred in Bohemia shortly after 1000. Changes in the following period took place gradually, culminating in the second half of the 13th century when glass-making started in local glasshouses.

KEY-WORDS: Bohemia, Middle Ages, archaeometry, chemical type of glass, glass-working, glass-making, glass ornaments, vessel, window panes

Different approaches can be applied to research on glass objects and evidence of glass production from prehistoric to modern times: typological, chronological, culture-historical, ethnological, and, last but not least, chemical. The results of archaeometric investigations, presented in the VITREA database since 2010, are coupled with archaeological observations to provide the essential body of evidence for this study focusing on changes in glass production in Bohemia during the period between 850 and 1300[1].

TYPES OF GLASS ARTEFACTS

The collection of analysed glass artefacts from the period between 850 and 1300 comprises all the main categories of objects made during this time: beads, rings, vessels, windowpanes and other small objects (Černá *et al.* 2015).

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[1] Regarding periodization of the Middle Ages in Bohemia, the period 850–1200 is known as the Early Middle Ages, while the period 1200–1300 is part of the High Middle Ages.

Beads occurred in Bohemia between 850–1000 in a variety of types, classified by Z. Krumphanzlová in the 1960s (Krumphanzlová 1965). Necklaces consisted of rounded, annular and cylindrical beads, olive beads, G-beads[2] and regular or irregular miniature beads. Segmented and segmented foiled[3] beads were also represented in high numbers. In contrast, prismatic beads were relatively rare. Throughout the 9th century monochrome beads prevailed over polychrome ones. Beads decorated with trails (in the shape of waves, crossing lines and bands), dots, eyes or *millefiori* eyes and *millefiori* beads occurred in limited quantities.

However, the information of beads for the 11th–13th centuries is insufficient for a full typological classification due to the low number. The range of beads is significantly narrower. Several types were known from the earlier period, i.e., segmented, regular rounded and cylindrical beads, but the types that were the most characteristic of the period are irregular cylindrical, annular and conical wound beads. There were also new variants of earlier types, such as red rounded and prismatic beads (Žalany) or beads with raised dots (Prague, Loretánské Square).

Rings/finger rings were an integral part of early medieval production and, from the 10th century onwards, were distributed over a large territory in central and eastern Europe. They appeared in Bohemia in the 11th century and continued to be present until the end of the 13th century, in exceptional cases through the beginning of the 14th century. Czech scholars have studied these artefacts from the 1960s (Nechvátal and Radoměrský 1963; Hejdová and Nechvátal 1967). As of 2000, 14 sites with finds of rings/finger rings were registered and published (Černá 2000), but at least 40 sites are currently known assuming that Prague is a single site (Fig. 1). One of the most important sites beside Prague is the town of Žatec (Černá 2007) with about 40 completely or partly preserved rings. From a typological point of view, the types most frequently represented in Bohemia are simple monochrome rings, rings with polychrome glass trails and shield rings with a plate fused onto the rim (types A, B and C according to Olczak 2000). Simple monochrome rings clearly dominate the other types in the archaeological record. This group also includes, in our opinion, a specific shape called *Ringperlen* by some scholars, which occurred at the end of the 12th and especially in the 13th century. As a rule, these rings are smaller and more corroded, making them difficult to analyze. It was usually impossible to determine the chemical type of glass used in their manufacture. The corrosion has made them an opaque black, pink or ochre color. In sporadic cases, the original greenish translucent color of the glass could be established.

Vessel glass was also present. The earliest vessels, dated to the second half of the 9th century, were found in the so-called princely grave at Kolín. One of the two vessels

[2] For olive and G-beads see Košta and Tomková 2011: 199–214; Košta *et al.* 2011: 586–607; Košta and Tomková 2012: 199–214.

[3] For segmented foiled beads and differences in making of segmented beads see Greif and Nalbani: 2015, 355–375; Staššíková-Štukovská and Plško 2015: 389–399.

discovered was a unique flat bowl, the other a beaker with trailed decoration. Both are occasionally encountered on other sites in Europe, e.g., in neighbouring Moravia, Slovakia, the Netherlands, Sweden, etc. (Košta *et al.* 2011; Košta and Lutovský 2014: 120–121).

Other vessels date to the 11th–12th centuries. Drinking glass from this period is attested by rare and atypical small fragments from Prague-Prague Castle, Prague-Old Town, Stará Boleslav and Žatec, that it is almost impossible to determine the original form. Only in the cases of Prague-Konvikt and Stará Boleslav the fragments evidently belonged to ribbed beakers (Černá 2000).

In the 13th century, especially in the second half of the century, there was a considerable increase in the number of finds. Vessels often were preserved fragmentarily, complete shapes being very rare. Compared to the earlier phase, the range of vessel shapes used in Bohemia in this period can be reconstructed more easily and precisely. It is surprisingly rich and includes four basic forms of vessel: beakers, bottles, jugs and goblets. The beakers, in particular, appear in a number of variants. There are: prunted beakers, ribbed beakers, beakers with optic-blown decoration, gilded and enameled beakers, etc. Bottles, although less common, took on several forms, such as bottles

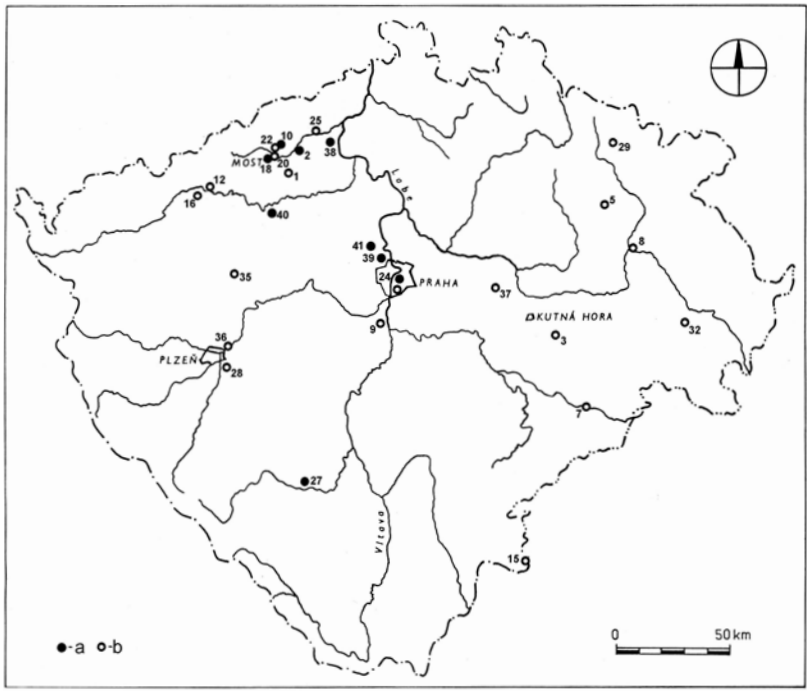


Fig. 1. Bohemia. Glass rings from the 11th to the end of the 13th centuries.
a – 11th–12th centuries; b – 13th century (after Černá *et al.* 2015)

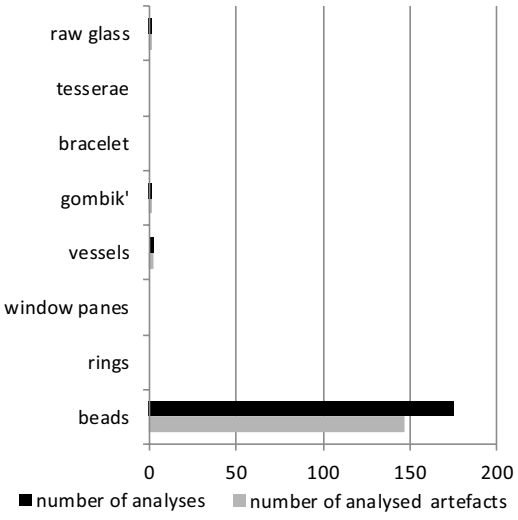
with a ribbed body and bottles with a tubular ring inside. All vessels from the time between the 11th and mid-13th centuries were imported to Bohemia from regions in the Near East, south, southwest or northwest of Europe. Local products appeared next to imports only among the later finds dating from the second half of the 13th century.

Window glass occurred infrequently from the 11th–12th century onwards (Prague, Stará Boleslav) and the 13th century only yielded a slightly higher number of finds (Černá 2004). From a technological-typological point of view panes manufactured by casting can be differentiated from those manufactured by cutting from larger panes. Earlier finds are monochrome, but there is a fragment of a painted window pane from Prague – Richter's house, dating from the mid-13th century.

Other glass objects were very rare in Bohemia during the Early Middle Ages. Looking at the 9th–10th centuries, one observes buttons made of soda-lime glass and glass inlays in metal decorations, metal globular buttons and so-called *kaptorgas*. Objects of this kind are not present among finds from the 11th–13th centuries, but tesserae, raw glass, fragments of an arm ring[4] (all from Žatec) and smoothers (Tisová, Prague) have been documented sporadically (Černá *et al.* 2015).

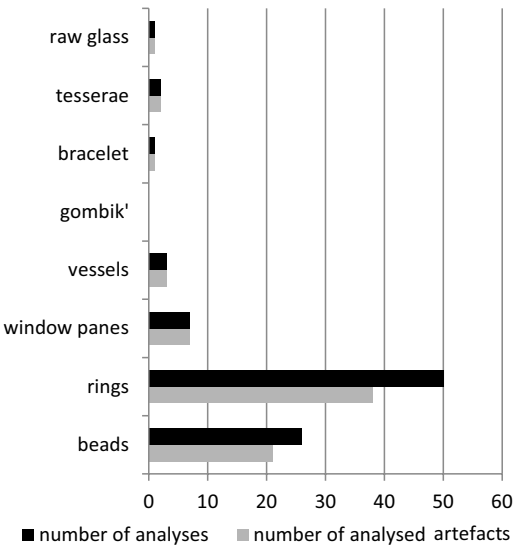
The changes in the range of glass artefacts which took place during the period in question (AD 850–1300) are also reflected in the samples selected for EPMA-SEM--EDS analyses (charts in Fig. 2). Beads predominated in the second half of the 9th and in the 10th century while vessels and other artefacts were rather rare (Fig. 2a). During the 11th–12th centuries, the number of beads dropped (due to their absence in cemeteries) and rings came to the fore (Fig 2b). Arm rings, tesserae and amorphous lumps of

[4] Two more fragments of arm rings are known from Prague-Na Poříčí (Bureš et al. 2000: 23, obr. 3).



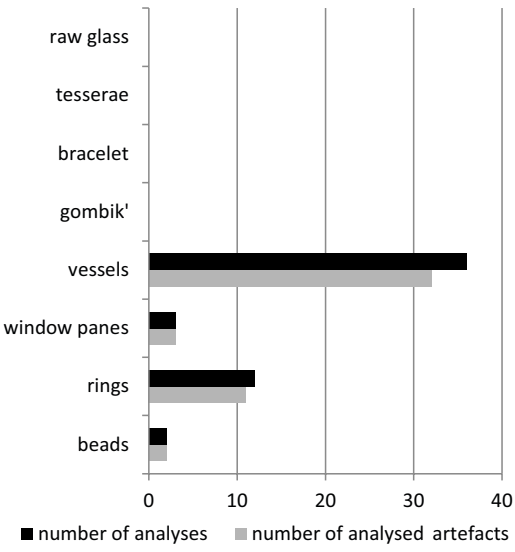
a)

object	number of analysed artefacts	number of analyses
beads	147	175
rings		
window panes		
vessels	2	2
gombik'	1	1
bracelet		
tesserae		
raw glass	1	1
TOTAL	**151**	**179**



b)

object	number of analysed artefacts	number of analyses
beads	21	26
rings	38	50
window panes	7	7
vessels	3	3
gombik'		
bracelet	1	1
tesserae	2	2
raw glass	1	1
TOTAL	**73**	**90**



c)

object	number of analysed artefacts	number of analyses
beads	2	2
rings	11	12
window panes	3	3
vessels	32	36
gombik'		
bracelet		
tesserae		
raw glass		
TOTAL	**48**	**53**

Fig. 2. The changing source base from the mid-9th to the 13th centuries: glass artifacts shown by types in the context of quantity of finds and number of analyses: a – mid-9th to 10th century; b – 11th–12th centuries; c – 13th century (after Černá *et al.* 2015)

raw glass were extremely rare. Window glass appeared in addition to vessel glass, which occurred on a more or less similar level as in the previous period. During the 13th century, the range of glass objects became significantly narrower and glass vessels took a primary role (Fig. 2c).

These changes are correlated to a large extent with the changes in site types/find contexts from which the glass originated. For the 9th–10th centuries, the study of glass is almost exclusively based on finds from cemeteries and only to a limited extent from settlement layers inside strongholds. During the 11th–12th centuries, the situation is almost exactly the opposite. By the 13th century, glass objects had completely disappeared from cemeteries and occurred instead in proto-urban settlements, towns, manor houses, castles, monasteries and glasshouses.

PROVENANCE OF GLASS, GLASS-WORKING AND GLASS-MAKING

Glass vessels and most of the glass beads were imported into Bohemia in the 9th–10th centuries. Olive beads and G-beads (Fig. 3), according to J. Košta and K. Tomková, prove that glass jewellery was manufactured in central Europe from imported raw materials and show that some of the beads may also have been produced directly in Bohemian territory (Košta and Tomková 2011: 335–337; Košta *et al.* 2011: 604).

A similar trend is to be observed throughout the 11th and 12th centuries, glass-working is presumed in the case of some rings/finger rings. There is no archaeological evidence for it from Bohemia, but from neighbouring Moravia the production of rings is documented from at least one site, the lowland hillfort of Vysoká Zahrada near Dolní Věstonice, and there is also some evidence for the existence of a similar workshop in Brno (Himmelová and Měřínský 1987: 129–133; Sedláčková and Zapletalová 2012: 538).

The 13th-century Bohemian small rings may also be imports, possibly from glasshouses located west of Bohemia. If glass artefacts can be dated from the second half of the 13th century, their local provenance is possible as well. It is well known that there were glasshouses in Bohemia at that time where glass was melted from primary raw materials and then processed (Fig. 4). Further, it is precisely from that time onwards that the general trend in the occurrence of glass in settlements begins to change. The total quantity increases and the share of local products seem to grow at the expense of imports, although it is sometimes quite difficult to determine the origin of individual artefacts, i.e., vessels. The determination of their provenance is further complicated by the absence of evidence of finished goods or semi-products from the earliest Bohemian glassworks (with the exception of two sites)[5] that could enable a reconstruction

[5] Several small atypical fragments come from a glasshouse in Svor, whereas excavations at the glasshouse Dolní Podluží I yielded a small fragment of a clay mould with a partly preserved geometric motif (Černá *et al.* 2015).

Fig. 3. Glass-working in central Europe. Olive (1) and G-beads (2) from Bohemia

of their product range. Apart from artefacts made of other materials (pottery or metals), only large amounts of production waste characteristic of the melting phase of glass production are known from these types of sites.

ARCHAEOMETRIC INVESTIGATION

Methods and research limitations

The following conclusions are based on the results of chemical analyses carried out with the EPMA – SEM-EDS method[6] which are stored in the VITREA database (Tab. 1)[7]. As of 2013, it contained data on more than 270 objects from Bohemia dating

[6] Artefacts analyzed before 2000 were measured on a JEOL JSM 25-IIIS scanning electron microscope equipped with a NORAN EDS analyzer. From 2002 to June 2008, a Hitachi 4700 microscope equipped with a Thermo NORAN D 6823 EDS analyzer was used. Since 2008 measurements have been carried out on a Hitachi S-4700 electron microscope equipped with an SDD photon detector.

[7] The database is online on the website of the Institute of Archaeology of the Czech Academy of Sciences in Prague (http://www.arup.cas.cz/VITREA/index.htm).

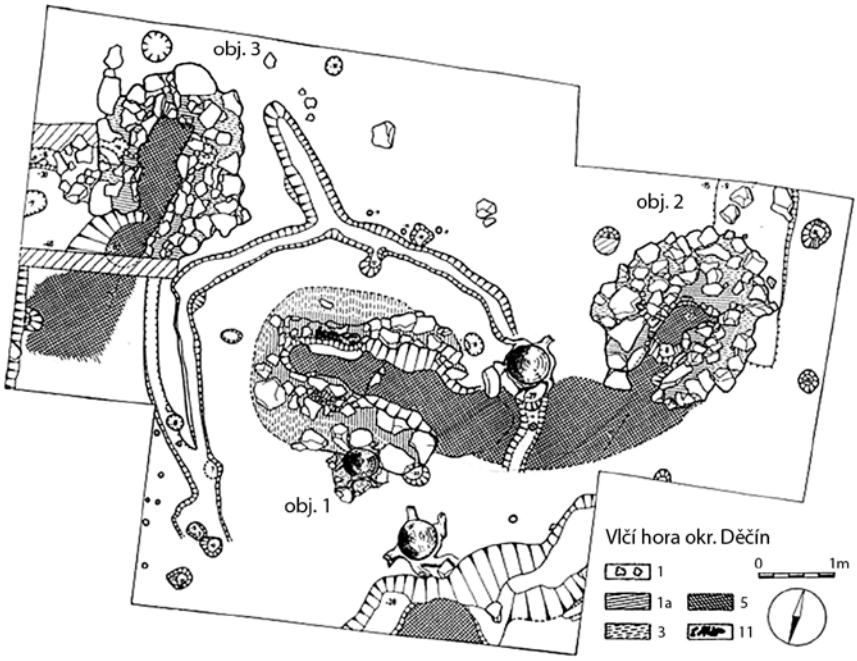


Fig. 4. Vlčí Hora, Děčín district. Medieval glasshouse. Site plan showing remains of three furnaces. 1– burnt daub, 1a – reddish bedrock, 3 – charcoal, 5 – layer of black opaque glass, 11 – clayey-stony sides. Drawing by H. Jonášová

from the period 850–1200. The results of earlier analyses, both chemical and semi-quantitative spectral, were also considered[8]. Two factors at the very least were found to encumber the investigation of glasses dating from the 11th–13th centuries as compared to glasses from 850–1000. First is the insufficient number of well-published finds and second, the often unclear chronology of accompanying pottery on which the chronological classification of glasses is based to a large extent. Since the dating of individual pieces could not be revised for obvious reasons, the previously published chronological classifications were generally respected. Another complication is the low chemical resistance of wood-ash glass and certain lead glasses, which corrode easily and heavily, limiting therefore the analytical potential of these artefacts. This situation pertains especially to finds dating from the 13th century, because the amount of less resistant

[8] In the Czech Republic, both prehistoric and high medieval glasses have been studied with the help of analytical methods from the 1950s onwards. Classic chemical or semi-quantitative spectral methods and, since the early 1980s, also NAA (neutron activation analysis) have been used. Microanalysis of glasses, especially early medieval ones, has been used from the late 1990s onwards. The development of archaeometric studies has been conditioned by projects supported by Czech grant agencies.

wood-ash glass increases during that period. Despite these limitations, archaeometric investigation has provided a number of findings, concerning not only the chemical composition of glass, but also the links between chemical types and various kinds of artefacts.

Chemical composition of glass artefacts

Six different chemical types of glass, designated A to F, have been identified for the territory of Bohemia (Černá *et al.* 2001; Černá *et al.* 2015). For the purposes of this paper, these chemical types of glass have been treated as wholes and the inner variability within the main groups has been ignored. First, let us consider which chemical types of glass were used for the production of specific studied glass objects.

Beads (Fig. 5). In the 9th–10th centuries, the typological variability of beads corresponds to the variability of chemical types of glass. Alongside the prevailing soda-lime glass beads (type A1, A2), beads made of high-lead (B), mixed-alkali (E), and wood-ash (F) glass also occurred. In the 11th–13th centuries, even though some of the analyzed

Fig. 5. Glass beads from the mid-9th to 10th century representing different chemical groups: A1 – natron glass, A2 – plant ash glass, B – lead glass, D – soda-lead glass, E – mixed-alkali glass, F – wood-ash glass (after Černá *et al.* 2015)

beads from Prague (Prague Castle – Loretánské Square), Malé Březno, Žalany, Žatec were made of soda-lime natron or plant-ash glass, or possibly mixed-alkali glass (Tab. 1: samples 98, 186), most of them were made of high-lead or lead-ash glass (e.g. Tab. 1: samples 213–215). In contrast to the previous period, no beads made of wood-ash glass have been identified so far.

Rings (Fig. 6). Most of the analyzed rings were made of high-lead, high-lead or lead-ash glasses (B and C) and only exceptionally of wood-ash glass (F).

Fig. 6. Glass rings and other small artefacts from the 11th–13th centuries representing different chemical groups: A1 – natron glass, B – lead glass, C – lead-ash glass, F – wood-ash glass

Vessel glass (Fig. 7). Vessels from the Kolín grave dating from the second half of the 9th century were made of soda-lime natron glass (A1). However, in comparison with other glasses in this group, they contain a lower amount of Na_2O and a slightly increased proportion of K_2O. Such a composition is not too extraordinary, as it was also identified in several analogous beakers from Great Moravian find contexts, earlier Frankish vessels of the Merovingian period, as well as Anglo-Saxon vessels from the mid-6th to 7th–8th centuries.

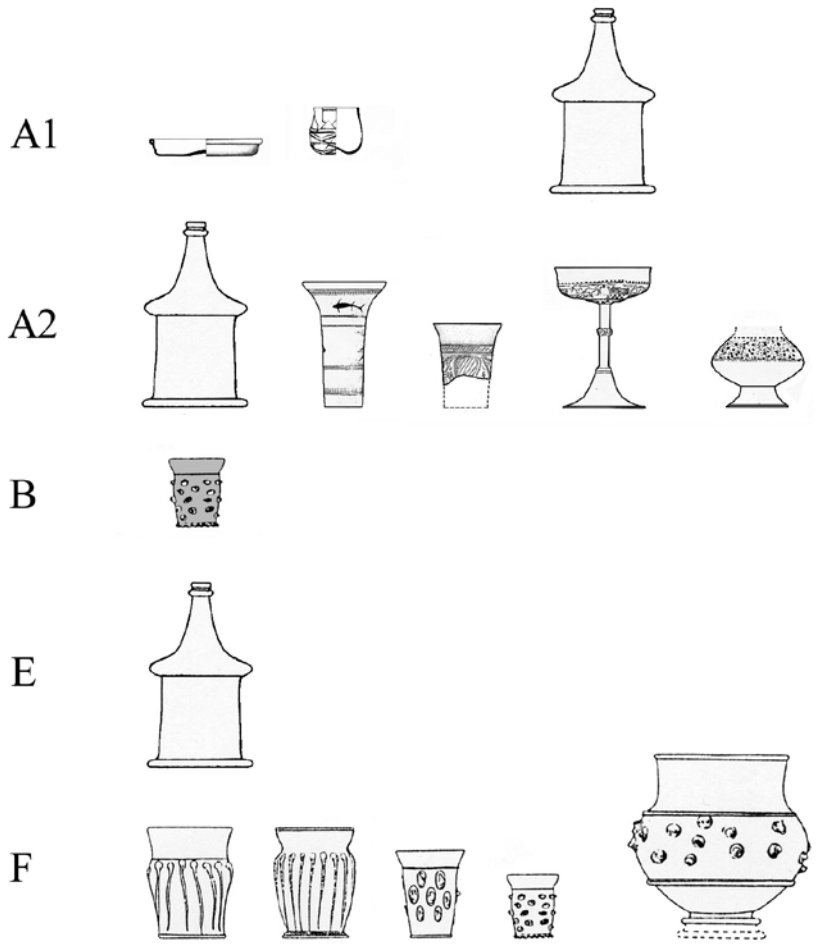


Fig. 7. Types of vessels from the 9th–13th centuries representing different chemical groups: A1 – natron glass, A2 – plant ash glass, B – lead glass, E – mixed-alkali glass, F – wood-ash glass. Drawing by H. Jonášová, compiled by Š. Martinková

Table 1. Analyses of selected artefacts from 10th–13th century Bohemia showing the principal chemical types of glass

Chemical type – sample	Object, colour	Location	Age	Na2O	MgO	Al2O3
A 1						
264	bead, blue	Kolín	850–870	16,54	0,60	2,32
195	bead, green	Prague, Prague Castle-Jízdárna	870–950	17,67	0,67	2,84
98	bead, blue	Malé Březno	11	14,52	0,00	2,74
156	tessera, blue	Žatec	11	17,29	0,56	2,37
157	fr. of vessel, blue	Žatec	11	15,17	0,65	2,39
139	raw glass, greenish	Žatec	11	18,40	0,89	2,66
417	bottle	Nymburk	13	15,01	0,75	0,51
A2						
228	bead, colourless	Žalov-Na panenské	870–950	15,06	6,12	0,53
943	bead, blue	Prague Castle – Lumbe´s Garden	10	11,2	4,4	1,30
186	bead, brown-yellow	Prague, Prague Castle	11–12	12,82	4,35	1,37
475	fr. of vessel, pink	Žatec	11	11,77	2,49	3,09
333	beaker	Prague	13	14,01	5,14	0,1
B						
803	bead, green	Prague Castle – Lumbe´s Garden	10	1,50	0,00	0,7
213	bead, black matrix	Prague 1, Loretto Square	12	0,00	0,00	0,89
214	bead, yellow	Prague 1, Loretto Square	12	0,00	0,17	1,51
675	ring, yellow	Žatec	11	0,19	0,01	1,58
120	shield finger ring	Liptice-Hrdlovka	12	0,00	0,00	0,00
168	window pane	Stará Boleslav	11	0,00	–	–
474	bracelet, green	Žatec	11	0,69	0,00	0,89
C						
215	bead, green	Prague 1, Loretto Square	12	0,07	0,00	1,65
146	ring grey-black	Žatec	11	3,22	0,00	0,66
489	ring turquoise	Prague, Prague Castle	11–13	0,93	0,17	2,16
479	window pane	Prague, Prague Castle	11–13	0,70	2,07	1,52
E						
219	bead, black	Prague-Motol	10	8,06	1,69	3,05
694	bead, brown-red	Žalany	11–12	6,81	0,52	1,56
81	bead, green	Žatec	13	6,10	0,00	1,67
419	bottle	Nymburk	13	7,91	1,88	2,56
F						
233	bead, green	Žalov-Na panenské	870–950	2,73	5,76	0,53
174	vessel	Stará Boleslav	11?	0,20	1,90	1,03
613	ring, light green	Žabonosy	11–13	1,96	3,82	4,16
754	ring, light green	Prague, Prague Castle	11–13	2,19	3,82	6,54
839	jug	Most	13	0,71	3,56	2,22

SiO_2	P_2O_5	SO_3	Cl	K_2O	CaO	TiO_2	MnO	Fe_2O_3	CoO	CuO	SnO_2	Sb_2O_3	PbO
70,34	0,13	0,00	0,76	0,91	7,63	–	0,12	0,43	0,10	0,15	0,00	0,00	0,00
69,18	0,00	0,00	0,99	0,59	6,30	0,00	0,65	1,11	0,00	0,00	0,00	–	0,00
69,41	0,00	0,33	0,63	0,70	7,72	0,00	0,63	0,88	0,67	1,77	0,00	–	0,00
68,96	0,00	0,43	1,17	0,41	7,14	0,00	0,00	1,27	0,00	0,39	0,00	–	0,00
68,14	0,00	0,00	0,87	0,86	8,33	0,00	0,50	1,29	0,00	0,61	0,00	–	0,65
66,66	0,00	0,93	0,99	0,74	7,26	0,00	0,68	0,78	0,00	0,00	0,00	–	0,00
74,08	0,00	0,00	0,22	1,31	7,53	0,00	0,41	0,18	–	–	–	–	–
69,09	0,00	0,15	0,48	2,36	4,20	–	0,21	0,26	0,04	0,00	1,08	0,18	0,26
69,20	0,20	0,20	0,70	2,60	7,70	0,10	0,50	1,50	0,20	0,20	–	–	–
66,43	0,00	0,30	0,78	4,20	8,73	0,00	0,52	0,51	0,00	0,00	0,00	–	0,00
66,24	0,22	0,28	0,84	2,28	11,13	0,09	1,24	0,35	0,00	0,00	0,00	–	0,00
65,24	0,67	0,84	0,50	2,27	9,65	–	0,78	0,24	0,07	0,00	0,52	0,00	0,00
18,01	0,20	0,00	1,70	0,30	0,20	0,10	0,10	0,20	–	0,60	–	–	76,2
22,45	0,00	0,00	0,00	0,00	0,43	0,00	0,00	2,47	0,00	0,59	0,00	–	73,17
25,64	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	–	72,68
25,86	0,00	–	0,16	0,09	0,00	0,13	0,05	0,24	0,00	0,00	0,00	–	71,71
21,81	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	–	78,19
18,70	–	–	–	–	–	–	–	–	–	0,00	–	–	81,3
24,46	0,00	0,00	0,06	2,56	0,00	0,18	0,00	0,15	0,00	0,93	0,00	–	70,09
35,91	0,00	0,00	0,00	5,57	0,79	0,00	0,00	0,00	0,00	0,00	0,00	–	56,02
32,28	0,00	0,00	0,00	9,83	3,55	0,00	0,00	0,37	0,00	2,12	0,00	–	47,97
26,98	0,00	0,00	0,23	4,73	0,15	0,00	0,00	0,11	0,00	0,51	0,00	0,00	64,03
39,89	0,73	0,00	0,31	11,52	11,97	0,26	0,58	0,50	0,00	1,46	0,00	–	28,49
62,98	0,58	0,46	0,65	7,65	4,27	0,61	7,04	2,96	0,00	0,00	0,00	–	0,00
76,86	0,07	0,00	0,13	9,07	1,41	0,35	0,03	0,61	0,00	1,83	1,01	0,00	0,00
74,50	0,22	1,30	0,30	13,94	1,44	0,00	0,29	0,24	0,00	0,00	0,00	–	–
62,57	0,39	0,26	0,58	11,35	10,87	0,11	1,16	0,35	–	–	–	–	–
56,09	3,65	0,12	0,62	16,03	12,19	–	0,47	0,49	0,05	0,09	0,79	0,24	0,19
63,76	0,99	0,00	0,00	15,24	13,46	0,63	2,48	0,31	0,00	0,00	0,00	0,00	0,00
45,89	1,77	0,44	0,05	16,41	24,42	0,24	0,24	0,61	–	–	–	–	–
44,84	1,19	0,28	0,05	17,01	21,93	0,35	0,93	0,85	0,00	0,00	0,00	0,00	0,00
–	–	–	–	14,69	17,11	–	0,71	0,56	–	–	0,01	–	0,02

Archaeometric studies show that vessels of the 11th–13th centuries were made of various chemical types of glass. Soda-lime glasses are relatively common, both from types A1 (Tab. 1: sample 417) and A2 (Tab. 1: sample 333). In contrast, high-lead glass is rare; it has been determined only in Prague-Ungelt and, with a certain degree of probability, in Most. The use of glass of the mixed-alkali type (E) is documented in the case of bottles with a tubular ring inside (Tab. 1: sample 409) which, according to the analysis results, were also manufactured of soda-lime natron glass, group A1 (Tab. 1: sample 417). Last but not least, the use of wood-ash or wood-ash-lime glasses (F) is also documented: initially in the 12th century, but more frequently from the mid-13th century onwards (Tab. 1: sample 839).

The earliest windowpanes (Stará Boleslav) dated to the 11th century were made of high-lead glasses (B). The specimen from Prague Castle – Theresian Wing, dating from the 11th–13th centuries, was made of lead-ash glass (C). Wood-ash-lime glass (F: K_2O-CaO-SiO_2) was used for the production of the painted windowpane from Prague – Richter's house, dating from around the mid-13th century.

In the case of other small objects, a fragment of an arm ring from Žatec was made of lead-ash glass in the 11th–12th century. The same site also yielded two tesserae and a piece of raw natron glass. The smoother found at Tisová near Staré Mýto dates from around the mid-13th century, but it was analyzed only by semi-quantitative spectral methods because of the corrosion.

Chemical types of glass

Soda-lime-silica glass occurs in two variants, differing in the source of alkali.

Type A1 – soda-lime glass, for the production of which naturally occurring natron was used – hence the name natron glass. In Bohemia of the second half of the 9th and 10th centuries, it is represented by vessels from the Kolín grave and numerous imported beads. In the period 850–950, this very glass penetrated into central Europe and probably also into Bohemia, where olive beads were made from it (Košta and Tomková 2011; Košta and Lutovský 2014).

Type A2 – plant-ash glass with ash of halophytic plants used for its production. In the Early Middle Ages, its production centre is associated with the Islamic world where this glass was produced from the 8th and especially the 9th century onwards (e.g., Henderson 2014). In Bohemia of the second half of the 9th and the 10th century, it can only be documented in the case of beads.

In the 11th–12th centuries, soda-lime-silica glass (A1, A2) are infrequently documented in several new and also earlier known types of beads, where it is not possible to decide whether they are products of that period or earlier intrusions (Tab. 1: samples 98, 186). In Germany, the use of this type of glass for the production of rings/finger rings as late as the 11th century is documented, for instance, by finds from Höxter

(Stephan 1977: 158, 163). Soda-lime-silica glass was used also for the production of vessels, as proved by the analyzed fragments from Žatec dating from the 11th–12th centuries (e.g., Tab. 1: samples 157 and 475) by the 12th-century fragment from Prague which came from a vessel decorated with gold and enamel. Only in the 13th century, which was generally richer in vessel glass, samples of soda-lime-silica glass (A1 and A2) became more frequent. For example, we can mention a bottle with tubular ring inside from Nymburk, which was made of A1 type-glass (Tab. 1: sample 417) and fragments of gilded vessels (A 2) imported to Bohemia from developed glassmaking centers situated in the south or southeast of Europe (e.g., Tab. 1: sample 333, a detailed classification of the results is provided after Černá *et al.* 2012: 401–408).

Type B – high-lead glass. This type of glass already existed in early medieval Europe in the 8th–9th centuries. In Bohemia, it appeared in the form of imported beads, in the 10th century. From the 11th century onwards, it was used for the production of almost all kinds of existing glass artefacts (see Černá *et al.* 2015: Tab. 2). As well as beads, this type of glass was used also for the manufacture of rings, rings/finger rings, and arm rings, although the latter category is represented only by fragments from Žatec (Tab. 1: sample 474) and Prague. It was also used to make windowpanes (Tab. 1: sample 168). According to our findings, high-lead glass remains a rarity in 13th-century Bohemia. They are a small bead from Hrdlovka (VITREA, sample 457), whose dating to the 13th century is not fully convincing, however, and a fragment of a ring with fused grains from Kadaň. The manufacture of rings from high-lead glass at that time has been proven by recent excavations of a glassworking workshop at Erfurt (Mecking 2013: tab. 1). Vessel from high-lead glass are recorded exceptionally (Prague-Ungelt and Most), and especially much later than other types of artefacts, at the earliest in the 13th century in Bohemia as well as in other Europe (Černá *et al.* 2015: 98; Baumgartner and Krueger 1988: 162). Their origin is still not quite clear, but like the cited authors, we believe that the production centers of this specific group of vessels (predominantly of a bright yellow colour) should be sought somewhere in the northwest of Europe, in the Hansa cities or possibly also in the southern part of Lower Saxony.

The provenance of Bohemian finds of lead glasses from the 11th–13th centuries, especially in the case of simple rings and beads, has been sought in Poland or in the more distant parts of eastern Europe. Correlation of the results of analyses of Bohemian and European finds led to the observation of a particularity of the chemical composition of several Bohemian glass with a remarkably high content of lead oxide (see Černá *et al.* 2001: 77–79 for more details about their occurrence and provenance, as well as about the possible existence of independent production centers using similar recipes). When looking for an answer to the still open question of the origin of Bohemian finds made from lead glass, one must not forget the early knowledge of the production of lead glass in Lower-Saxon monasteries, which is attested both by

archaeological sources from, e.g., Brunshausen (Stephan and Wedepohl 1997), and by written ones[9]. With reference to O. Mecking (2013: 648, 656), it could be pointed out that the increase in production of lead glasses in the 10th–14th centuries can be placed in context with the growing production of silver. Lead-isotope analyses have proved that the same source of lead (Harz Mountains) was used for the wood-ash lead glass and the high-lead glass in western Germany and the two types of lead glass from Erfurt.

Type C – lead-ash glass. This type of glass, which frequently occurred in Bohemia and other European territories from the 11th century onwards, probably has earlier roots (for a list of solitary finds from antiquity and the early Middle Ages, see Dekówna 2000: 187–191; for new analyses of artefacts dated since the second half of the 10th century from Silesia; see Pankiewicz et al. 2017). Similarly as in the previous case, this type was used for the manufacture of beads, rings and rings/finger rings, and on rare occasions, also window glass. The last mentioned category is represented by only one find: a glass windowpane from Prague Castle, which cannot be dated more precisely within the studied period. Most of the lead-ash glasses identified up to now in Bohemia belong to a type which Mecking (2013) classifies as the newly defined *Central European lead-ash glass* and for which a low content of CaO is characteristic (most often less than 1%). However, there are also exceptions, such as the Žatec ring dated to the 11th century, where the CaO content is slightly higher, up to 3.55% (Tab. 1: sample 146), or the windowpane from Prague Castle – Theresian Wing, where the CaO content is even higher, up to 11.8% (Tab. 1: sample 479). With its CaO content, the glass of both these objects is closer to glasses from western Europe, which Mecking calls *wood-ash lead glass* and of which such a high content of CaO is characteristic. In the 11th–12th centuries, the range of artefacts is nearly as wide as in the case of the previous chemical group (only the arm rings are missing, see Černá *et al.* 2015: Tab. 2). However, the total number of finds is apparently lower and no artefacts made of glass with this composition are known during the subsequent period.

Type D – so far, soda-lead glass among Bohemian finds has only been proved in the case of polychrome eye beads dating from the 10th century, found in a cemetery in Lumbe's Garden in Prague (Tomková *et al.* 2014: 157–158).

Type E – mixed-alkali glass containing soda, potash and lime (usually with a Na_2O content of 4 to 12% and a K_2O content of 4 to 13%). The process of its production still remains an open question. There are some speculations that early medieval glasses emerged by mixing soda-lime glass with wood-ash glass melted from the ash of European tree species. It appears only rarely in Bohemia. Only a few beads are known from the period 850–1000. The following period is represented both by beads (Žalany, 11th–12th centuries and Žatec, 13th century) and vessels (bottle with a tubular ring inside

[9] The use of lead in the batch mixture is mentioned by Theophilus Presbyter in his treatise entitled 'Diversarum Artium Schedula', as already noted in Theobald 1933.

from Nymburk, 13th century). This type of glass features a much higher fluctuation of individual element content. These differences are prominent especially when one compares the amounts of chemical elements in objects distant in time as demonstrated by a comparison of CaO content in three of the above mentioned samples (Tab. 1: samples 81, 694, 419).

Type F – wood-ash glass was melted from the ash of European tree species. The beginning of the use of wood-ash alkali on the European continent can be dated to the 8th century (Wedepohl 2003: 91–92). In the period 850–950, one of the olive beads found in Bohemia shows this type of composition. Analysis of two G-beads indicates that this type of glass was also used for the production of these kinds of beads, the occurrence of which is limited to Bohemia, and in particular to central Bohemia. This fact, as well as their simultaneous occurrence with olive beads and the tendency to imitate them indicate that wood-ash glass might have been imported to Bohemia during the period 850–950 and processed locally (Košta *et al.* 2011).

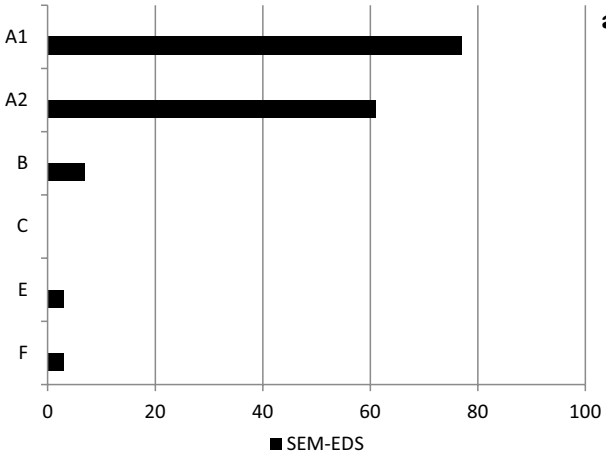
Somewhat later, a ring from Prague Castle – Jiřské Square with a core consisting of colourless, translucent, slightly greenish glass with a surface covered by corrosion products forming a black opaque layer, and a non-corroded ring from Žabonosy (Tab. 1: samples 613 and 754) were made of this type of glass. Both these finds are roughly dated to the 11th–13th centuries. The presence of objects made of wood-ash glass in the 11th–12th centuries is also confirmed by analyses of other specimens made of secondarily opaque glass, carried out by the semi-quantitative spectral method, which, however, does not provide absolutely exact data on the content of individual elements.

Wood-ash glass is convincingly documented again as late as the 13th century, in window glass and vessels. Both find categories are preserved in the form of fragments that are often not suitable for archaeometric investigations due to corrosion. Despite the negatives which are associated with wood-ash alkali, the production of glass from ash of wood species became so widespread in central Europe that it gradually replaced all other chemical types of glass during the 13th century. From the very beginning (from the mid-13th century onwards) Bohemian glasshouses produced glass according to the same formula as the glass-making centers in neighbouring countries. When the results of chemical analysis of the windowpane from Prague – Richter's house (Dragoun 2000: 13) are compared with glasses from Germany (so-called *Holzasche-Glas* 1050–1200; Wedepohl 2008: Tab. 1), the similarity of their chemical compositions, i.e., the content of the main represented elements, is apparent. However, over the following decades, in the context of gradual development of the glass-making craft, the newly established production centers became more differentiated through their range of products, in the spheres of both typology and chemistry. A formula based almost exclusively on wood-ash alkali was used in central European glasshouses, however, the resultant melt did not contain completely identical quantities of main and trace elements.

CONCLUSIONS

A comparative analysis of archaeometric data revealed that soda-lime glasses were without doubt dominant in the collection of 9th–10th century Bohemian finds. The share of lead glass is somewhat lower and both mixed-alkali and wood-ash glass are hardly represented (Fig 8: a). In the 11th–12th centuries, a surprising boom in lead glasses, both the high-lead ones, and the ternary ones containing wood-ash alkali is recorded, while soda-lime glasses became less frequent. Wood-ash glass was documented in exceptional cases only (Fig. 8: b). Thirteenth-century finds reveal a permanent, although insignificant representation of soda-lime glasses and, at the same time, an increasing proportion of wood-ash glass (Fig. 8: c). Less frequent artefacts made of soda-lime glasses can be considered without doubt as imports from more distant glass-making areas, either in the southwest, south or southeast of Europe, or even in the Near East. In contrast, the origins of wood-ash glasses can be sought in glass-making centres located near Bohemia or in western Europe. Lead and mixed-alkali glasses are only marginally represented. With regard to ongoing archaeometric research, which enlarges the range of finds investigated with modern methods, it is reasonable to suppose that future analyses will demonstrate an even higher proportion of wood-ash glass.

Most chemical types of glass were used over a longer period and, with the exception of wood-ash glass (F) and lead-ash glass (C), they have their roots in prehistory (Tomková and Venclová 2014). Except for the lead-ash glass, the other types can be encountered both in the period of the 9th–10th centuries and in the 11th–13th centuries. However, the ratios in which they are used for the manufacture of different products are

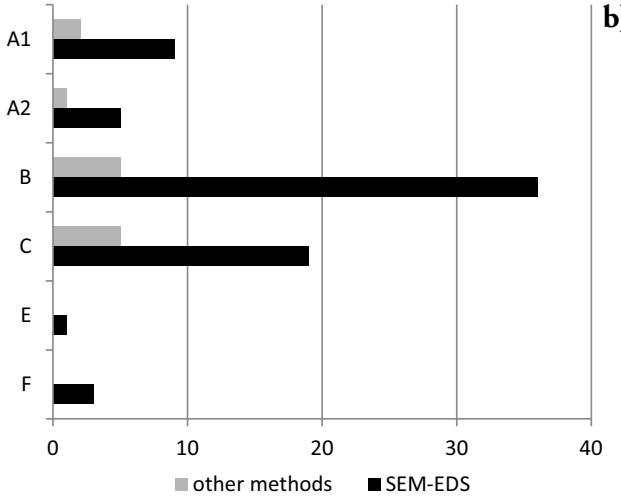


a)

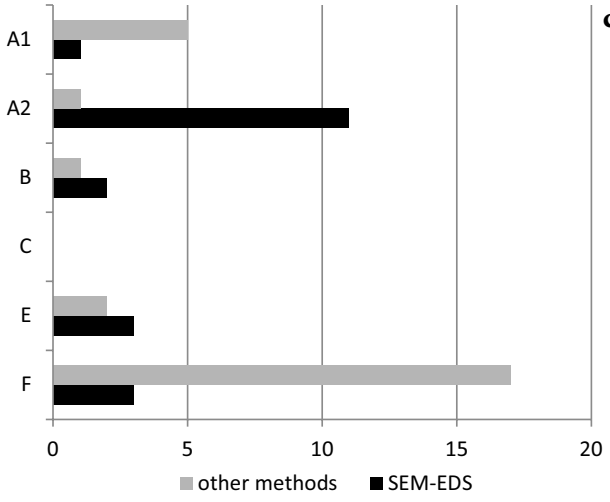
	SEM-EDS	other methods
F	3	
E	3	
C	0	
B	7	
A2	61	
A1	77	
	151	

changeable. Although we are able to notice an inner variability within the basic chemical types at the present stage of our research, we leave aside the evaluation of their transformations which take place during both time periods.

When archaeometric data are linked to archaeological observations, two significant changes become apparent. The first change happened around the year 1000, or more



	SEM-EDS	other methods
F	3	
E	1	
C	19	5
B	36	5
A2	5	1
A1	9	2



	SEM-EDS	other methods
F	3	17
E	3	2
C		
B	2	1
A2	11	1
A1	1	5

Fig. 8. Share of different chemical types of glass in different periods from the mid-9th to the 13th century: a –mid-9th to 10th century; b – 11th–12th centuries; c – 13th century (after Černá *et al.* 2015)

markedly at the beginning of the second millennium. In a way, it can be characterized as a complex change occurring in all the mentioned parameters very quickly and practically simultaneously. The other change took place over a longer time period, during the 12th–13th centuries. In contrast to the previous one, this transformation can be interpreted as an evolutionary change. Its characteristic feature is the asynchronous appearance of the aforementioned elements: in the range of glass artefacts and in the use of chemical types as well as in the find contexts.

If we compare these findings with the situation abroad, we may notice certain common patterns. A similar case can be found, for instance, on the Baltic coast, where in context with the gradual decline of Haithabu in the course of the 11th century, a certain population growth occurred in neighbouring Schleswig. This transfer of settlements was also accompanied by changes in the range of glass artefacts, both from the typological and the chemical point of view (Steppuhn 2002: 103–105, Fig. 55). A comparable situation for the period of the 12th to the mid-13th centuries is represented by the scarcity of window and vessel glass in both the settlement and the production milieu, which can be observed in Bohemia as well as in the neighbouring central European countries. In this context, we have to mention the obstacles faced while trying to put our findings into a broader European context. Both at the practical and at the theoretical level, they are caused by the variability of analysis results and the differences in their interpretation. Apart from the application of different analytical methods and the continuous progress in the level of our knowledge, there are also changes in the dating of artefacts and the presence of different scholarly milieus.

If we acknowledge the changes in fashion in Bohemia around the year 1000, which are demonstrated by the arrival of new types of beads and, initially, as the apparent preference for embellishments in the form of rings and finger rings, it is also necessary to notice several signs of continuity. The origins of several types of beads dating from the 11th to 12th centuries reach deeper into the past. Eventual differences between the earlier and later specimens may be related, although not necessarily, to different techniques of manufacture or different chemical types of glass.

Early and high medieval glass-making technologies were, and still are, studied separately. Such isolated studies have resulted in the creation of an artificial barrier, which is usually dated around the year 1200 and which is thought to separate the manufacturing practice of these two cultural-historical periods. This fact is also accepted without criticism by professional glassmakers, although, as our research shows, the reality was different. Our study proves that significant changes reflecting the development of the glassmakers' craft in Bohemia took place earlier than expected, during the early medieval period, more precisely shortly after the year 1000. Additional changes associated with the development of a local production of glass took place after the middle of the 13th century. Since that time onwards, apart from luxurious imported vessels, the more common drinking (i.e., table) glassware appeared, which was

produced in the newly established glasshouses in the mountain border regions of Bohemia. The growth in local production enabled the spread of glassware among the lower social strata and caused a drop in the number of imported goods.

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The symbolism of Hercules in the religious and political propaganda of the Roman Empire as attested by a *terra sigillata* bowl from Górzyca in Słubice County

Lubomira Tyszler[a], Anna Jankowiak[b]

The paper considers the symbolic aspects of the figure of Hercules depicted on a *terra sigillata* bowl discovered in Górzyca, Słubice County, in the context of the Roman mythical hero cult. Hercules, a superhuman hero equal to the gods, played a very special role in Roman religion and Imperial ideology. The vessel is an example of exquisite tableware produced in specialized provincial workshops. The relief decoration of such dishes allows us not only to identify particular potters and workshops, but also to propose the dating in terms of absolute chronology. *Terra sigillata* vessels constitute one of the most important categories of Roman imports in the *Barbaricum*, a community of Wielbark culture being one of the recipients.

KEY-WORDS: Hercules, Lezoux, *terra sigillata*, imperial propaganda, Górzyca, Wielbark Culture, *Barbaricum*

BURIAL OF A YOUNG FEMALE ARISTOCRAT

Intense archaeological excavation in recent years in the mid-Oder river region, led to the discovery of numerous archaeological sites representing Wielbark culture. One of these is site 20 in Górzyca in the Lubuskie Province, demonstrating a sound cultural and chronological sequences of occupation and including a cemetery of the said culture (Socha and Sójkowska-Socha 2012; 2014). It is located in an area known as the Lubusz Breakthrough on the Oder, on a wide floodplain terrace just 0.8 km from the river bed. The site was damaged substantially due to intensive modern land transformation in the region.

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The burial ground from the Roman period in Górzyca includes graves of the so-called Lubusz group of the Elbe cultural circle and Wielbark culture, the latter accounting for about 70% of the discovered graves (85 in all). The bi-ritual necropolis of the Wielbark community dates to the B_2, B_2/C_1–C_{1a}, C_1 phases of the Roman period (Socha and Sójkowska-Socha 2012: 92, 112–113; 2014: 34–43). Numerous imported goods from Roman workshops, such as bronze brooches (*tutulus* type, disc brooch) and glass and amber beads, were discovered in the graves. One such import was the *terra sigillata* bowl.

The bowl was found in a partly damaged cremation burial (no. 9). Together with several other objects it made up the grave goods of a young woman aged around 22–25 (Socha and Sójkowska-Socha 2012; Wrzesińska 2012; Tyszler 2012a). It appears to have been placed in the pit first, followed by other wares and utensils, including a golden spherical pendant, a coin (*subaerat*?), a Jurassic mollusk *Pholadomya* fossil used as the centerpiece of a pendant, a bronze fibula, numerous glass beads and decorated clay beads, a casket ferrule, a key, bone and metal needles (Socha and Sójkowska-Socha 2012: 97–112, figs 9–17). The condition of the artifacts is characteristic of a cremation burial. The rich equipment indicates that the remains buried here belonged to a young female aristocrat of Wielbark Culture origin. The grave is dated to the B2/C1 phase of the Roman period, which is synchronized in the absolute chronology with the last quarter of the 2nd century AD and the first two decades of the 3rd century AD.

DECORATION AND ATTRIBUTION OF THE *TERRA SIGILLATA* BOWL (Figs 1–3)

The bowl discovered in the burial of a young female aristocrat in Górzyca was found in 77 pieces and only a few small fragments turned out to be missing following reconstruction. These were either not placed in the burial or were diffused outside the pit and hence impossible to find during the exploration. The condition of the fragments is diverse: some of them are burned and disfigured, others only burned with secondarily discolored slip; one piece presented the original dark red slip without any signs of burning. The vessel is a hemispherical bowl type 37 in Dragendorff's classification (Dragendorff 1895), with rim diameter of approximately 23.8–24.0 cm and height of about 13.5–13.8 cm. The bowl has been published (Socha and Sójkowska-Socha 2012: 93, 97, figs 4, 5, 7, 9) and studied (Tyszler 2012a)[1].

Bowls of this kind were produced in two stages. First a matrix was prepared with the decoration in negative and often stamped by the producer. The second stage

[1] It was exhibited at the 'L'archéologie c'est notre histoire. Les dernières découvertes à Lezoux' in France from April 13 to December 31, 2013; http://www.puydedome.com; http://www.muzeum.kostrzyn.pl; http://archeologia.uni.lodz.pl/blog/porcelana-antyku).

Fig. 1a–c. Górzyca, site 20, Słubice county. *Terra sigillata* attributed to the Laxtucissa or Laxtucissa-Paternus II workshops in Lezoux. Photo by W. Pohorecki, design by L. Tyszler

involved impressing the clay bowl in the matrix and attaching a wide, smooth (undecorated) rim with a rolled edge as well as a profiled foot to the decorated body. A pre-firing potter's stamp could have been added at this stage. The next steps, which were typical of all *terra sigillata* wares, included applying a slip and firing, both procedures executed by highly specialized potters. The relief decoration and shiny slip in various shades of red indicated high quality. Products of this kind constituted coveted luxury goods.

The relief decoration on the Górzyca bowl was incorporated into a broad register of decoration. A line of ovoli (type Rogers B 206) with a wavy line under it (type Rogers A 23) marks the top of this zone, running around the circumference. The main part of the register is filled with circular medallions within plain double concentric rings, each medallion featuring a figure of Heracles probably stamped with the same die, although the condition of the vessels makes it difficult to verify it. The iconography of this figural representation will be analyzed below. Lines of bead-and-reel ornament (type Rogers A 10) separate the metopes with the medallions from the intervening metopes and divide this field also into two parts horizontally. In the top part are single leaves (type Rogers J 45) and two geese (type Oswald 2301/on the left) within a hanging arc; the lower contains a small medallion with the head of Silenus (type Stanfield, Simpson, fig. 104: 4, here on the left). Smaller trefoil floral ornaments of various sizes (type, Rogers G 102, G 159), lily flowers (type Rogers G 88), rosettes (type Rogers C 123) and decorative column imitations (type Rogers P 37) fill all the available space in keeping with the *horror vacui* principle. There are also, both popular in the Lezoux workshops. The decoration style and the use of certain decorative elements, like the small single circles and larger double circles popular in the Lezoux workshops, suggest the workshops of either Laxtucissa or the duo Laxtucissa–Paternus (style II) active in Lezoux at the time that the bowl was made. The potter Laxtucissa was dated to about AD 145–170 or AD 150–170 (Stanfield and Simpson 1990: 228–229; Rogers 1999: 156) and Paternus style II to around AD 150/160–180/190 (Stanfield and Simpson 1990: 239; Rogers 1999: 190). Bearing in mind the proposed dating, we can assume that our bowl was made around AD 145/150–170/180 or AD 150/160–170/180 (for a complete discussion of decoration and stylistics as well as dating of the vessel, see: Tyszler 2012a: 128–131, tab. 1, fig. 1A–B, 2, 3A–F, 4A–B).

POTTERY WORKSHOPS IN LEZOUX

The best known workshops in central Gaul were active in Lezoux (ancient *Ledosus*) near Clermont-Ferrand (district of Puy-de-Dôme) (Bet and Vertet 1986: 138–144; Tyszler 1999 I: 27–28, note 1; 2012b: 183–184). They belonged to a larger group of ateliers, known from places like Les Martres-de-Veyre, Terre-Franche, Lubié (Bémont and

Jacob 1986). Many connections have been demonstrated to exist between these workshops, both in the making of certain products and the creating of new branches. Lezoux was a vast agglomeration, which included a number of workshops, operating in different time periods. More than a hundred pottery kilns were discovered between the 17th and the 19th century (this being the lowest estimate, Bet and Vertet 1986: 141), validating the importance of this pottery center. *Terra sigillata* started being produced in Lezoux in the reign of Tiberius and, following a period of recession, climaxed in the late Flavian period and in the reign of Trajan; it continued at a high level through the reign of Commodus (Bet and Vertet 1986: 139). The Górzyca bowl was made during the heyday of the Lezoux workshops, in the reign of the emperors Antoninus Pius or Marcus Aurelius. The provincial Danube markets declined significantly as a result of the Marcomannic Wars (AD 166/167–180) and the delivery of goods from the *terra sigillata* pottery workshops ceased at the close of the wars (Tyszler 1999 I: 33–34; 2012b: 188). A major crisis of the central Gaulish workshops during the reign of Septimius Severus is also worth mentioning. It is assumed that production weakened significantly because of the fighting in the Lyon (Latin *Lugdunum*) area in AD 197, which cut off the workshops from most markets (Stanfield and Simpson 1990: 29). The crisis was augmented by rising competition from pottery centers on the Rhine in Germania and eastern Gaul.

THE MEDALLIONS WITH HERCULES (Figs 4–6)

The figure of Hercules depicted on the Górzyca bowl is depicted sitting on a cross-framed folding chair, the Latin *sella curulis* or curule seat. He is well-built, with an athletic chest and muscular arms and legs. The head is small compared to his enormous body and the facial features are barely visible. In his left hand Hercules holds a small, symbolic, studded club, while supporting himself on his right hand resting on the corner of the said seat. The *sella curulis* was restricted in ancient Rome for senior officials, judges, consuls and praetors. Over time it started being used by the Roman emperors in their political propaganda. The interpretation of this stamp in Oswald's catalog (1991, No. 773) contains many mistakes, including a small jug (libation vessel) placed in Hercules right hand, while in fact this hand rests on the corner of the chair (Tyszler 2012a: 131, Fig. 3B–C). The bowl from Górzyca features a full version of the Hercules image.

A club and a lion skin are the most recognizable attributes of Hercules, aside from a quiver and arrows. It is an interesting combination, considering that the hero made the first two himself, whereas the others were gifts of the gods Apollo and Hephaestus as a sign of their support (Berens 2009: 198). The club and the skin derived from the first task that Hercules received from Eurystheus, that is, killing the lion that was

Fig. 2a–c. Górzyca, site 20, Słubice county. Herkules sitting on a curule seat (*sella curulis*) Photo by W. Pohorecki, design by L. Tyszler

ravaging the Nemean Valley northeast of Mycenae. The hero stunned the lion with his handmade club and then strangled the beast with his bare hands. The skin which he took off with his bare hands became his trademark just as the club (Morford and Lenardon 2003: 523). Its symbolism is a very broad concept, with a certain amount of ambiguity assigned to the nature of this kind of weapon: at once an attribute of glory and bravery, and a symbol of brutality, a thunderbolt, penalty and treason. It was made of oak as befitted a hero's club, emphasizing the power and strength of its owner. Oak was used to make the weapons of the solar heroes. In the case of Hercules, it was a symbol of wildness, cruelty, thunder and lightning (Kopaliński 1991: Maczuga <club>).

Potters from the workshops in Lezoux in Central Gaul decorated their vessels willingly with figures of Hercules with the various attributes symbolizing his various works: club and lion skin, lion skin and bow, libation vessels, strangling two snakes, fighting a lion, leading Cerberus, carrying the Erymanthian Boar, picking apples in the garden of the Hesperidia and others (Oswald 1991, nos 746, 748–749, 751, 753, 755–757, 759–760, 768–769, 773–776, 779–785, 789–790, 792–793, 795–796) (Fig. 7). The image of an old, bald man holding three of the hero's most important attributes: club, lion skin and bow (Oswald 1991, No. 746), should be identified as the Celtic god Ogmios-Smertulus. Oswald's catalog does not contain a full list of variant representations of Hercules attributed to Lezoux and this tends to grow every time new manufactories belonging to the Lezoux pottery group are discovered. Included especially are the workshops in Martres-de-Veyre, where figural representations of Hercules on *terra sigillata* vessels were noted frequently in various forms, for example, Oswald numbers 773, 757, 784 and others without counterpart in the catalog (Terrisse 1972, pl. 29: 704; 34: 703, 416, 468, 469, 1080; Romeuf 2001: pl. 67: 5).

THE HERO-GOD IN THE RELIGION AND IMPERIAL IDEOLOGY

Hercules was of particular importance in Roman religion and imperial ideology, as well as in the provincial cult. The Romans took over his cult deriving from the Greek world, where the hero was known as Heracles, and enhanced it. He was the son of Zeus (Jupiter to the Romans) and Alcmene, wife of Amphitryon, king of Thebes. found a guardian and protectress in the goddess Athena (Roman Minerva). As a baby in the cradle he manifested his tremendous strength by strangling the poisonous snakes sent by the goddess Hera (Morford and Lenardon 2003: 519–521; Berens 2009: 195–196). As a grown man he performed twelve extraordinary labors commissioned by the king Eurystheus, making himself famous. These labors were: 1/ slaying the lion ravaging the Nemean Valley, 2/ slaying the hydra spreading terror in the Lernaean swamp, 3/ capturing Artemis's favorite animal the Golden Hind live, 4/ capturing the boar that lived on Mount Erymanthos in Arcadia and was devastating the area, 5/ cleaning

Fig. 3. Stamps with the images of Hercules from the workshop in Lezoux. Types No 748, 749, 755, 756, 746, 785, 769, 760B, 775, 773, 783, 792, 784, 796, 789. After Oswald 1991; design by L. Tyszler

out the Augean stables, 6/ chasing the birds from the area of the Lake Stymphalia inArcadia, 7/ capturing the Cretan Bull, 8/ stealing the Mares of Diomedes, son of Ares and the king of the Thracian tribe of Bistones, 9/ getting the girdle of Hippolyta, Queen of the Amazons, 10/ rounding up the cattle of the monster Geryon, 11/ stealing the apples of the Hesperides, 12/ capturing Cerberus, the dog which guarded the entrance to the underworld (Morford and Lenardon 2003: 523–530; Berens 2009: 199–213).

The Hercules cult was introduced in Rome during the Republic period; it has been confirmed in the year 399 BC. The Ara Maxima altar was erected on the Forum Boarium on the Tiber, resulting in the deified hero's popularity among merchants and traders. Being a guardian of businesses, he was given the title *Custos*. Trade agreements were pledged and vows taken at the Ara Maxima and with time it became a custom to offer a tenth of the profits from such agreements to the god himself (Beard *et al.* 1998: 2, 173–174; Wojciechowski 2005: 33). Most likely around 300 BC, the cult of Hercules as patron of merchants at the Ara Maxima was replaced by a cult associated with the military aspect of the deity (Wojciechowski 2005: 39). Hercules Invictus had his own festival in the Roman calendar on August 12, when sacrifices were made in his honor.

During the Samnite Wars the military aspect of the hero was emphasized more resulting in his receiving another title, *Victor* – victorious, and later also *Invictus* – invincible. Hercules Victor combined two seemingly contradictory aspects: he was a patron of both merchants and warriors (Wojciechowski 2005: 46–47). Over time, Hercules Invictus worshiped as a patron of victory was identified increasingly often with the god of war Mars, a connection emphasized by the fact that he had his own collegium of Salii, which is proved in his sanctuary at Tibur (Marzano 2009: 86, 88).

During the reign of Augustus Hercules already played a certain religious role and with time he became a protective deity of the imperial family. However, he was not the favorite deity of Augustus, as Mark Antony used to mention being connected with the hero in his propaganda (Hekster 2004a: 1). Nevertheless, with the connivance of the emperor, comparisons of Augustus and Hercules were made by the poets of this time (Hekster 2004a: 8).

The mighty son of Zeus was least favored during the Julio-Claudian dynasty. He was treated more favorably by the Flavians, particularly Domitian who wanted to be identified with the god. The apogee of his popularity came during the reign of Trajan and his successors. He became a guardian of the imperial household, and as such received the title of *Hercules domus Augusti*. He was rapidly made a central figure of the emperor's imperial ideology. His special place in Trajan's and Hadrian's religiosity was certainly due to the tradition from their native Italica near ancient Gades (modern Cadiz), where Hercules Gaditanus was worshipped. He was the equivalent of the Punic Melkart. Furthermore, the hero wandering through the world and helping the weaker,

to which Pliny the Younger compared Trajan, or a strong leader, who is the same for his people as a shepherd to his flock, a hero who travels the world alone and takes care of its welfare – this image quickly proved to be worthy of the emperor. Only by a man of extraordinary, heroic strength, like Hercules, could hold a position of such importance and responsibility, defeating tyrants and bringing peace to the world, and like the hero destined to become immortal (Hekster 2005: 1–2; Barry 2011: 21). The importance of the deity was also highlighted by Trajan who chose him for his military-related coinage. An image of Hercules replaced that of the emperor on the obverse of one of the coins, surrounded by the inscription IMP CAES TRAIANI AUG GERM; the reverse showed a boar as the emblem of a legion. Another coin bore the image of the emperor on the obverse and, on the reverse, of Trajan's Column in the form of a club, set on a pedestal draped with lion skins. Yet another shows the statue of Hercules Gaditanus/Victor (Hekster 2005: 2; Barry 2011: 21–22).

Hercules Gaditanus was present even more strongly in Hadrian's ideology. While Trajan had promoted the image of a warrior hero conquering the world, his successor portrayed him more as a traveler. Hercules was connected with Gades, the hometown of the emperor's mother, by two legends referring to the labors he performed. One version of the myths located the garden of the Hesperides in the westernmost part of Europe and it was also there that the hero was supposed to round up Geryon's cattle. Moreover, returning with the cattle, he stopped in Italy, where he fought Cacus. The Ara Maxima was set up as a result of these adventures, thus making a direct connection between the deity and the Eternal City. Hadrian issued special coins associated with the hero, among others a series of aurei with Hercules Gaditanus and Oceanus on the reverse. A sanctuary of Hercules Victor was also built in the residence of the emperor in Tibur (modern Tivoli) (Hekster 2005: 3; Barry 2011: 22–23).

The figure of Hercules continued to be used in imperial ideology, but the most favored variant from the reign of Antoninus Pius was Hercules Victor/Invictus (Hekster 2005: 3). One of the tenets of Antoninus Pius's religious policy was to return to tradition; the emperor wished to recreate the Republican religious spirit as well as reinforce and spread the rituals and worship of the true Roman gods throughout the empire. Between AD 147 and 149 the celebrations of the 900th anniversary of the founding of Rome took place, celebrated among others by the issue of coins and medallions designed to draw attention to the religious history of the empire. Hercules and his labors were also recalled in those days. A medallion released between AD 140 and 143 depicted Hercules defeating Cacus on the reverse; another one, issued after AD 145, showed Hercules feasting after a sacrifice. On coins he was represented in the garden of the Hesperides (AD 140–143), fighting the centaurs (AD 148) and recognizing his son Telephus (AD 145–147) (Bryant 1895: 141–143; Rowan 2014: 111–113). Antoninus Pius legitimized Hercules as a fully Roman deity and this reflected the manner of his government. Hercules was presented no longer as a great traveler but rather as quiet

guardian residing in Rome. Like the emperor he had no need to travel around the empire, since he was informed of everything through a well-developed information system (Hekster 2005: 3–4). In the time of Commodus, however, the emperor proclaimed himself the 'new Hercules' and claimed to be the reincarnation of the god on earth in order to substantiate his divine right to rule and used all means of propaganda to emphasize this. Coins were issued with a representation of the emperor together with Hercules or as the god himself. Statues of the kind were made and the emperor frequently dressed in public as Hercules. He even fought as a gladiator in order to demonstrate to his people the resemblance to the hero who protected the world from chaos and danger. Many ceremonies were held during this emperor's reign to commemorate the achievements of the deified hero (Hekster 2005: 4–9).

HERCULES, THE ANCESTOR OF THE GAULS

Over time the cult of Hercules was introduced in the provinces, Gaul included, where it was connected with local deities. Hercules was given local titles: Andossus, Ilunnus, Deusonienis, Magusanus and Saxanus. He was also identified with the Celtic Ogmios/Smertulus. Both were associated with regeneration and symbolized the connection between the world of the living and the underworld. Both overcame death and become demigods. Ogmios was a god from whom all life derived and Hercules was supposed to be the ancestor of all the Gauls (Hekster 2004b: 672; Koch 2006: 905–906, 1393). Diodorus Siculus wrote of Hercules stopping in Alesia on one of his journeys to the north and fathering there Galates, from whom the Gauls originated. His role therefore was special, bonding the province to the Roman Empire. Moreover, because of his unique relation to animals, Hercules took an important place in a pastoral society (Koch 2006: 906; d'Encarnação 2008: 34–35).

It seems, however, that the deities linked to their Roman equivalents in the 2nd and the 3rd century AD were no longer recognizable as the gods worshipped by the pre-Roman inhabitants of Gaul in the 2nd and 1st century BC. Too little is known of pre-Roman Celtic religion for the evolution of Celtic beliefs under Roman influence to be clearly understood. Local religion had evolved long before the time of Augustus and continued to do so long after his death. Gods with Celtic theonyms, including Hercules with the Celtic titles and identified with pre-Roman deities, could have been a part of change that was intended to integrate to local community. One must keep in mind that only a handful, the druid priests, had knowledge of the gods in Celtic society. It is quite possible that Hercules was intended as a means of bringing the spiritual world closer to the people. Hercules also played a very important role in the integration of local traditions with those of the Roman religion. There was a widespread cult of local ancestor-heroes who acted intercessors between humans and gods

in Celtic religion until the 1st century AD. The Roman god became a kind of replacement. In Roman times, we can observe a continuation of this tradition in the form of temples erected on burials of this kind (d'Encarnação 2008: 13–20).

Epigraphic sources are very useful for studies of the Hercules cult in Gaul. The following were found in the various administrative units of Gaul respectively:

Gallia Narbonensis: 17 monuments and 16 inscriptions associated with the Hercules cult, three of which overlapped the categories, giving in effect 30 sites associated with the deity; four persons were identified as dedicating such inscriptions;

Gallia Aquitania: 22 monuments and eight inscriptions, two of which overlapped, giving 28 sites associated with the deity and five dedicating persons;

Gallia Belgica: 158 monuments and 32 inscriptions, 11 of which overlapping, which gives 179 sites associated with the deity and 20 dedicating persons;

Gallia Lugdunensis: 39 monuments and 1 inscription; none of them overlapping, hence 40 sites associated with the deity (Hekster 2004b: 670; Wojciechowski 2005: 182).

Inscriptions in honor of the deity can be found throughout the province, but mostly in the northeastern region. This area was associated with Hercules Magusanus who gained the greatest popularity among soldiers and was introduced into the Roman pantheon thanks to the army. The epigraphic evidence is not the only grounds for estimating the popularity of the Hercules cult, ergo it does not mean that his worship was less common in other parts of Gaul (Wojciechowski 2005: 181–183; d'Encarnação 2008: 16). It should be underlined that Hercules was very successful in Gaul and many local gods and deities were identified with this hero. In military areas, he was worshiped as a protector of soldiers, one who guaranteed victory.

CONCLUSIONS

To recapitulate, the representation of Hercules on the *terra sigillata* bowl, discovered in Górzyca, attributed to the Laxtucissa or Laxtucissa-Paternus II workshops in Lezoux, can certainly be considered as a form of implementing Roman propaganda and ideological motifs. The hero cult, popular in the Republican period, was given new meaning in the religious policies of the empire. Hercules, son of Jupiter, offered new opportunities for identifying the emperor with the hero-god. It was not until the time of Trajan, however, that a substantial change occurred, turning the demi-god into a model of a good emperor and man, both winning and bringing peace. The reign of this emperor coincides with a period of prosperity of the workshops in Lezoux, observed in the relatively frequent use of different representations of Hercules by the potters in their decoration of *terra sigillata* vessels, which is the main topic of the present article

(Tyszler 2012a: 133). Hercules maintained his significant position in the religious policies of the Empire during the reign of Antoninus Pius, which is when the bowl from Górzyca was made, between about AD 145/150 or 150/160 and about AD 170/180. Keeping in mind the production process, one can assume that it is one of many copies of the same bowl molded in one or more matrices, distributed together with bowls from other workshops, via the trading guilds within the limits of the empire. Roman soldiers stationing on the Limes were a major customer for *terra sigillata* products. The luxurious tableware was used by the middle-class soldiers and it fulfilled perfectly the function of spreading imperial propaganda. Relatively few bowls from the Lezoux workshops passed beyond the Limes, reaching *Barbaricum*, including Polish lands (Tyszler 1999; 2012a). It is certainly not that obvious that the Hercules symbolism or the figure of the hero itself for that matter was understood outside of the Roman Empire, in this case by the elites of the Wielbark culture in the Górzyca area on the middle Oder.

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Oswald = Oswald 1991
Rogers = Rogers G.B. 1974
Stanfield, Simpson = Stanfield J.A., Simpson G. 1958, 1990

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The question of ash glasses in the Roman period focusing on finds from Poland

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This paper presents the results of physico-chemical analyses of approximately 170 products, beads and vessels from the Roman period coming from the territory of Poland. These are the soda high potassium artifacts, which may be considered as ash glasses. Glasses with higher potassium content (HKG) were melted using the ash from halophyte plants in the workshops of the Roman East and probably other places in the Mediterranean. These were mainly coloured glasses used to produce ornaments, mosaic vessels, decorative plaques and tesserae. In the Roman period, especially in its later stages, and in the Franconian period, ash glasses began to be produced also in the western provinces of the Empire, and these were mainly the low magnesium specimens (LMG). However, questions about the frequency of ash glasses in the Roman period and the location of production centres as well as the kinds of alkaline raw materials require further research.

KEY-WORDS: Roman ash glasses, beads and vessels from Poland, technique of forming, ash glasses from Roman Empire

INTRODUCTION

Compared to other periods the basic recipe used for glass melting in the Roman period was quite uniform. It was the soda recipe and the chief differences in it was the alkaline raw material used. Most researchers agree that it was a mineral soda, mainly natron, and that soda-rich plant ash was used to melt glasses at a later time, already in the early Islamic period (e.g., Freestone and Gorin-Rosen 1999). However, the 'ash' technology was known in the Middle East from the Bronze Age and such glasses were made also in Mesopotamia in the Sassanid period (Mirti *et al.* 2008: 443–444). Consequently, finds of glasses with higher K_2O content in the Roman period clearly pose an important research issue.

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In the Roman period, low-potassium glasses ('sodium'), LKG, were the predominant group, whereas specimens with higher potassium oxide content (which may be called 'ash') glasses, HKG, were in the minority[1].

The classification of artifacts into respective technological sub-groups is made difficult by, among others, the difference in opinions on the degree of potassium concentration in glasses that suffices to indicate the addition of plants rich in soda (halophytes). R.H. Brill (1992: 15) sets the line at 2% K_2O. Other researchers (among others, Forbes 1957: 115ff.; Rehren 2000: 1225; Freestone 2002: 68) have adopted similar values, considering specimens with less than 1% K_2O and MgO as typical Roman soda glasses.

In turn, some specialists (Sayre and Smith 1961: 1824ff.; Smith 1963a: 283–290) believe that typical Roman glasses melted using a mineral soda contained less than 1.5% of potassium oxide and just as much of magnesium (similar degrees of concentration: 1.5% both for K_2O and MgO adopted by Freestone, Bimson and Buckton 1990: 271–279). Also V.A. Galibin (2001: 75) believes that ash glass should contain no less than 1.5% K_2O, whereas Na_2O:K_2O should be 7.5. Still lower degrees of concentration were assumed by J. Scapova (1975: 34–35) and M. Dekówna (1980: 31): K_2O lower than (or equal to) 1.3%, with the proportion of Na_2O:K_2O less than 1:13. This author had adopted similar criteria until recently (Stawiarska 1984; 1993b; 1999), but now believes a more cautious approach is in order: 1.5% K_2O.

This paper presents the soda high potassium artifacts with a K_2O content ranging from 1.5% to 4% (including a few with 6%), which may be considered as ash glasses. Their potassium fraction in the general sum of the alkaline content, i.e., the K_2O:(Na_2O+K_2)x100%, is between about 8% and 20% (see Tab. 1 and Fig. 4), which is equivalent to the proportion of that fraction in the ashes of many halophyte plants such as *Kalidium caspicum*, *Keli*, *Salicornia herbacea*, *salsola kali* and others[2]. The chemical composition of halophyte ashes has been analysed by several researchers, especially M.A. Bezborodov (1969: Tab. 5), R.H. Brill (1970; 1999) and Y. Barkoudach and J. Henderson (2006).

One should also note the ambiguities regarding the content of the other glass-making component, magnesium oxide, in the recipes. Items with the MgO content below 1%, which dominated in the discussed period, are considered as low magnesium (LMG) glasses. For the high magnesium (HMG) glasses there are no degrees of concentrations; T. Rehren (2000: 1225–1226) speaks of typical values. For the high potassium-magnesium glasses (HKMG), it is 4% MgO.

As an indicator of alkali use for melting one can use the phosphorus content in the glass, e.g., it is more than 1000 ppm in the raw material of products from the Sassanid

[1] Some researchers, including Tomasz Purowski (2012: 155), divide the glasses melted according to the soda recipe into 'mineral' and 'ash' variants.

[2] Halophytes grow on salty soils, near the sea, mainly on marshy coasts, in mainland salty areas and in some deserts and semi-deserts.

workshop of Veh Ardašīr in Mesopotamia (Mirti *et al.* 2008: 443). In artifacts made with the use of mineral soda, the content of P_2O_5 usually reaches several hundredths of one per cent, but in some glasses it reaches 0.25% (Velde 1990: Tab. 3). However, phosphorus has not been taken into account in the published results of most analyses of glasses from the territory of the Empire, as well as from Poland.

Another controversial issue are the extra-recipe reasons why potassium can be found in the raw material. Small concentrations of K_2O may have got into the glass mass from the crucibles (Jackson, Cool and Wager 1998: 58). It has also been suggested that it may have been the ash from the wood-burning furnaces (Tal, Jackson-Tal and Freestone 2008: 91), but these claims are not well documented. When making technological assessments of respective glasses one should keep in mind the error threshold in the analysis. For this reason it is advisable to use due caution when determining the K_2O concentrations that will be threshold values for distinguishing soda and ash sub-groups.

The description of a sub-group of glasses cannot be limited to observations of the chemical properties of the raw material; other features include form, morphology of the artifacts, and technology of production.

GLASSES WITH HIGH POTASSIUM CONTENT (ASH GLASSES) FROM THE TERRITORY OF POLAND

There are currently for consideration results of physico-chemical analyses of approximately 170 products from the Roman period coming from the territory of Poland. The analyses, which were carried out at the Institute of Archaeology and Ethnology, PAS, in Warsaw, applied the spectral emission method (for 23 components) and the flame photometry method for determining the alkali (cf. Stawiarska 1993a). A small group of glasses: 26 specimens of mostly beads and just a few vessels, turned out to have increased potassium oxide content (HKG). The beads came mainly from northern and central Poland, whereas the vessels from the same areas as the beads and from southern Poland as well. The author has had personal access to most of the finds, which were found in well dated burial assemblages (for more details, cf. Stawiarska 1984: 102–106; 1985: 64–78; 1987; 1999).

Beads

More than 22 beads are made of soda glass with a higher K_2O content, which is more than 25% of all such analysed ornaments from the territory of Poland. The remaining 75% were made from Roman low potassium sodium glass typical of the Roman period (cf. Stawiarska 1984: 41). The former come from burials from the second half of the 2nd–early 3rd century (Phase B_2–C_{1a} after Eggers 1955) from the Wielbark and Bogaczewo cultures, from sites in Lubowidz, Odry, Pruszcz Gdański,

Table 1. Chemical features of Roman ash glass from Poland. Type III – Na-K-Ca-Mg-Al-Si; Type IV – Na-K-Ca-Mg-Si; Type V – Na-K-Ca-Al-Si; Type VI – Na-K-Ca-Si; n.d. – not analysed; *supposed ash glasses, ash type-glasses uncertain; cat. no.: see Stawiarska 1987. For a description of the artifacts and full analysis results, cf. Stawiarska 1984: 102–106, Appendix 1; Stawiarska 1999: Appendix 1

App. no	Site, grave, cat. no.	Na_2O	K_2O	CaO	MgO
54*	Pruszcz Gdański g. 168, no. 133	16.80	1.30	7.60	2.40
55a	Lubowidz g. 105, no. 139	16.60	1.55	7.60	2.33
55b	Lubowidz g. 105	~16	~1.5	6.70	1.35
56	Lubowidz g. l05, no. 137	17.00	1.65	8.20	2.47
57a	Lubowidz g. 249, no. 134	16.80	1.75	8.90	2.65
57b	Lubowidz g. 249	~17	~1.7	~8	~2
58a	Lubowidz g. 52, no 138	16.00	1.75	8.00	2.80
58b	Lubowidz g. 52	~16	~1.7	~8	~2
58b	Lubowidz g. 52	~16	~1.7	~8	~2
59	Wyszembork g. 27, no. 33	~15	2.70	9.80	2.75
60a	Odry g. 127, no. 164	10.00	1.80	9.00	2.0
60b	Odry g. 127	~10	≤1	~9	~2
61	Wyszembork g. 19, no 147	9.20	2.00	12.50	2.60
62	Rusinowo lose, no. 152	15.20	2.80	10.40	2.15
63	Szwajcaria h VII, g. 2, no. 144	15.00	2.50	14.00	2.90
64	Niedanowo g. 426, no. 136	15.60	2.10	7.60	2.75
65	Wyszembork g. 313, no. 145	13.00	2.75	10.00	2.45
66	Wyszembork g. 321, no. 11	~12	~3.5	13.00	2.45
67	Borkowice g. III, no 146	14.00	3.10	11.20	2.45
68	Borkowice g. III, no. 151	12.60	2.05	10.80	1.77
69*	Rusinowo stray find no. 58	18.40	1.45	8.20	1.10
70	Wyszembork g. 319, no. 60	16.00	1.85	7.60	1.70
71*	Odry g. 137, no. 19	15–20	≤1	9.40	2.80
72*	Pruszcz g. 210, no. 14	15–20	~1	9.90	1.45
74	Kowalki g. 7, no. 77	~15	~2	7.00	0.59
76*	Wyszembork g. 321, no. 34	15–20	1–2	8.00	1.65
92	Brześce Kolonia g. 22, no. 49a	~18	2.50	7.80	0.83
184	Pajewo Szwelice g. 3, no. 76	17.00	2.50	11.00	2.85
186	Wrocław-Zakrzów g. 1, no. 199	13.87	2.02	5.76	2.64
187*	Wrocław-Zakrzów g. 1, no. 2–4	16.35	1.41	4.38	2.07
115	Konopnica, stray find, no. 214	7.80	2.40	19.00	2.10

Al_2O_3	Fe_2O_3	PbO	CuO	Type	RN	(K_2O)	(MgO)
2.55	2.50	~3.0	1.500	III	1.81	(7.2)	(24.0)
2.30	2.24	>2.5	1.800	V	1.82	(8.6)	(23.5)
2.25	2.18	>2.5	1.800	III	2.10	(8.6)	~(16.8)
2.40	2.45	>2.5	1.270	III	1.75	(8.9)	(23.1)
2.27	2.00	>2.5	0.800	III	1.60	(9.4)	(22.9)
~2	~2	>2.5	3.060	III	~1.9	~(9)	(20)
2.22	2.60	>2.5	0.750	III	1.64	(9.8)	(25.9)
~2	~2	>2.5	3.800	III	~1.7	~(9.6)	~(20)
~2	~2	>2.5	0.750	III	~1.8	~(9.6)	~(20)
2.00	2.00	>2.5	0.700	III	~1.4	~(15.2)	~(17.7)
2.20	2.35	>2.5	3.500	III	1.07	(15.2)	(18.2)
~2	~2	0.26	0.115	III	~1	~(10)	~(18)
2.20	2.20	> 2.5	0.150	III	0.74	(11.9)	(17.2)
2.15	1.80	0.36	2.250	III	1.43	(15.5)	(17.1)
2.28	1.80	0.72	3.200	III	1.04	(14.3)	(17.2)
1.90	2.25	2.00	0.960	IV	1.71	(11.8)	(26.5)
1.75	2.10	>2.5	2.200	IV	1.23	(17.4)	(19.7)
1.70	1.95	>2.5	10.000	IV	~1	~(22)	(15.9)
1.88	2.00	0.80	2.560	IV	1.25	(18.1)	(17.9)
2.05	2.20	1.95	7.500	V	1.16	(14.0)	(13.4)
2.15	1.08	0.68	1.200	V	2.13	(7.3)	(11.8)
1.62	2.30	1.15	0.830	VI	1.90	(10.4)	(18.3)
1.70	1.65	0.06	0.110	IV?	~1.5	…….	(22.9)
2.12	~5	>2.5	6.500	V?	~1.6	……	(12.7)
2.15	1.80	0.46	0.240	IV?	~2.2	~(11)	(7.9)
1.80	1.80	>2.5	0.330	VI?	~1.9	…..	(17.1)
1.95	1.19	0.35	1.500	VI?	~2.4	~(12.5)	(9.6)
2.55	1.60	0.10	0.000	III	1.40	(12.8)	(20.57)
2.97	0.94	n.d.	1.960	III	1.89	(12.7)	(31.4)
3.24	1.68	n.d.	3.230	III	2.75	(7.9)	(32.0)
3.00	2.60	0.03	0.030	III	0.53	(23.5)	(11.05)

Wyszembork, Szwajcaria, Niedanowo, Brześce Kolonia (Tab. 1: app. nos 54–60, 63–64, 71–73, 75–76, 92), from assemblages from the 3rd century (Phase C_{1a}–C_2) from Wyszembork (Tab. 1: app. nos 65–66) and from the 3rd–4th century (Phases C_{1b}–C_2 and D) from Wyszembork, Borkowice, Kowalki (Tab. 1: app. nos 61, 66–68, 70, 74). These specimens were submitted to physico-chemical analyses as well as microscopic analyses of petrographic thin sections (Stawiarska 1984; 1987).

Beads nos 54–58, 60, 64 are mosaic barrel-shaped specimens with an ornament of transverse or oblique stripes or eyes (in four cases also the chemical composition of the decorative elements was analysed). The remaining beads are monochromatic: mainly barrel-shaped or in the form of short cylinders, dark-red, orange, sand-orange, bright green and black in colour (Fig. 1). They were shaped using various techniques, as evidenced in the thin sections and microscopic photos (cf. Fig. 3).

11 beads were made with the use of more sophisticated methods: fusing of elements (mosaic technique) and stretching of the glass tube (nos 59, 66, 71–72, 75–79). Quite complex operations were performed for the purpose: on the core of a bent rod (Fig. 3:1), then stretched possibly and the mosaic elements fused (Stawiarska 1987: 3:1). Also some of the undecorated beads were made of two layers: the outer red layer was placed on a core made of glass of another colour with lateral structure (Stawiarska 1987: 39–40). The remaining plain beads were made with the simple techniques of free-forming (Fig. 3:2–4, nos 61, 62, 65, 67–68, cf. Stawiarska 1987: 84–85, 88, 94) and winding glass paste on a core (nos 69–70, 74, 92, cf. Stawiarska 1987: 45–48, 52).

The glass used to make the discussed beads from the territory of Poland contains between 1.5% and 3.5% K_2O (Tab. 1). Slightly lower concentrations of potassium oxide were found in the case of glasses nos 54, 69, 71–72, 76. These specimens were included in the discussed group because of other technological and morphological similarities. More than 70% of the glasses with the higher potassium oxide content have also higher concentrations of MgO: more than 2% (or slightly less: app. nos 54–68, 70–71), so they should be classified as high magnesium ones (HMG). The remaining glasses have low concentrations of magnesium oxide: between 0.59% and 1.65% (these are LMGs, cf. Fig. 4). In almost all the specimens the Al_2O_3 concentration is about 2%.

The greatest similarities of chemical composition, forming technique and morphology can be found among the mosaic beads (nos 54–58, Fig. 1). Considerable, also formal similarities indicate that the beads were probably produced in the same workshop. Several red and orange barrel-shaped beads (nos 62–63, 67) have similar chemical compositions and were made using similar techniques. Artifacts made of stretched tubes, which share the chemical composition, are also similar in their morphology and these include specimens nos 59 and 66. Parallels for the chemical composition exist between miniature beads nos 72 and 73 formed by the same technology (observed despite the lack of full analyses of the alkali). Thus, in the group of glasses with higher potassium content, in many cases, morphological similarities are accompanied by

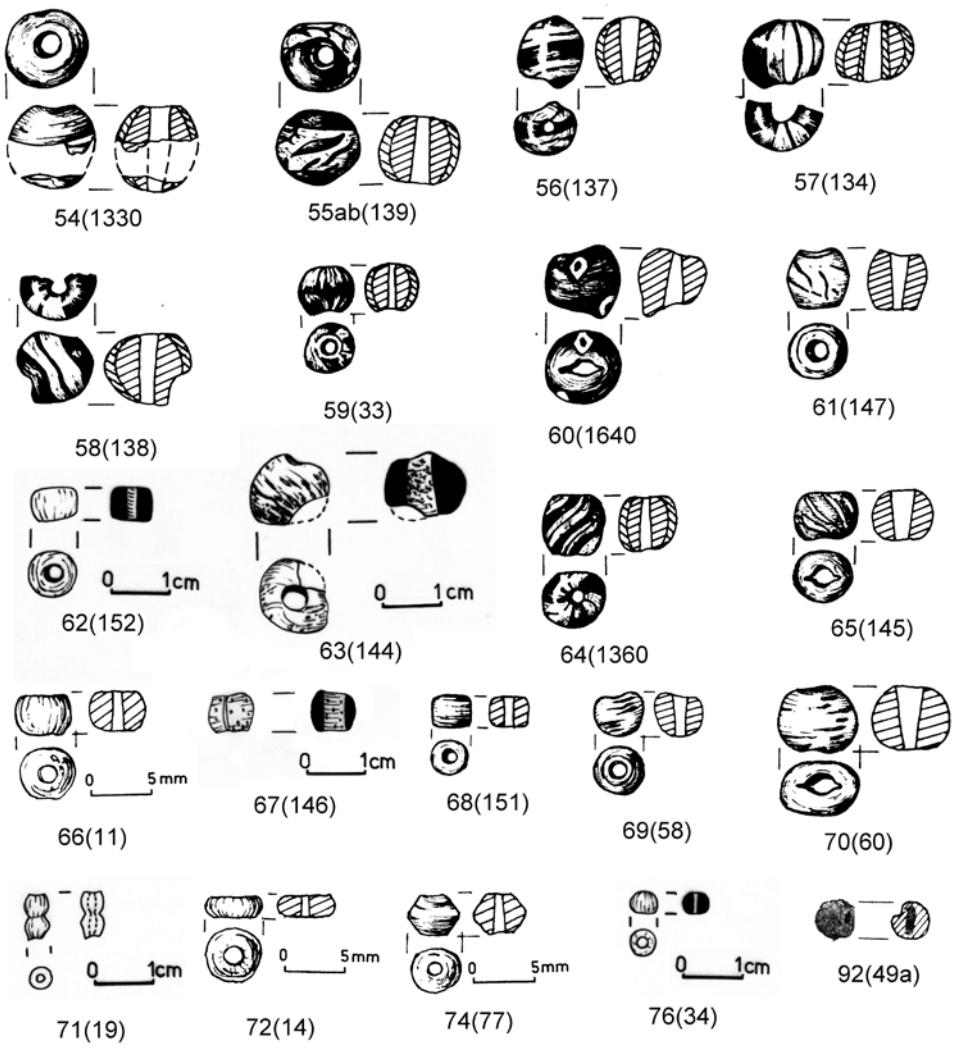


Fig. 1. Beads of ash-type glass from Poland. Borkowice, zachodniopomorskie voivodeship: 67–68; Brześce Kolonia, lubelskie voivodeship: 92; Kowalki, zachodniopomorskie voivodeship: 74; Lubowidz, pomorskie voivodeship: 55–58; Niedanowo, warmińsko-mazurskie voivodeship: 64; Odry, pomorskie voivodeship: 60, 71; Pruszcz Gdański, pomorskie voivodeship: 54, 72; Rusinowo, zachodniopomorskie voivodeship: 62, 69; Szwajcaria, podlaskie voivodeship: 63; Wyszembork, warmińsko-mazurskie voivodeship: 59, 61, 65–66, 70, 76 (in brackets: catalogue numbers after Stawiarska 1987). Drawing by E. Fido

technological ones: chemical composition and forming technique. Relatively close similarities of technology and morphology of the discussed glasses from Poland can be found in specimens from the bead workshop in Tibiscum, Dacia, dated to the 2nd–3rd century (Fig. 4: *T1–7*) (see also Stawiarska 2014: 30–34).

Vessels

Very few vessels made of glass with higher potassium content were found at the territory of Poland (four specimens, Fig. 2, nos 184, 186, 187, 115). They were unearthed in Przeworsk and Wielbark culture cemeteries. A miniature beaker of emerald colour (no. 184) was discovered in a grave from the first half of the 3rd century from Pajewo-Szwelice. A fragment of a thin-walled vessel of unknown form (very deformed due to melting) was discovered in a Late Roman cemetery in Konopnica (no. 115, cf. Stawiarska 1999: cat. nos 76 and 214). The remaining artifacts come from the princely grave in Wrocław-Zakrzów, dated to the second half of the 3rd century. These are fragments of a luxury two-layer (blue-green) artifact, cold-decorated with concentric grooves (no. 186) and a mosaic vessel (no. 187), which, like the other mosaic vessels from that burial, was dated to the early Roman period (glasses from Wrocław-Zakrzów, cf. Stawiarska 1999: 96–97, 159, cat. no. 199, 3–4).

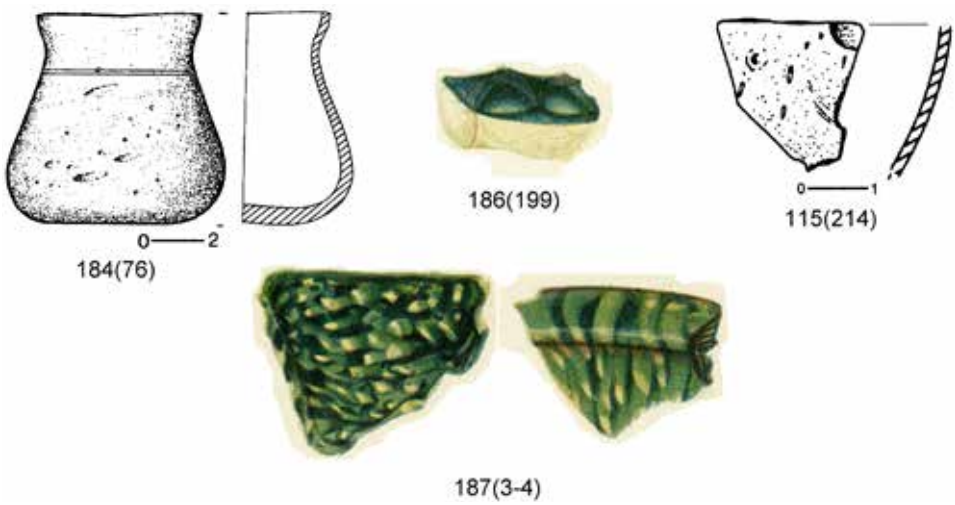


Fig. 2. Vessels of ash-type glass from Poland. Konopnica, łódzkie voivodeship: 115; Pajewo Szwelice, mazowieckie voivodeship: 184; Wrocław-Zakrzów, dolnośląskie, voivodeship: 186–187. Nos 186–187, scale 1:1 (in brackets: catalogue numbers after Stawiarska 1999). Fig. nos 115, 184 after L. Kobylińska; nos 186–187, cf. Grempler 1887: Tab. VI

The potassium oxide content in the three glasses is more than 2%, in the mosaic specimen, only 1.4%. The MgO concentrations do not exceed 2%, thus these are high magnesium glasses, HMG (cf. Tab. 1, Fig. 4).

As regards the raw material of both the beads and the vessels with the higher content of K_2O coming from the territory of Poland, one should note several regularities. Most are HMG glasses and only a few are LMG; almost all of them are low or medium-alkaline, where the relation of the sum of the alkali to the alkaline earth elements, called the recipe norm (RN), is between 0.74 and 1.8. The one exception is the glass of the mosaic vessel, which is high alkaline (the relation is 2.75).

ASH GLASSES FROM THE EMPIRE AND OTHER AREAS OF THE *BARBARICUM* *

Glasses from the Roman period with a higher content of potassium oxide (HKG), found on various sites in the Empire and in some other areas of the *Barbaricum* (outside Poland), are not very numerous (about 90 specimens) compared to 1000 of the analysed items (it is difficult to establish their exact number).

Some of these artifacts were analysed in the early 20th century (cf. Stawiarska 1984: Appendix 2, nos *6–7, 10, 12–13, 20–21, 33, 35, 37, 48–49, 122, 128, 131–133*). E.R. Caley (1962: 20–21) assessed the results of these analyses as correct and comparable with those conducted later on. However, their publication is not sufficiently detailed, which makes it impossible to use them in full (among others, there are no detailed descriptions and drawings of the artifacts). The remaining specimens were submitted to various physico-chemical analyses in recent decades. For this material there is generally a full dossier on their chronology and their important formal-morphological and other features.

These artifacts, called ash glasses below, are presented in the graph (Fig. 4, cf. also Appendices 1 and 2) with indications of the chemical type of glass, recipe norms (RN) and the values of the potassium fraction (K_2O) in the sum total of the alkali.

These glasses can be divided into two groups (Appendix 2) and one of them, definitely larger (45 specimens), may be considered as relatively uniform. These are artifacts produced in secondary workshops: opaque, coloured and mosaic beads, mosaic vessels, decorative *opus sectile* plates, game pieces and dice as well as *tesserae*. They are production remains, half-products and finished products (Elephantine, Hambach); some of the were found in workshops producing ornaments (among others in Tibiscum in Dacia).

The second group comprises the remaining glasses, which are not identified more precisely for lack of source data. They include mainly blown vessels and remains of their production (among others from Ardašīr), one lamp and very few

* The numbers of the items of this group are written in italics

windowpanes. Some of the artifacts are glasses, the use of which could not be determined. Some pieces could represent raw glass, which should also be linked with glass processing.

The specimens with higher potassium oxide content (ash glasses) dated to earlier times come from Egypt: Elephantine, dated to the 2nd–1st century BC (nos *128*, *131–133*); Alexandria, 1st century BC–1st century AD (no. *83*); La Négade, 1st century BC–2nd century AD (nos *530–534*), Rome, 1st century BC (no. *37*) and Salona, 1st century (no. *393*) and 2nd century (nos *6–7*, *10*, *12–13*). The remaining ones are dated to the 2nd–4th century AD and most of them to the 3rd–4th century (cf. Stawiarska 1984: Appendix 2).

In comparison with artefacts from the territory of Poland, high magnesium (HMG) ash glasses with more than 2% MgO are less numerous than the low magnesium (LMG) glasses (35:53). The low magnesium glasses include more specimens melted following the high alkaline norms, in which the RN is more than 3. These are, among others, the early Roman mosaic finds nos *85–87*, *411*, glasses from Alexandria, nos *83* and *122*, Rome, no. *37*, Salona, no. *393* and Elephantine, no. *128*.

A considerable part of the products made in the processing workshops of the Empire (first group) and the above discussed beads from the territory of Poland are opaque. They were coloured with copper and iron compounds, often with high concentrations of lead (PbO 2–16%). According to R.H. Brill and Cahill (1988: 17–19), glasses may have been coloured with copper compounds, among others, this may have taking place at different stages of melting of the glass mass.

Several authors, including M.A. Bezborodov (1969: 130), J.E. Dayton (1993), J.L. Maas, M.T. Wypyski, R.E. Stone (2002), have indicated that coloured glasses may have been obtained using slag of bronze and other metals (also silver) and other metallurgical waste, as well as products of bronze corrosion. The use of 'copper filings' for colouring blue frit is mentioned in some written sources, including Vitruvius (*De Architectura*, VII.xi). According to the so-called Theban Papyri from the 3rd century, malachite, 'purified copper', verdigris, and minium were used for colouring ('seasoning') imitations of semi-precious stones (Stawicki 1987: 122).

The probability of using metallurgical waste for colouring glasses is confirmed by the results of analyses of glasses from the two sets. This may have been both waste from iron production (Salona, no. *10*, Fe_2O_3 8.2%) and lead-bronze (Elephantine, no. *132*, CuO 4.4%, PbO 6.28%; Wyszembork, no. 66, CuO 10%, PbO >2.5%; Borkowice, no. 68, CuO 7.5%, PbO 1.95%) or iron and copper together with lead (specimens from Tibiscum *T11* and *T12*, Fe_2O_3 3–5%, CuO 7.5%, PbO >2.5%, Pruszcz no. 72, Fe_2O_3 5%, CuO 6.5%; Odry, no. 73, Fe_2O_3 5%, CuO 9%).

The majority of the high potassium glasses (HKG) of the second group, representing mostly vessels and windowpanes, are translucent, greenish, blue, natural and colourless glasses. Some of them, found in the western provinces, are specimens with a low magnesium content (LMG, among others nos *33*, *181*, *183*, *353*, *556*, *C1*, cf. Fig. 3).

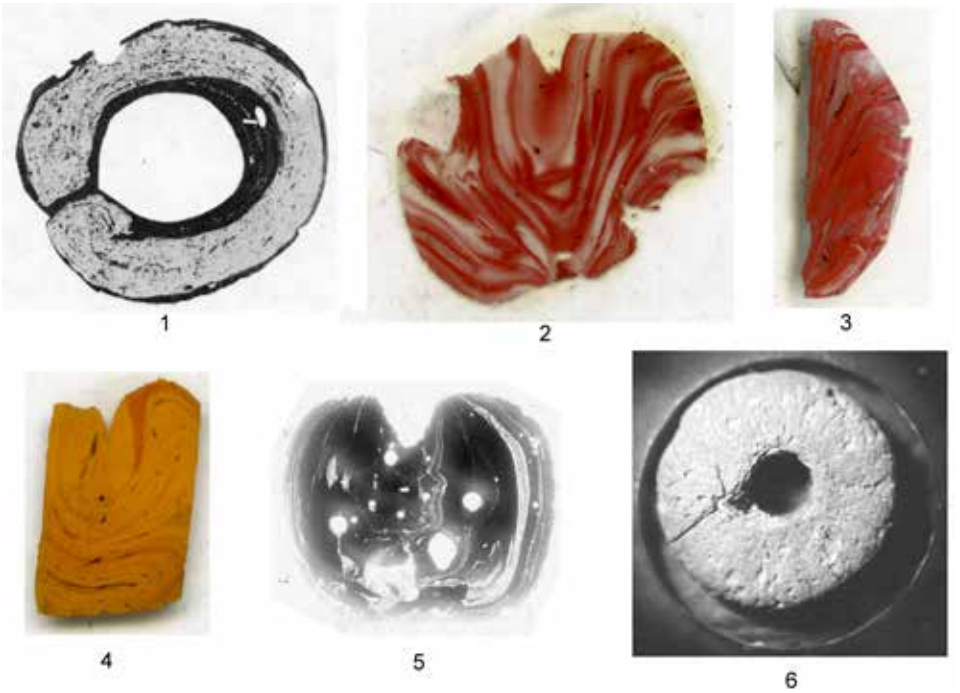


Fig. 3. Thin-section and microscopic photograph of beads from Poland. 1 – glass rod folding technique (bead no. 57); 2–4 – semi-liquid glass melt boring technique (beads nos 60, 65, 61); 5–6 – drawing technique (beads nos 66, 72). Photo by S. Biniewski

SUMMING UP

Although artifacts with increased potassium oxide content comprise a small percentage of the Roman glasses, one cannot ignore their evidently distinct character in comparison to other typical soda glasses made with the use of mineral alkali. To melt the former, other raw materials were used, mainly ashes of halophyte plants. There is no agreement as to when the ash technology appeared and how long it lasted.

According to R.W. Smith (1963a: 284–290; 1963b: 521ff.), soda glasses with higher content of potassium and magnesium oxides (HKMG) occurred mainly in the 2nd millennium BC in Egypt, Greece, Mesopotamia, and Persia, and in the early Islamic period (8th–9th century) in broadly understood Mesopotamia and Egypt. However, this researcher suggests that in Mesopotamia such glasses were continually produced from antiquity until the Middle Ages. In the Mediterranean, they can be found in the Roman period. Cautious confirmation of this comes on the grounds of an analysis of a considerable number of glasses from the territory of the Empire and the *Barbaricum*

with clearly higher concentrations of potassium presented in this paper. Ash from halophyte plants was used probably also to make glasses in the Mediterranean and, as said below, in the western provinces.

In order to melt a large block of raw glass from Beit Shearim in Israel, halophyte ashes were certainly used. Although the find cannot be dated precisely (the block was found without any archaeological context), it is generally assumed that it was not melted before the Islamic period (Freestone and Gorin-Rosen 1999), when the alkaline raw material is said to have been replaced by plant ashes. The raw material of the block has similar chemical features as the raw glasses and production waste from the Sassanid-period workshops from Veh Ardašīr and Choche in Mesopotamia: these artifacts are ash high magnesium (KHMG) specimens (cf. Fig. 4: nos *134–137*, *VI–7*, *185*). Thus, it is not excluded that the glass mass (which was intended to be coloured) from Beit Shearim was melted in the late Roman period (Stawiarska 2009: 189ff.). This was production on a large-scale (export?).

The trade in raw glass in the form of lumps, cakes and rods was probably a normal procedure in the Roman period; areas where workshops melting such glass were located, the range of the export and recycling issues are the main topics of research. Large quantities of coloured glasses were necessary mainly to produce the *tesserae* commonly used for interior decoration.

At present it is difficult to determine which of the many halophyte plant species to be found in the Mediterranean among others were used for glass melting. The chemical composition also depended on which part of the plant was used and how old it was (Bezborodov 1969: Tab. 5; Brill 1970: Tab. 2). It is even more difficult to establish which plants were used based on the MgO concentration in the glass. Namely, this component may have come from ash equally well as from calcium-magnesium raw material (cf. Stawiarska 1984: 35). Ashes were also subjected to many purifying treatments (rinsing, drying, etc.) in the same way as in later periods.

The glasses melted from halophyte plant ashes can be found also in the West, including among others the remains of glassmaking workshops in Köln (app. no. *397*) and Coppergate (Britain, no. *C1*). Some of them came from the late Roman and Franconian periods: the workshop in Hambach (no. *373*) and the settlement in Runde Berg (nos *556–557*). All of them are low magnesium (LMG) glasses. Similar features are evidenced for the glass mass from the workshop in Macquenoise (Tierarche region) from the 5th–6th century and a beaker Type Kempston from Spong Hill from the 5th–7th century (Hunter and Sanderson 1982: Fig. 3; Stawiarska 2000: Tab. 2: e, w).

According to R.H. Brill (1992: 17) mixed alkaline glasses were produced already in the early Iron Age. They were melted using soda combined with potash. The results of analyses of the late Roman and Franconian specimens (second half of 4th–first half of 5th century) found in the settlement of Runde Berg near Urach may suggest that ashes of continental trees may have been added earlier on to glass melted in the West. Beside

the ash glasses, finds included five potassium glasses, evidently melted with the use of the ash of continental plants (Czygan 1987; cf. Stawiarska 2000: app. nos *556–557* and *537–541*). It is assumed that potassium technology appeared at the earliest in the second half of the 8th century (Dekówna 1981). However, researchers have stressed that some western glasses contained increased potassium and they believe that the process of replacing imported alkaline raw material with the ash of continental trees could have begun already during the division and decentralisation of the Empire (Filarska 1952: 26). According to E.M. Stern (1977: 153ff.), this first occurred, among others, in the Franconian forest glassworks. These glassworks, which existed from the late 2nd century, were established by the Romans in the area of Thierache, for example. The change of raw material was a gradual process. Probably mixed raw material was used for the first time and initially a low proportion was added of the ash from the local trees, which were used at the beginning to heat the glass furnaces.

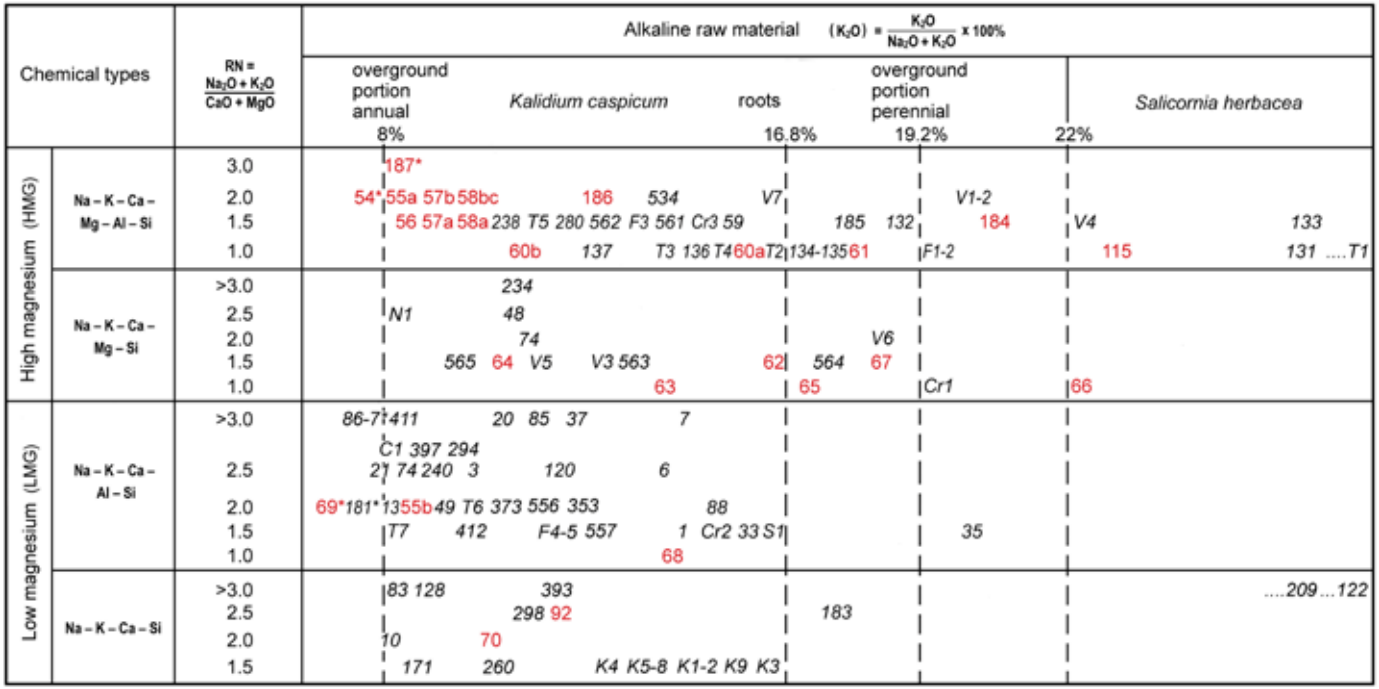
Questions about the frequency of ash glasses in the Roman period and the location of production centres as well as the kinds of alkaline raw materials certainly require further research. To sum up, it is worthwhile to present the following more or less controversial hypotheses:

1. The least controversial is the general statement that glasses with higher potassium content (HKG) were melted using the ash from halophyte plants in the Mesopotamian–Egyptian–Syrian tradition: in the workshops of the Roman East and probably other places in the Mediterranean. These were mainly coloured glasses used to produce ornaments, mosaic vessels, decorative plaques and *tesserae*.
2. More questionable is the assumption that in the Roman period, especially in its later stages, and in the Franconian period, ash glasses (mainly vessels) began to be produced also in the western provinces of the Empire, and these were mainly the low magnesium specimens (LMG).
3. It remains an open question whether in the discussed period mixed, sodium-potassium glasses were produced. They were probably melted with the use of natural soda with an addition of small amounts of ash of continental plants. Such recipes were probably first applied in the West, in the late Roman and Franconian glass-producing centres.

APPENDIX 1. GLASSES FROM THE COMPARATIVE ASSEMBLAGE (Fig. 4)

The correlation table of technological features of ash glasses (Fig. 4) was compiled using the results of analyses of specimens from the territory of the Roman Empire and some parts of the *Barbaricum* presented by T. Stawiarska (1984: Appendix 2; ibid. 1999: Appendix 3). These glasses are marked with numbers.

Fig. 4. Correlation of technological features of Roman Period ash-type glasses: red – glasses from Poland; black – glasses from Europe,* ash-type glasses uncertain



Other analysed glasses are marked with letters: *C1* – Coppergate (Jackson, Cool and Wager 1998: Tab. 1), *Cr1-4* – Corinth (Brill 1999, vol. I: 129, V.W. 3285–3288), *F1-5* – Faragola (Santagostino Barbone *et al*. 2008: FN1, FC1, FE1, FC2, FC3), *K1-9* – Kenchreai (Brill 1999, vol. I: 100, V.H. 973–976, 3060–3064), *N1* – Novae (Olczak 1998: Tab. 1:2), *S1* – Shikmona (Freestone, Bimson and Buckton 1990: 277, 29351U), *T1-7* – Tibiscum (Stawiarska 2014: Appendix 2. no. 31, 39–45), *V1-7* – Veh Ardašīr (Mirti *et al*. 2008: Tab. 2: VA 15, 17, 26, 27, 33, 35, 36).

APPENDIX 2. ARTIFACTS FROM THE COMPARATIVE COLLECTION

Group I. Products and production waste from processing workshops:

- mosaic vessels and decorative plaques: Weisenau, no. *3*, Alexandria, no. *83*, 'Roman millefiori', nos *85–88*, Wechmar, no. *411*.
- beads and enamels: Larbro, no. *280,* Lithuania, no. *209*, Abidnia, no. *234*.
- game pieces and dice: Mainz, nos *48*, *49*, Sedeinga, no. *565*.
- *tesserae* and *opus sectila*: Salona, nos *6–7*, *10*, *13*, Faragola, no. *F1-5*, Kenchreai, no. *K1-9*, Shikmona, no. *S1*.
- remains of glass processing, including finished products: Elephantine, nos *128*, *131–133*, Tibiscum, no. *T1-7*, Hambach, no. *373*.

Group II. Other finds:

- waste from the production of vessels and other artifacts, raw glass: Novae, no. *238*, *N1*, Köln, no. *397*, Coppergate, no. *C1*, Sentinum, no. *294*, Vah Ardašīr, no. *V1–7*, Beit Shearim, nos *134–137*, Corinth, no. *Cr1-3*.
- vessels and lamp: Weisenau, no. *1*, Mainz, nos *20*, *21*, Alzey, no. *35*, Rome, no. *37*, Novae, no. *120*, Alexandria, no. *122*, Komarovo, Ukraine, no. *171*, Intercisa, no. *183*, Choche, no. *185*, Saintes (vessel?), no. *240*, Heis, no. *260*, Luni, no. *298*, Rouen, no. *353*, Salona, no. *393*, La Négade, no. *534*, Runde Berg, nos *556*, *557*, Sedeiga, nos *561*, *562*, *564*.
- window panes: Bonn, no. *33*, Caerleon, no. *181*, Sedeinga, no. *563*.

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Radiolarite sources from the Bakony mountains: new research

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New geological data on the Transdanubian radiolarites and a revision of the so called Szentgál-complex has brought a new archaeological picture of the Bakony mountains. Earlier radiolarite subgroups such as Szentgál-type, Hárskút-type or Úrkút-Eplény-type have no further relevance, because colour variation cannot be used as an indication of the exact location of the different chert outcrops. All possible colour variations, from brick-red to dark brown and varying yellowish, can be found in all parts of the Bakony mountains. Independent CRF-examinations resulted in similar observations. Such radiolarites can be found throughout the Bakony mountain range with uniform variation across the massif. Technological examination of different chopped tools from the surrounding archaeological settlements of Szentgál has provided fresh data: the settlements round Szentgál were not directly connected to the mines and to tool production. The presence of flakes, reduced cores, tablets and large volumes of waste indicate that these were not workshops preparing the mined raw material, but rather sites of regular tool production.

KEY-WORDS: chert, radiolarite, Transdanubian radiolarite, Bakony mountains, CRF-examination, Szentgál-komplex

INTRODUCTION

The diversity of raw materials in the chipped stone industry in the Transdanubian region of Hungary is not that significant. The so-called Transdanubian radiolarite dominates the archaeological lithic assemblages, mostly in conjunction with different grey flint types from Tevel and other areas of the Bakony mountains. Obsidian is seldom found in the lithic collection, as retouched tools or as *supports*. This manner of lithic variation was typical of the Neolithic period and changed only in the early Copper Age/Chalcolithic when bifacial techniques appeared in the region and new communities started to exploit 'local' raw material outcrops (different limnosilicite and opal sources) probably in Burgenland.

Flint was always a very important raw material in chipped stone production. Good knapping quality, conchoidal fracture, the hardness and rigidity of this rock material

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ensured a very good base for tool production. Comparing different materials from the earliest periods, we find extensive variation of the raw materials of different origin and quality (flint, radiolarite, horn flint, opal, limnosilicite, etc., Biró 2010: 198–199). This can be divided into five larger groups as proposed by Antonín Přichystal: siliceous sediments (silicides), minerals of SiO_2, natural glasses, classic silica sediments and other rocks (Přichystal 2010: 178).

The main difference between silicides and silicon dioxide minerals is that silicides contain microfossil remains. These can be radiolarians, foraminifers, echinodermatas or other siliceous sponges (Brandl 2014: 44–45). The different obsidians and horn flints are natural glasses, while the classic silica sediments are built of quartz and flint debris (Přichystal 2010: 178–179). Silicon dioxide constitutes 80–90% of the inner cluster of radiolarian chert and the other main component is calcite. From a petrographic point of view, radiolarians can therefore be preserved in different ways, the selection which types of radiolarian skeletons remain and which are deformed or completely disintegrated occuring during the crystallization process. Even so, the filled out shape can be preserved and is easily recognised under a microscope (Mateiciucová 2008: 48). The colour varies from black to dark brown and different shades of grey; from blue to reddish brown, green, brown or brick-red, white and yellow (Brandl *et al.* 2013: 147). The geological processes responsible for such wide colour variations are not always immediately clear. The red colour is generated primarily by hematite, iron oxide or hydroxide, while the darker colours are created by magnesium chloride or iron (III) chloride. Different iron chlorides are responsible for the green colour (Cheben and Cheben 2010: 26; Hauptmann 1981: 9).

RADIOLARIAN CHERT FROM THE BAKONY MOUNTAINS

Radiolarian chert of different colour is the most representative, beside flint, among the archaeological finds from Transdanubia. Moreover, the Transdanubian variants of chert from Sümeg, Gerecse and Bakony (Biró *et al.* 2009: 26) are the most widespread form of raw material from Hungary in the Neolithic period. Radiolarian chert is an organogenic flint stone occurring in limestone layers from the Mesozoic period (Konda 1986: 165–169). Older cherts are known from the earlier Triassic Period, from a geological formation called the Vászoly and Bruchenstein platform (Budai and Csillag 1998: 19).

The evolution of radiolarian chert in the Bakony mountains started approximately 165 million years ago, already in the middle Jurassic period, in the bench of the Bath level (Dobosi 1978: 12; Dosztály 1998: 277). The main content are the different pure radiolarians: the triptylea and the polycystina (Brandl 2014: 44). A traditional archaeological study classified the radiolarites as Szentgál-type (red), Úrkút-Eplény-type

(mustard yellow) and Hárskút-type (brown) based on the colour of the rocks (Biró 2008: 22). This classification also related the radiolarite types to distinct geological formations, but the geological structure of Bakony Mountains does not support this suggestion. The geomorphology of the mountain range is a unified stratum articulated with basins and slopes. In the Jurassic era, at the Bath and Callovian levels, a large volume of radiolarian was deposited on the limestone in different thicknesses owing to surface variation. Because of this the silicic acid and carbonate content in the radiolarian cherts may vary despite the geologically uniform structure of the mountains of Transdanubia between the Gerecse mountains and Zala Basin (Vörös and Galácz 1998: 76–77). Therefore, a single geological source may yield macroscopically different radiolarian chert, while morphologically similar chert can be found at different locations. Katalin T. Biró recognized this (Biró 1995: 405), but even so, a reddish hue remained the main discriminant of the Szentgál-type in their classification.

The exploitation of various types of radiolarian chert has long been the subject of archaeological research, the main focus being the study of long-range social and trading routes. To support these ideas, different scientific investigations have been applied to separate the types and their sources with a focus on the internal structure of radiolarian chert. The first attempts at these analyses were sporadic and destructive: OES in 1981 (Kozłowski *et al*. 1981), WS, OER, IR, XRD and NAA in 1986 (Biró and Pálosi 1981), NAA in 1991 (Biró and Dobosi 1991; Varga 1991) and different measuring sequences with PIGE-PIXE in 2002 (Biró *et al*. 2002). Within the frame of the Tét-Project a smaller examination with the non-destructive PGAA-method was accomplished on different radiolarian chert samples from the Transdanubian region (Biró *et al*. 2009). This method was successfully applied in other projects on different siliceous rocks (Kasztovszky *et al*. 2009: 37). The main goal behind these investigations was to differentiate the raw materials and connect them to specific geological outcrops. Of prime importance were analyses of trace element distribution. Small quantities and high variability of the raw material available for study identified the origin of the rocks down to the mountains: Gerecse, Mecsek and Bakony, but without differentiating between sources within these mountains. It was also shown that more than one type of radiolarian chert could originate from one geological site and different locations can yield similar samples, too. Examination of geological samples of different chert types from Szentgál, Úrkút-Eplény and Hárskút gave the same UCC (Upper Continental Crust) numbers. Geological samples from the Gerecse and Bakony mountains had nearly the same analytical curve. Moreover, archaeological samples from the excavation of Vörs, identified as cherts from Gerecse, had characteristics similar to the geological samples from the Bakony Mountain – the analytical curve was in full correlation (Biró *et al*. 2009: 38–39). These facts stand in confirmation of the theory that radiolarian cherts from the Jurassic Period are almost identical throughout Transdanubia, from Gerecse Mountain to Zala Basin, making their separation a challenge.

RADIOLARIAN CHERT FROM SZENTGÁL AND THE MINE AT TŰZKÖVESHEGY

The area of the Szentgál-Tűzköveshegy mine was known as a prehistoric site even in the early 20th century. In the 1980s, geological investigations mapped the different radiolarian chert deposits/outcrops. The first archaeological excavations were carried out from 1983 to 1985. Five mining pits and several heaps of radiolarite debris were registered on a wide plateau at the foot of the Tűzköves hill (Biró 1995: 402). There were no distinctive finds and the typological classification of the knapped lithics yielded no information for relative chronology. The radiocarbon charcoal sample from trench V yielded a date of 685±120 BP, referring to the medieval period (Biró and Regenye 1991: 341)[1]. Each mining pit was of a different shape, which may indicate that they were dug in different periods employing different mining methods. The largest mining pit (Object 4) was oblong, almost 3 m at the deepest point and cutting across the radiolarian chert layers. The other pits were shallower (Biró 1995: 407). The main difficulty with the archaeological interpretation of the finds is that chert extraction continued into late medieval times and even the early 20th century.

New material and results

Four geological samples (L86/147–150) were recorded in the Lithotheca (Biró and Dobosi 1991: 47–48). The red types (L86/147 and 150) are described as local materials, the brown and the yellow ones (L86/148–149) as transported by chert miners from geological sources located elsewhere. New geological examinations concentrated on the whole hill and not only on the wide plateau and the vicinity of the modern quarry (Fig. 1).

On the plateau in front of the hill no useable/knapped radiolarian chert was found, most likely due to intensive mining activity in the 20th century. However, at the top of the hill and on the steep slopes a huge amount of debris, fragmented chert platforms and in some cases heaps of mining debris (flakes, bigger fragmented blocks, etc) can be found, occasionally accompanied by late medieval pottery fragments. The thicker chert beds can be traced easily along the whole hillside, where some layers are nearly 30 cm thick. Their colours are brown, red and brick-red, and in some cases, small black veins are visible in the texture of the rock.

CHERTS FROM HÁRSKÚT AND THE MINE OF ÉDESVÍZMAJOR

The raw material sources can be found in a Mesozoic limestone bed in the vicinity of Hárskút, between Gyenespuszta and Némettanya. The Jurassic radiolarian chert in

[1] Two different and independent laboratories obtained the same results (Biró and Regenye 2001: 95).

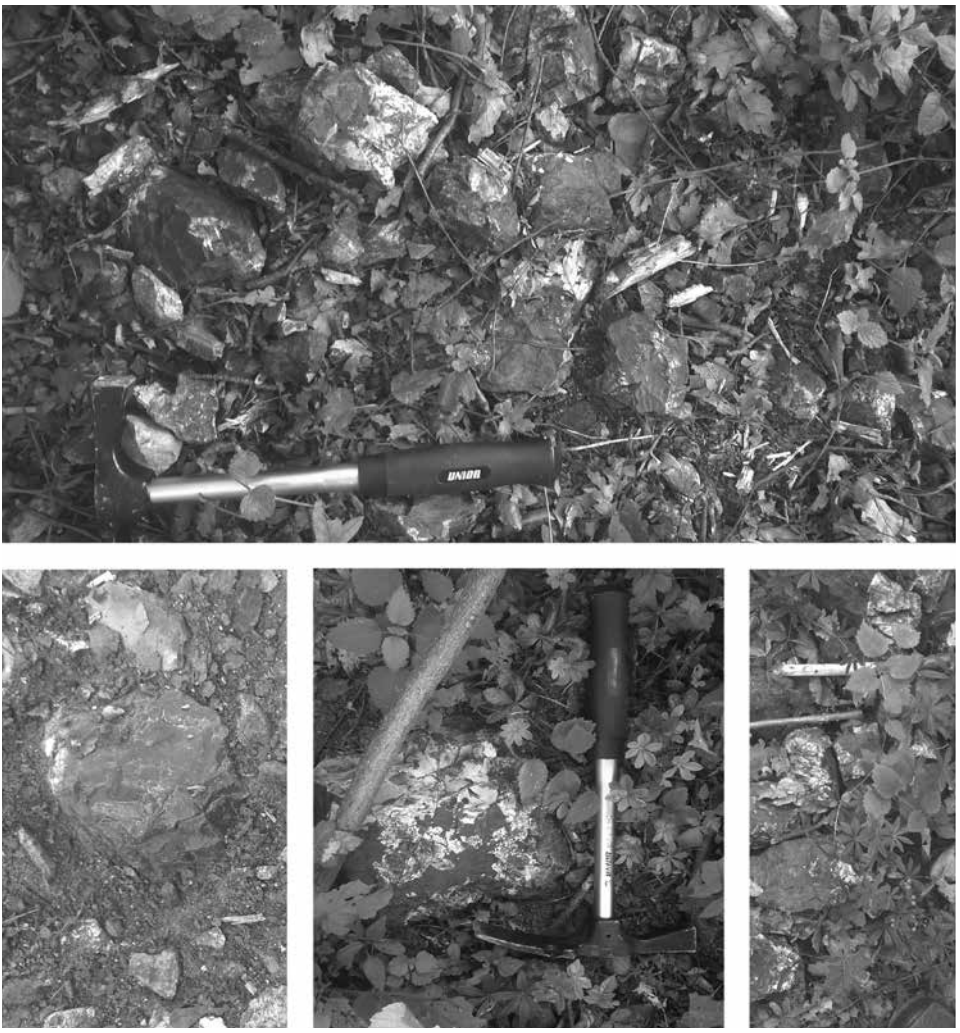

Fig. 1. Fragmented chert platforms in Szentgál-Tűzköves. Photo by the author

this area is mostly red, covering the whole area and can easily be mined. The first prehistoric mine was found during geological testing of the region by József Konda in 1970, the survey focused on localizing different chert layers. Some remains of mining activities were documented in the mining pits, approximately 180 cm below the surface: different mining tools, antlers, stone pebbles and mining debris (Bácskay 1982: 11; 1995a: 408).

New evidence from the collected raw materials

The Lithotheca contains five different geological samples (two pieces from Édesvíz-forrás, two pieces from Gyenespuszta and one piece from the vicinity of the Közöskút). The documented colours alternate between dark brown and red spotted, but the violet-coloured variation is also known (L86/088, Biró and Dobosi 1991: 32, 114). In Biró's traditional grouping only the dark brown chert pieces originate from Hárskút.

The new research in this geological formation concentrated on three larger areas: the smaller hummock between Gyenespuszta and Németpuszta (known also under the name of Édesvíz-forrás), a small hill called Rendkő (mostly its western slopes) in the western part of this area, and another hill called Borostyán-hegy in the southern part of Hárskút.

Hárskút – Gyenespuszta/Édesvíz-forrás (Némettanya) (Fig. 2)

In the vicinity of the known geological point, long strips of cracked platforms, debris and larger fragmented blocks can be detected on the steep slope. Thicker, fragmented and colourful radiolarian chert beds can be found in areas that are deeply rain-washed and on the eroded hillside. The chert deposits can be followed continuously along the northern and eastern sides of the hill. The average thickness of the chert layers is between 5 and 15 cm, but in some cases, much bigger blocks can be documented, 25–30 cm in size. There is a wide range of colours, alternating from the red and deep brown up to yellow and mustard yellow. Two main types of the reddish chert can be distinguished: one with an enhanced red colour which is very similar to the so-called Szentgál-type and the other one of light red colour with mottled dark veins. The dark brown pieces have a very clear and fine internal structure and their matrix is very similar to the Szentgál cherts. Beside these, a very unique chert type was found, until now unknown, changing colour from red to mustard yellow and usually spotted or striped with pale lines.

Hárskút – Rendkő and its vicinity

Colourful radiolarian chert beds can be found on the internal side of the wide hilltop plateau. Fragments of larger concentrations of nodules are present beside the eroded chert layers. The colour variants range from light red to dark brown. In some cases, mustard yellow and red-spotted yellow chert types can also be located.

Hárskút – Borostyán hill (Fig. 3)

A huge number of chert beds can be found around the settlement situated along the old and periodic anabranch of the Aranyos River, which cut deeply into the northern slope of the Borostyán hill along the steep and eroded slope of the hill. This hill is part of the Jurassic limestone massif. Larger nodules, varying in color from red to

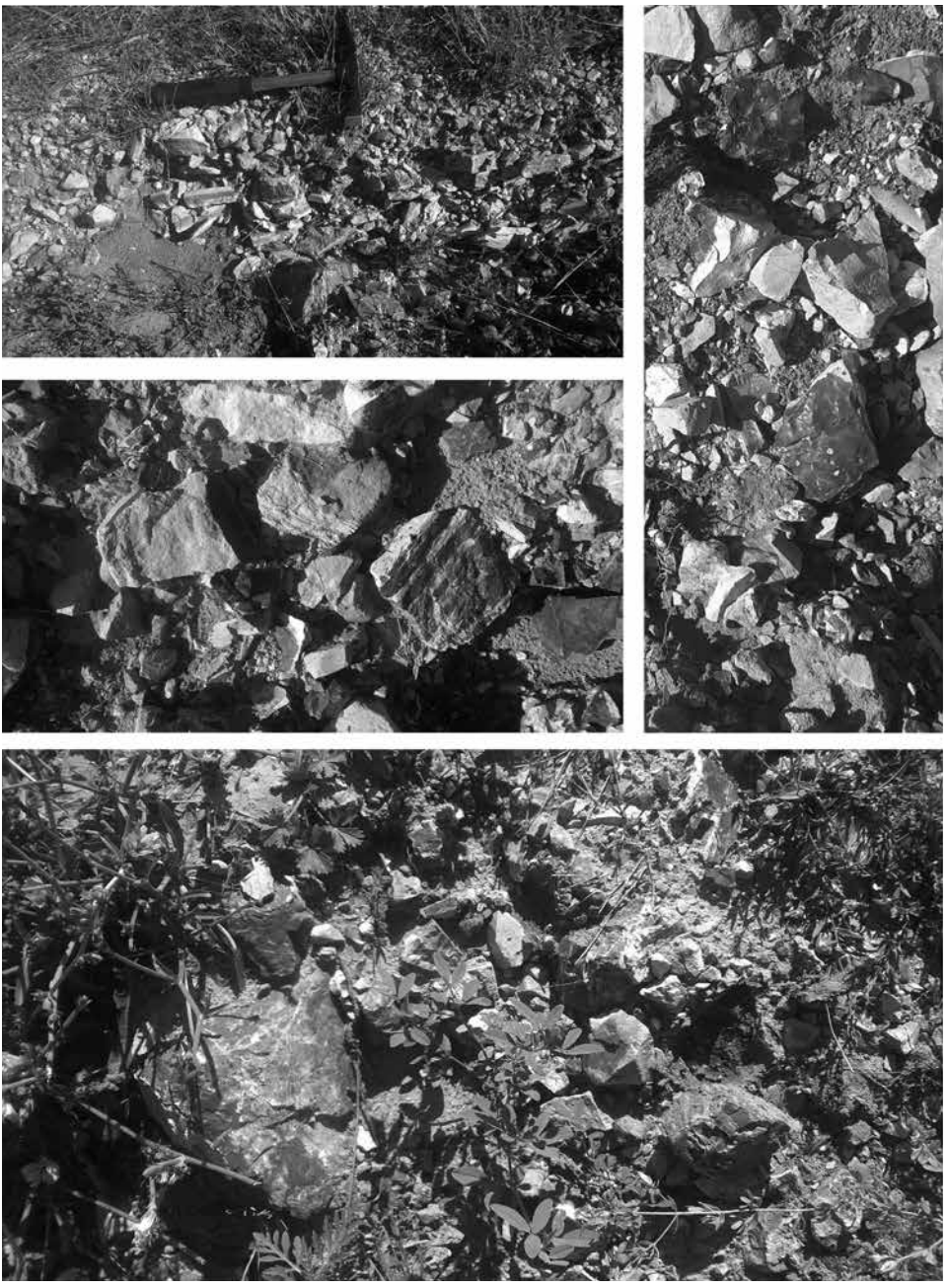

Fig. 2. Cracked chert platforms, debris and bigger blocks in Hárskút-Gyenespuszta/Édesvízmajor. Photo by the author

Fig. 3. Eroded slope with chert beds in Hárskút-Borostyán Hill. Photo by the author

deep brown, can also be seen beside the fragmented chert blocks and bigger deep brown nodules and brick-red radiolarite platforms and blocks have also been documented next to the striped red chert types.

RADIOLARITES IN ÚRKÚT AND IN EPLÉNY AND THE QUESTION OF THE LÓKÚT-TYPE CHERTS

No evidence for mining activity or archaeological finds is known from this area. Yellowish cherts have been recorded in this area. The Lithotheca Collection has three important geological samples registered from the Csárda-hegy hill (L86/171 and

L89/038–039, Bíró and Dobosi 1991: 53, 141), all of which date from the Jurassic period. Their colours alternate between yellow and yellowish brown with white thin veins in the matrix. The area at present is under geological protection and no further collection or examination is possible. There is no evidence for comparative material from the area of Eplény. Geological maps show the Jurassic limestone bed formations mostly in the Lókút area and not in the vicinity of Eplény. Radiolarite chert deposits are found in this deep valley only on the border of Eplény. In the Lithotheca Collection these types were catalogued as chert from Lókút-Hosszúárok (L86/121–123, Biró and Dobosi 1991: 41). In geological research, this valley is eponymous for radiolarian chert formations in Jurassic limestone (Dosztály 1998: 273–274). The most concentrated areas are in the awash valley of the so-called Gyökeres-völgy and in the northern eroded slopes of Mohos-kő hill.

Newly collected radiolarites from Lókút

Deeply cut in the valley surrounded by the northern face of Mohos-kő hill is the southern part of the settlement of Lókút. Radiolarian chert formations are easily traced throughout the rift valley owing to washed and eroded surfaces (Fig. 4). Mostly

Fig. 4. Chert formations in the Lókút-Mohos valley. Photo by the author

rectangular chert blocks can be found in colourful variety. Red, yellow, reddish-yellow, brick-red and brown types can be observed. The red types can be further subcategorised into two assortments: a homogenous type with shiny surface (the same as the so-called Szentgál-type) and a deeper red-coloured chert block formation with dark veins in the internal structure. The mustard-yellow type is also characteristic of the valley and has been registered already in different areas (for example, in Szentgál and in Hárskút). The internal structure of this yellowish chert is very homogeneous and sometimes with faint flecked or darker veins.

RADIOLARITE FROM SÜMEG

The colour of the raw material in this area is mostly grey, but reddish and pink varieties are present. The chert blocks are of high quality. Blocks are 10–15 cm wide mostly in the western part of the mine. As such, it is easy to locate and mine radiolarian chert blocks from vertical limestone layers. In some cases radiolarites appear across large areas on the top of the Mogyorósdomb (Bácskay 1995b: 385–396).

A prehistoric mine was discovered in 1958 and the first archaeological excavation was made by László Vértes in 1960 and 1961. Vértes characterized this early mining activity and placed it within the timeframe of European mines (Vértes 1964): radiocarbon dating put it in the Copper Age (4520±160 BP, Damon and Long 1964: 212–213). Geological exploration was carried out in 1963 and 1976, and from 1976 to 1986 archaeological excavations were continued parallel to the geological investigations (Bácskay and Vörös 1980: 7–8).

More than 500 pieces of different worked/used deer antlers and 800 pieces of quartz pebbles were excavated, nearly all with use-wear traces. Evidence of mining tools included wedge expanders, chisels, and hammers (Bácskay and Vörös 1980: 30–41; Vörös 2007: 28–29). The mining process was generally the same as elsewhere in Europe: upper soil was first removed, following which exploitation of the raw material began immediately in smaller galleries. The size of these pits varied. In some cases, mostly in the case of high quality raw material, radiolarian chert layers were traced to a depth of more than 7 m (Bácskay 1995b: 386).

Newly collected chert material

Nowadays chert outcrops are still easily found in the area. This situation can be documented across nearly the entire hilltop. Radiolarian chert layers stand vertical. The tectonic drifts moved the layers into an upright position, making it easy for the prehistoric miners to find and mine them. Wherever tectonic movements had not altered the situation, layers stayed so deep under the surface that erosion could

not reveal the chert deposits. The greyish chert blocks which reached the surface are very easy to dig out from the limestone.

CHERT FROM BAKONYCSERNYE–TŰZKÖVESÁROK

Radiolarian chert platforms of good quality and good for knapping can be found in the Jurassic limestone formation on the Bath level. Most of them are red in colour with blackish manganese impurities. The first geological survey by Lajos Kocsis in 1967 uncovered some mining pits and mining tools on the western slope of a deep valley called Tűzkövesárok. The average depth of the pits was between 1 m and 2.5 m. Angularly positioned radiolarite layers appeared at a depth of approximately 1.5 m (Bácskay 1982: 10). The mining tools were made of deer antlers which is typical of the Neolithic (Bácskay 1995c: 401).

New data from newly collected chert material

The Lithotheca Collection records only three samples from this area. Their surface is shiny, homogenous and slightly waxy. The colours vary between red and yellowish red, while the third piece (L86/104) is greyish in colour.

The new survey was concentrated in two main areas: the already well known valley of Tűzkövesárok and the valley in the southern part called Hosszú-Kígyós.

Bakonycsernye-Tűzkövesárok

A great deal of eroded chert deposits/layers and fragmented radiolarite flakes can be found in the southern part of the settlement, between the valley of Tűzkövesárok and the place called Erdei Szentély. The layer with radiolarian cherts can be followed easily through the valley. The chert comes mostly as block formations, but also as nodules in some cases. The colour varies from shiny light red, sometimes with light veins (so-called Szentgál-type), to brick-red and dark brown, yellow and mustard yellow. Reddish pieces with yellowish stripes and a less shiny surface have been documented, too.

Bakonycsernye-Hosszú-Kígyós

Chert blocks and nodules can be found sporadically on the eroded surface in the ridding-cut of the Hosszú-Kígyós, dented into the eastern slope of the hill called Hárshegy. The colour of radiolarite pieces alternates mostly between red and dark brown. The larger flint nodules of greyish colour, whitish cortex and homogenous surfaces can be classified as Tevel-type flints. Some sponge remains that can be seen in their matrix under the microscope connect them with the deep-sea formatted flints

originating probably from the Cretaceous age. Only these so-called Tevel-type flints from the vicinity of Pápa were known as local flints until now, this beside the imported flints from Moravia (Biró 2011: 213). It can be assumed that different types of flint nodules can be found in this wider area.

CHERT FROM BAKONYBÉL

This area was never explored for chert resources and there is no archaeological data from the vicinity of Bakonybél. Two bigger geological territories had previously been examined: the so-called Tűzkőhegy and the deep and long valley of the Száraz-Gerence.

Bakonybél-Tűzkőhegy

Eroded flint blocks are present on the surface to the north of the traditional Jurassic formations in the northern and western slopes of the Tűzkőhegy mountain. The so-called Liassic flints can be found in different hues of red, brown and yellow. The use of this raw material is evidenced in the archaeological material from different excavations in the vicinity Pápateszér – Állomás dűlő (Regenye and Biró 2012: 10) and Veszprém – Jutas (Regenye and Biró 2014: 34). A larger dark brown radiolarite nodule was found on the lower terrace of the hill, but its provenience is still questioned, as it could be in secondary position.

Száraz-Gerence

The deep valley of Száraz-Gerence is located in the north of Bakonybél, between the hill of Kőris-hegy and Som-hegy. Many radiolarite pebbles and radiolarian chert flakes can be found in the river wall (Fig. 5). The collected pieces vary widely in colour and type. Colours are between red and brown with white veins, but some yellow pieces with homogenous internal structure have also been documented. The shiny red pieces are very similar to the so-called Szentgál-type radiolarites.

CRF-examination results

A CRF X-ray analytical field instrument was chosen to prove the variation in radiolarian chert from the Bakony Mountain. The set is an analogue X-ray tube which bombs the surface with high intensity beams with the help of an optimized drift detector. The length of the reflected waves shows the presence and the quantity of the different elements (Table 1). The range of the impacts gives the rate between the elements[2].

[2] I am grateful to Zoltán Zentai for the CRF-examinations.

Fig. 5. Radiolarite pebbles in Száraz-Gerence. Photo by the author

Several elements were detected in the different samples: sulphur, potassium, calcium, scandium, titan, vanadium, chromium, manganese, iron, cobalt, nickel, copper, zinc, arsenic, selenium, rubidium, strontium, zirconium, molybdenum, tungstein, mercury, lead, silver, cadmium, tin, antimony, tellurium, caesium and barium. Five of these elements in quantities comparable with statistical methods were detected in every sample: potassium, calcium, titan, manganese and iron. In the case of the other elements, the margin of error of beam impacts was too high in the different samples or it was impossible to detect the amount of certain elements in the samples under examination.

The divergence between groups of samples from different geological sites in terms of potassium, calcium, titan and manganese was statistically significant. Taking into account the average ratio percentages of these elements in the samples, ANOVA showed that only the Fe ratio is similar in each sample, while the ratio of other elements differs significantly (Fig. 6). The control sample from Wien-Mauer does not differ in the ratios from the Transdanubian samples.

A comparative check of different element ratios in the raw material samples demonstrates a significant separation of the manganese ratio in the samples from Szentgál-Tűzköves compared to potassium, calcium and titan (Fig. 7). Thus, it would appear that radiolarites can be differentiated by analyzing the ratio of different elements. However, if we compare this to the results of the hierarchical cluster analysis with Ward linkage, only six bigger groups can be drawn (Fig. 8). The groups are very heterogeneous in terms of sample location. For instance, the Bakonycsernye samples were sorted with samples originating 50 km away. In some cases, the closest geological sources showed the greatest differences, although the samples were taken 100 m apart and their

Table 1. CRF-examination raw data (number of impacts of potassium, calcium, titan, manganese and iron)

Total number of impacts	Number of impacts					Sample No.	Geological source
	K	Ca	Ti	Mn	Fe		
5391.62	35.86361798	49.12290	0	0	14.97491	1	Hárskút-Rendkő
4771.70	39.60789656	23.41409	2.081229	1.091644	20.77645	2	Hárskút-Rendkő
4880.95	33.06774296	16.81353	5.776744	2.093855	36.94936	3	Hárskút-Rendkő
4133.99	38.97832361	24.91491	7.355122	1.674411	24.8779	4	Hárskút-Gyenespuszta
3765.06	30.25927874	15.12300	2.517623	2.194387	47.74452	5	Nagytevel
2939.14	24.20878216	28.43008	4.250563	3.158407	33.80581	6	Bakonybél-SzárazGerence
4792.97	25.01246617	36.15754	2.812452	2.934298	30.99456	7	Tűzkövesárok
21656.79	7.723720828	13.59370	2.381285	56.38837	17.81474	8	Szentgál-Tűzköves
56112.69	2.300691697	93.80358	0.305599	0.525300	2.403734	9	Hárskút-Borostyán-hegy
6129.15	30.86822806	40.67807	3.243353	0	21.7221	10	Bakonybél-Tűzkő-hegy
10287.79	14.99573767	72.81253	1.988279	0	8.551302	11	Bakonybél-Tűzkő-hegy
13461.95	16.87548981	59.54917	2.160088	0.978536	16.75537	12	Wien-Mauer
16690.80	10.21868335	62.85535	1.668584	4.490677	16.96186	13	Wien-Mauer
1416.77	35.55270086	22.87527	6.058852	4.650720	24.09848	14	Bakonycsernye-Hosszúkígyós
38135.47	1.77842308	96.27224	0.201309	0.367243	0.985408	15	Hárskút-Borostyán-hegy

Total number of impacts	Number of impacts					Sample No.	Geological source
	K	Ca	Ti	Mn	Fe		
21024.09	17.17534504	22.23055	4.272194	37.86028	16.66507	16	Szentgál-Tűzköves
6928.93	27.25500185	29.4044	4.027173	3.193278	34.14524	17	Bakonycsernye-Tűzkövesárok
20941.59	5.8639769	86.48856	0.779883	0.506074	5.900459	18	Bakonybél-SzárazGerence
3662.09	35.35958974	21.56692	5.108831	2.607800	32.25917	19	Lókút
3237.19	36.4553826	33.67736	4.633339	0	22.34067	20	Nagytevel
3445.21	19.39243181	49.93281	1.060603	4.463589	22.28572	21	Hárskút-Gyenespuszta
3250.31	21.54809849	43.17619	1.005750	4.698321	24.70195	22	Hárskút-Rendkő
4132.33	28.78981108	37.80361	4.102770	2.325565	21.9663	23	Hárskút-Rendkő
113964.37	1.033902087	98.03161	0.132331	0	0.38054	24	Nagytevel
2849.27	39.21846648	17.36059	4.642242	0	34.7503	25	Lókút
3234.23	26.25168896	23.76516	2.820764	3.365562	36.87555	26	Bakonybél-SzárazGerence
6420.78	0	0	0	63.69475	36.30525	27	Bakonycsernye-Tűzkövesárok
12557.09	21.72278768	27.65139	4.078572	28.06383	15.24812	28	Szentgál-Tűzköves
56952.21	1.394151342	96.49896	0.093903	0.360337	1.522294	29	Hárskút-Borostyán-hegy
2400.05	46.89902294	22.54120	10.75019	0	16.20008	30	Bakonycsernye-Hosszúkígyós
6906.79	23.74518409	28.54553	4.074686	1.472174	37.50338	31	Wien-Mauer
17301.73	8.483082328	84.09454	0.828761	0.420478	5.070938	32	Bakonybél-Tűzkő-hegy

ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
k	Between Groups	3369,777	10	336,978	3,047	,015
	Within Groups	2322,468	21	110,594		
	Total	5692,245	31			
ca	Between Groups	15445,567	10	1544,557	3,336	,010
	Within Groups	9722,864	21	462,994		
	Total	25168,431	31			
ti	Between Groups	99,940	10	9,994	2,442	,041
	Within Groups	85,955	21	4,093		
	Total	185,895	31			
mn	Between Groups	4498,142	10	449,814	2,683	,029
	Within Groups	3352,926	20	167,646		
	Total	7851,068	30			
fe	Between Groups	2254,350	10	225,435	1,815	,120
	Within Groups	2608,939	21	124,235		
	Total	4863,289	31			

Fig. 6. Significant divergence between groups – ANOVA-analysis

formation was the same. Based on these examinations, it is plausible that the Bakony radiolarites cannot be divided into subgroups by the ratio of the elements examined here and should be defined as a single unified group as was the case for the cherts from St. Veit (Brandl 2013: 102).

SUMMARY OF NEWLY DISCOVERED GEOLOGICAL REFERENCE POINTS

General conclusions

Extensive beds of Jurassic radiolarian cherts can be found embedded within Mesozoic limestone at various locations in the Transdanubian mountains. Beside known outcrops of radiolarite (Hárskút, Szentgál and Úrkút), radiolarite layers, fragments, blocks or nodules can be found in numerous locations along the Bakony mountain range (Fig. 9). Revised and new data on chert outcrops in the area enable a refined model of prehistoric chert supply in the region. Prior to this research and mostly because of the theory of the Szentgál-complex, the Szentgál area in the Late Neolithic Period, with the surrounding settlements of Lengyel Culture, was believed to be

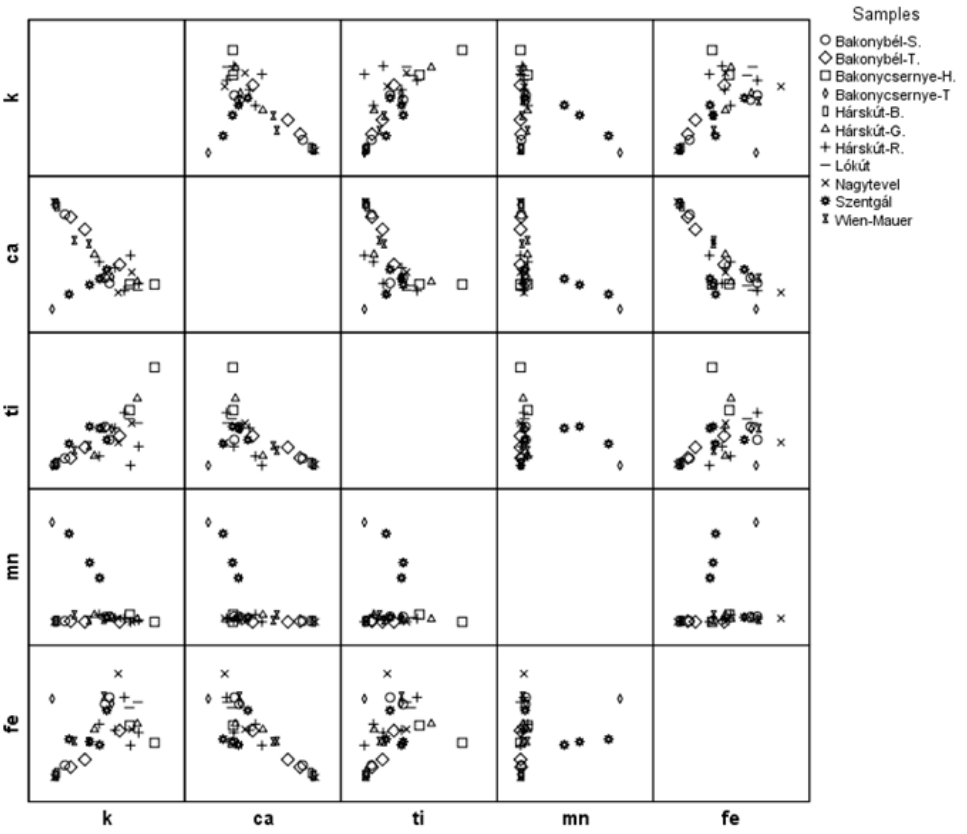

Fig. 7. Significant separation between the different raw material groups

a closed mining centre with specialised workshops. However, the new information reveals a more complex and multi-tier system:

1) Radiolarite of all colour variations, from brick-red to mustard yellow and deep brown, either with inclusions or a homogeneous surface without any insertions, is observed in nearly all areas from Bakonybél to Szentgál and the environs of Bakoncsernye or Sümeg.
2) All the radiolarian chert blocks, platforms or nodules can easily be located on the eroded surface and easily mined.
3) The raw material can be found across a huge area of the Bakony mountains as the radiolarian chert platforms are not impounded into micro-areas. Thick chert layers can be followed from Bakoncsernye up to the Zala Basin. The only difference is

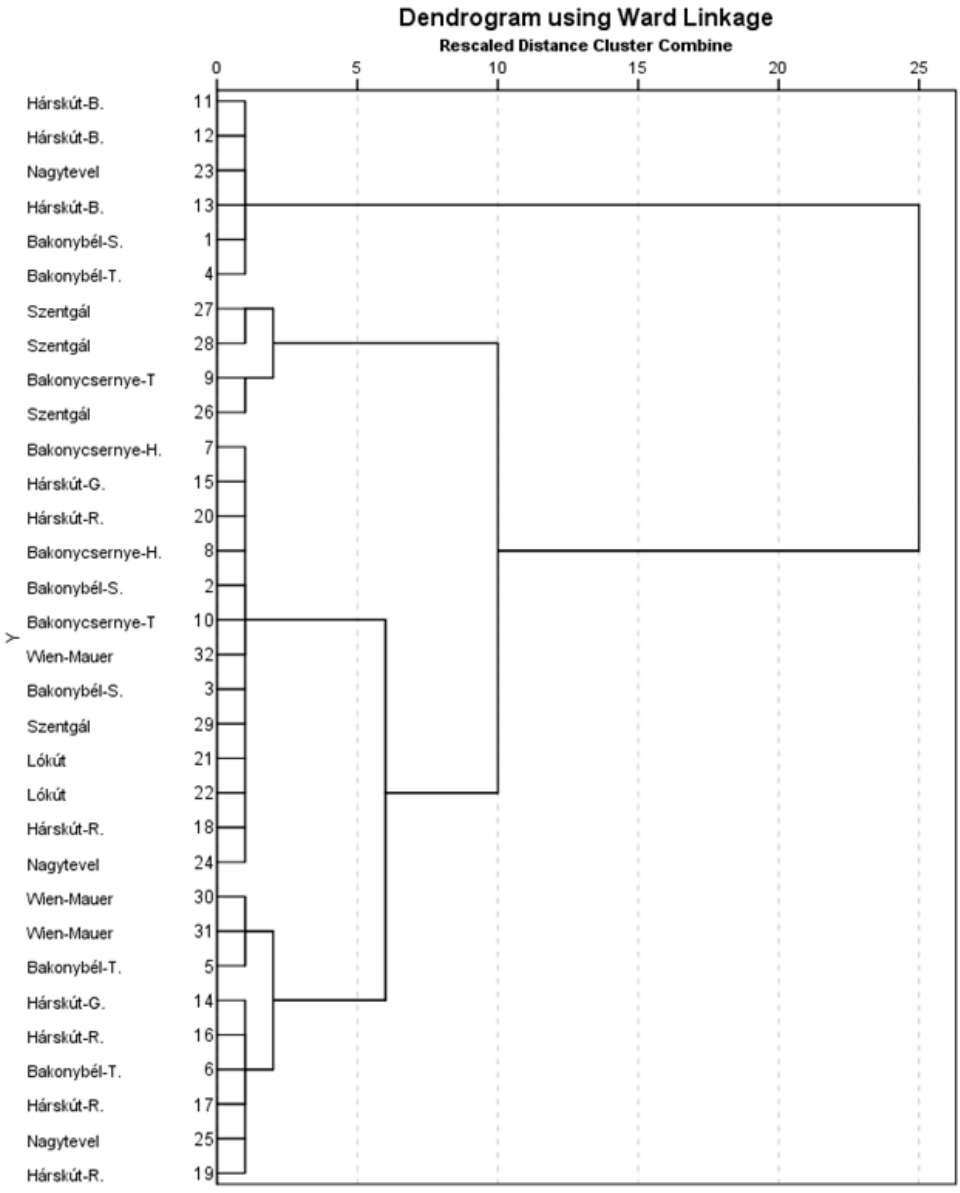

Fig. 8. Cluster analyses with Ward linkage between the different geological sites

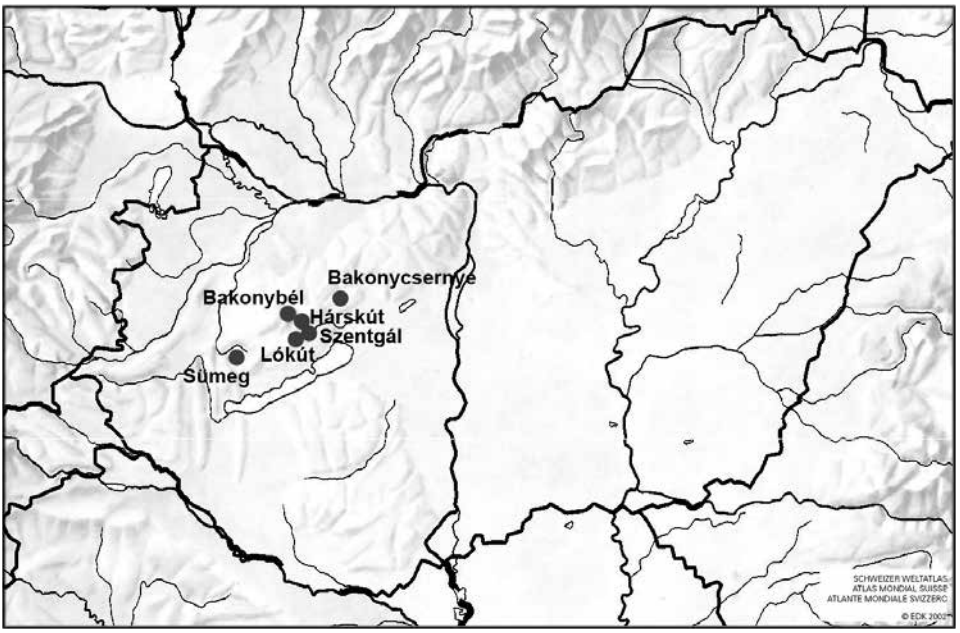

Fig. 9. Location of different Bakony radiolarites

that in the Bakony area chert deposits are localized close under the surface, while in the Zala basin blocks are 100 m deep below ground-level. Sümeg is the only exception, because tectonic movements rotated the limestone plates into vertical forms and erosion brought radiolarian chert deposits to the surface.

4) Cultural tradition sufficed to find these places on the eroded slopes or on the side of periodic streams. No deeper mining knowledge was required to dig out these radiolarite blocks.

Radiolarian cherts from the Bakony mountains cannot be defined or distinguished more specifically to location even with geochemical examination, primarily because all of Bakony is one formation and radiolarites layers were formed in the same period and under the same circumstances. The geochemical content of the radiolarites is very complex. In the Mesozoic period, chert platforms started to form everywhere at the same time in the Bath level under the Tethys Ocean. In deeper ocean basins, the conformation started already at the so-called Bajócian level. Thus it is that the formation of different radiolarian chert platforms started at the same level under the same circumstances. Radiolarites in this area have the same complex characteristics almost

everywhere (even if they are located more than 100 km apart). Colour variations are of no importance and the new results of examinations did not provide a geological location either. To conclude, the raw material deposits/outcrops were so famous in prehistoric times for no other reason than that they were easy to locate and easy to mine.

Revision of the Szentgál-komplex

In 2001, Katalin T. Biró and Judit Regenye established a new mining model for the Neolithic period centred on Szentgál. The connectivity models for this mining complex were different over time.

1) Expeditionary from mining centre to the various sites in the age of the Linear Band Pottery culture (LBP).
2) Not used in the times of the Sopot culture.
3) A defensive ring of a couple of smaller mining settlements (Szentgál-Füzikút, Szentgál-Teleki-dűlő, Szentgál-Tobán, Ajka-Pál major, Ajka-Fekete-hegy, Bánd, Herend-Csapberek and Városlőd-Újmajor) established around the mining centre in the Lengyel culture period (Biró and Regenye 2001: 95).

Once these theses are compared with the results of new technological examinations of samples from West Hungarian sites and the newly discovered geological resource areas in the Bakony region, a completely different picture emerges.

The expeditionary connection model for the LBP period is plausible. The only issue is how the raw material was transported to the settlements: by specialized groups or directly from the resource site to the place of application by the knapping group? As regards Sopot culture, the case is more than ambiguous. Szentgál-type radiolarites are missing completely from the lithic assemblages and the yellowish types dominate the chert material. Reddish Szentgál-types have been recorded among the chipped stones from Baláca (Biró *et al.* 1989: 57; Biró and Regenye 1991: 356), but other colour variations have been demonstrated to originate from Szentgál as well (or perhaps the red-coloured cherts were transported from other sites where the resource was available, like Hárskút and Lókút; after all, the red types can be found from Bakonycsernye to Úrkút).

With regard to the Lengyel culture model, it is difficult to combine the newly discovered data with the existing model. Some groups may have shared the cultural traditions and mining locations in the Szentgál area, but it is more realistic to assume that chert was mined in a far larger area. Different communities could have used different raw material outcrops all over the Bakony Mountains at the same time. The lithic material from the settlements around the mine of Szentgál presents classical workshop material, just as Katalin T. Biró suggested in her publications (Biró 1993–94; Biró and Regenye 1991; Biró and Regenye 2001). But from a technological point of

view, the interpretation of these materials gives a different view. The flint debris is a classical waste assemblage from flint tool production, not the pre-processing of mined raw material. These settlements were not processing workshops connected to the mines, producing pre-cores for other settlements, but rather places of regular tool production like in every Neolithic village. For example, if we check the chert assemblages from the Szentgál–Füzikút site, we will see characteristic tool production waste: the cores are used to the very end, prepared from different orientations, truncated from different sides (mostly with *tablettes* or chopped from the cone-shaped end), etc. (Biró 1993–1994: 101, Fig. 10/3, 6, 10). Even the small lamellas were chopped down from different orientations. This can be seen easily on the surface of the used-up cores as well. Beside these, a huge amount of debitage can be found: blades, lamellas and different truncated blades (in some cases, with signs of the percussion failures on the surface). Based on these technological facts, the defending ring around the mine and the pre-workshop activity in these settlements have no grounds in the evidence.

CONCLUSION

New evidence suggests it would be better to use the general name of Bakony radiolarites for the cherts from this area. The designations of smaller groups like Szentgál-type, Úrkút-Eplény-type, Hárskút-type, etc., which were identified mostly by their colours, should not be used anymore. All manner of colour variation can be found in each and every geological source and it is impossible to define them even by geochemical examinations. Radiolarite is a very common material, easy to find throughout the Bakony area and easy to mine, and therefore, precisely because of its commonness, it is pointless to try to pin it down to specific locations.

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