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Early medieval glazed objects from the Wrocław and Opole strongholds: function, origin and social significance

Raně středověké glazované předměty z hradů ve Wrocławi a Opoli: funkce, původ a sociální význam

– *Aleksandra Pankiewicz*, Sylwia Siemianowska* –

KEYWORDS:

Glazed items – Silesia – Early Middle Ages – imports and local products – production technology – chemical composition of glazes

ABSTRACT

This study concerns glazed objects from two major centres in Silesia: Wrocław and Opole. All the glazed items from layers dated from the late 10th to the first half of the 13th century are appraised, i.e. ceramic and stone Easter eggs, knobbed rattles, 'stars' and pottery. Each category of artefacts is appraised separately as they differ from each other in terms of the production technique and presumably their provenance. Therefore, the locations of the workshops that produced these items is considered. Based on the collections from Wrocław and Opole, a different frequency of individual glazed items is observed, which is related to their specific distribution and most likely the different role of both centres. A separate issue is determining the value and social function of the glazed vessels, Easter eggs and rattles. In contrast, less emphasis is placed on their symbolic function, as this issue has been widely discussed by other researchers.

* Corresponding author – E-mail address: ohlap@poczta.onet.pl

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Introduction

In contrast to 'ordinary' pottery, glazed products are treated as unique items and, therefore, attract the attention of researchers. Despite numerous studies of medieval glazed pottery, this topic (Żaki 1965; Kaczmarek 1998; Auch 2004; 2007; 2008; 2009; 2012; 2016; Auch, Skrzyńska-Jankowska 2004; Ślusarski 2004; Auch, Trzeciecki 2007; Bodnar et al. 2006; Stoksik 2007, 178–217, 274–295; Siemianowska 2008; Rzeźnik, Stoksik 2011; Wajda 2009; 2013; Dzik 2014; 2016; Siemianowska 2015; Siemianowska et al. 2017; Rozmus 2014, 225–245; Rozmus, Garbacz-Klempka 2017; Gruszczyńska-Ziółkowska, Siemianowska 2017; Siemianowska et al. in print) still remains a mystery, specifically in relation to the western part of Silesia and the Early Middle Ages. This is particularly when it concerns vessels and artefacts other than Easter eggs and rattles.

A subject of discussion is whether the glazed products were made locally or were imported goods. This has been the crux of discussions since the initial studies of this category of artefacts (Hilczerówna 1950; Hołubowicz 1956, 121–123; Olczak 1968, 76–77; Siemianowska 2008; Dzik 2016; Pankiewicz, Siemianowska 2018a, 158; Siemianowska et al. in print). This study briefly refers to the issue of the provenance of glazed pottery divided into different types of objects. Glazed products are not a uniform category. Among the specimens occurring in Poland, which strongly feature in the collections from Wrocław and Opole (Fig. 1–3), Easter egg rattles, knobbed rattles and 'stars'[1] can all be distinguished.

The next consideration is the production technique and technology, i.e. the methods of glazing and the types of glazes. The Easter egg rattles from Opole and Wrocław have already been thoroughly characterised (Siemianowska et al. in print) and the results serve as a comparative background. The issue of the technology for glazing vessels and Easter egg rattles has also been discussed in earlier literature (Hołubowicz 1956, 121–123; Olczak 1968, 76–77; Kaczmarek 1998, 553–555). However, new data on the methods of glazing pottery (Auch 2016, 215–271) and observations resulting from the analysis of the chemical composition of glazes as well as the microscopic observation of artefacts has prompted us to revisit this issue.

Another compelling issue is the social function of the glazed objects. We consider to what extent the glazed products were regarded as valuable items in the Early Middle Ages, how they were distributed and the reason for the varied frequency of individual products at different sites. We focus less on the actual function and the symbolic role of the glazed objects (mainly Easter eggs and rattles). This issue has already been widely discussed by other researchers (Hilczerówna 1950, 15–16; Hilczerówna 1970, 115; Bukowska 1958; Kaczmarek 1998;

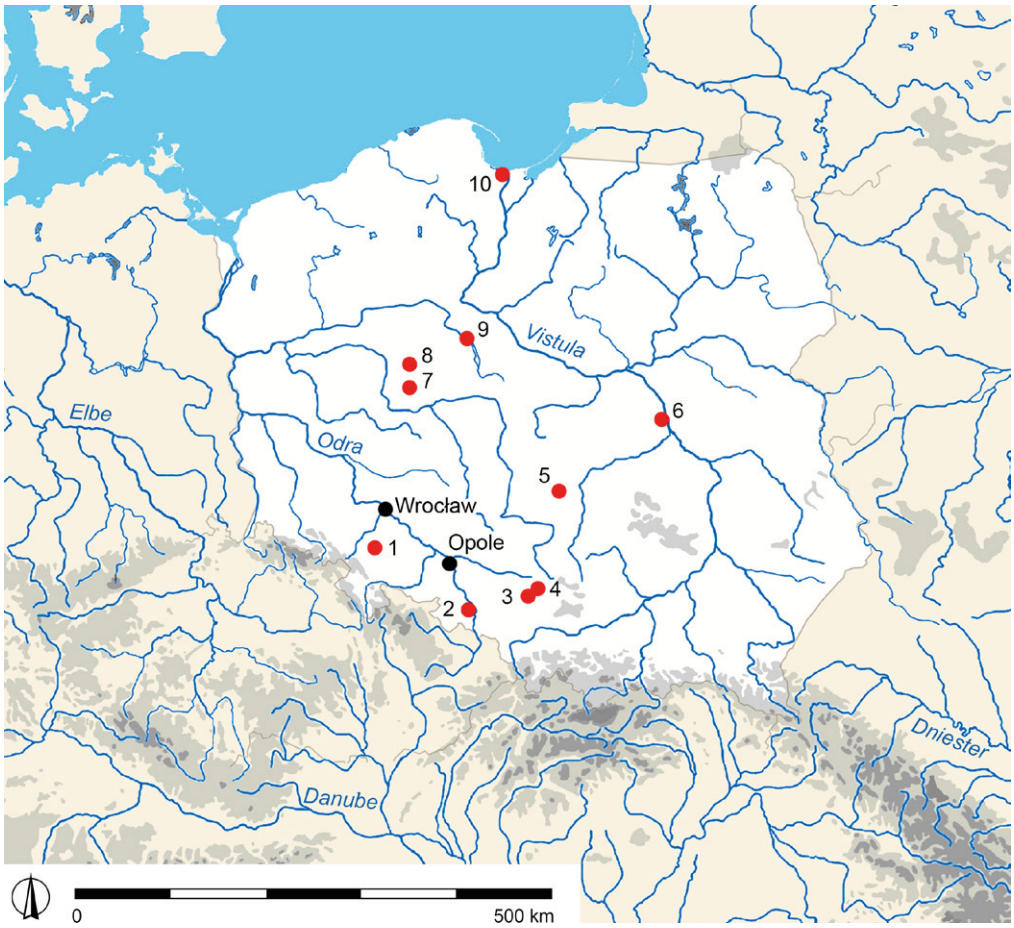

Fig. 1. Location of the studied sites on a map of Europe and other sites mentioned in the article: 1 – Niemcza; 2 – Racibórz-Ostróg; 3 – Strzemieszyce Wielkie; 4 – Dąbrowa Górnicza-Łosień; 5 – Lubień; 6 – Czersk; 7 – Giecz; 8 – Ostrów Lednicki; 9 – Kruszwica; 10 – Gdańsk. Created by S. Siemianowska, A. Pankiewicz.

Obr. 1. *Umístění lokalit zmíněných v textu na mapě Evropy. 1 – Niemcza; 2 – Racibórz-Ostróg; 3 – Strzemieszyce Wielkie; 4 – Dąbrowa Górnicza-Łosień; 5 – Lubień; 6 – Czersk; 7 – Giecz; 8 – Ostrów Lednicki; 9 – Kruszwica; 10 – Gdańsk. Vypracovaly S. Semianowska, A. Pankiewicz.*

Ślusarski 2004, 91–94; Wrzesińska, Wrzesiński 2000, 109–113; Siemianowska 2008, 74–78; Kajkowski 2020).

The basis for this study is all the glazed items from excavations in Wrocław Ostrów Tumski and Opole Ostrówek (Fig. 2–3). These were found during storage and museum queries, and those known from archived data. It must be emphasised that although some items have been featured in literature for years, the majority have never been mentioned in publications (Tab. 1).[2] These finds come from layers dated from the late 10th century to the early 13th century (Tab. 1). The article also includes artefacts from later layers of early medieval origins. The 13th century is a temporal border when glazed pottery related to the so-called location breakthrough occurs (e.g. Niegoda 1999, 160–161; Auch 2016, 7–8). In terms of production workshops and stylistics, it differs significantly from early medieval products so is excluded.

All items found during the museum query were subjected to macroscopic observation. The chemical composition of the glazes was analysed for 14 artefacts. The research was conducted using the X-ray analysis method (EPMA) with the CAMECA Sx 100 device, which provided a detailed chemical analysis of the selected materials. For the glass and glazed objects, it was possible to identify the main glass-forming components as well as colouring elements and discolouration agents. The analysis conditions, controlled on various patterns of synthetic oxides, natural minerals and glasses (Nowak et al. 2010; Purowski et al. 2012), were accelerating voltage 15 kV (electron energy 15 keV), beam current 10 nA and beamwidth on the sample (spot) of 15 microns. Artefacts on which a fracture was visible were also subjected to microscopic examination (BSE images). This enabled to observe the glaze layer and the method of application on the ceramic body.

Glazed Easter egg rattles and Easter eggs

There are nine glazed Easter egg rattles known from Ostrów Tumski in Wrocław. Two of these are completely preserved, three survived in fragments, and the remaining four are known only from inventories (Fig. 4a–e; Tab. 1). Five complete and nine partially preserved specimens were discovered in Opole Ostrówek (Fig. 4f–j; Tab. 1).

The glazed ceramic Easter egg rattles from Wrocław and Opole are in the shape of a hen's egg, although usually slightly smaller than in reality (height 3.8–4.3 cm; diameter approximately 3 cm). They are made of clay paste with an admixture of fine and medium tempering. A space was left inside, in which pebbles or ceramic balls were placed to provide the rattle. They were fired in oxidising and reducing atmospheres although eventually, attempts were made to achieve a bright colour on the body. Specimens from Wrocław and Opole are covered in dark brown or greenish glaze and decorated with white and/or yellow threads running around the specimen or with a feather or festoon ornament (Fig. 2, Tab. 1; see also Siemianowska et al. in print). In terms of typology and style, they do not differ from other objects of this type known from the territory of Poland (Hilczerówna 1950; 1970; Bukowska 1958; Kaczmarek 1998; Ślusarski 2004; Siemianowska 2008).

Easter egg rattles discovered in Wrocław Ostrów Tumski and Opole Ostrówek mostly come from layers dated from the end of the 11th century to the mid-12th century, but also occur up to the mid-13th century. The oldest specimen comes from Opole, layer E3, dated to the end of the 10th century (Tab. 1) although more recent studies on the level of this layer give the dendrochronological date after 1060 (Gediga 2000, 174–176). The need to date the oldest settlement horizons from Ostrówek in Opole has

been emphasised several times (Suchodolski 2000; Dzik 2016, 403–404, with literature). Layer M, which yielded the oldest Easter egg from Ostrów Tumski in Wrocław, is dated to the second quarter of the 11th century. The correction of the chronology was also postulated for this site, in that the layers from trench I–II should be dated to later decades (Moździoch 2000, 344; Robak 2008). The popularity of Easter egg rattles and rattles in Wrocław and Opole, therefore, coincides with the period of their occurrence in Poland, which is usually dated to the 11th–13th centuries (Hilczerówna 1950, 19–20; Wrzesińska, Wrzesiński 2000, 108; Ślusarski 2004, 82; Siemianowska 2008, 70; Kajkowski 2020).

It should be mentioned at this point that apart from the typical Easter egg rattles, three glazed limestone Easter eggs (Fig. 4k, l), as well as limestone and ceramic egg models, were also found in the layers of the Opole stronghold. The completely preserved glazed limestone Easter eggs differ from the ceramic specimens. Apart from the differences in raw materials and because it was made of stone, they could have not functioned as rattles and the distinctly different proportions are particularly noticeable. These Easter eggs are slender and distinctly elongated and vastly different from the ceramic Easter eggs. Instead of surrounding lines or combed patterns, these specimens are covered with floral and geometric patterns in a system of closed rectangular fields.

Knobbed rattles

Knobbed rattles, also referred to by some researchers as warted rattles, can be found throughout the territory of contemporary Poland, especially in the area between the Vistula River and the Odra River (Fig. 5; Ślusarki 2004, 86). As with the Easter egg rattles, their chronological range is the 11th–12th centuries. They are characterised by a spherical or almost spherical shape, semi-circular knobs placed over the entire surface, a small circular opening and most are covered with green, greenish-yellow glaze differing from the body. The aforementioned knobs were made in two ways – they were attached by pins or formed from the outer part of the ball.[3] Small pebbles or clay balls were placed inside them (see Ślusarski 2004, 84–87; Dzik 2016, 397–398).

In Opole-Ostrówek, six specimens of this type of artefacts were found, of which four[4] were covered with green glaze (Fig. 6d, e). They are also the most aesthetic artefacts (see the fragment below) from the entire assemblage. In the case of Opole, glazed specimens were discovered in layers E7 and E5 and dated to the 10th century, while unglazed ones were discovered in layers A4 and A6, i.e. several construction levels higher. Nevertheless, the 10th-century chronology of the glazed rattles is questionable. They would be the oldest such specimens

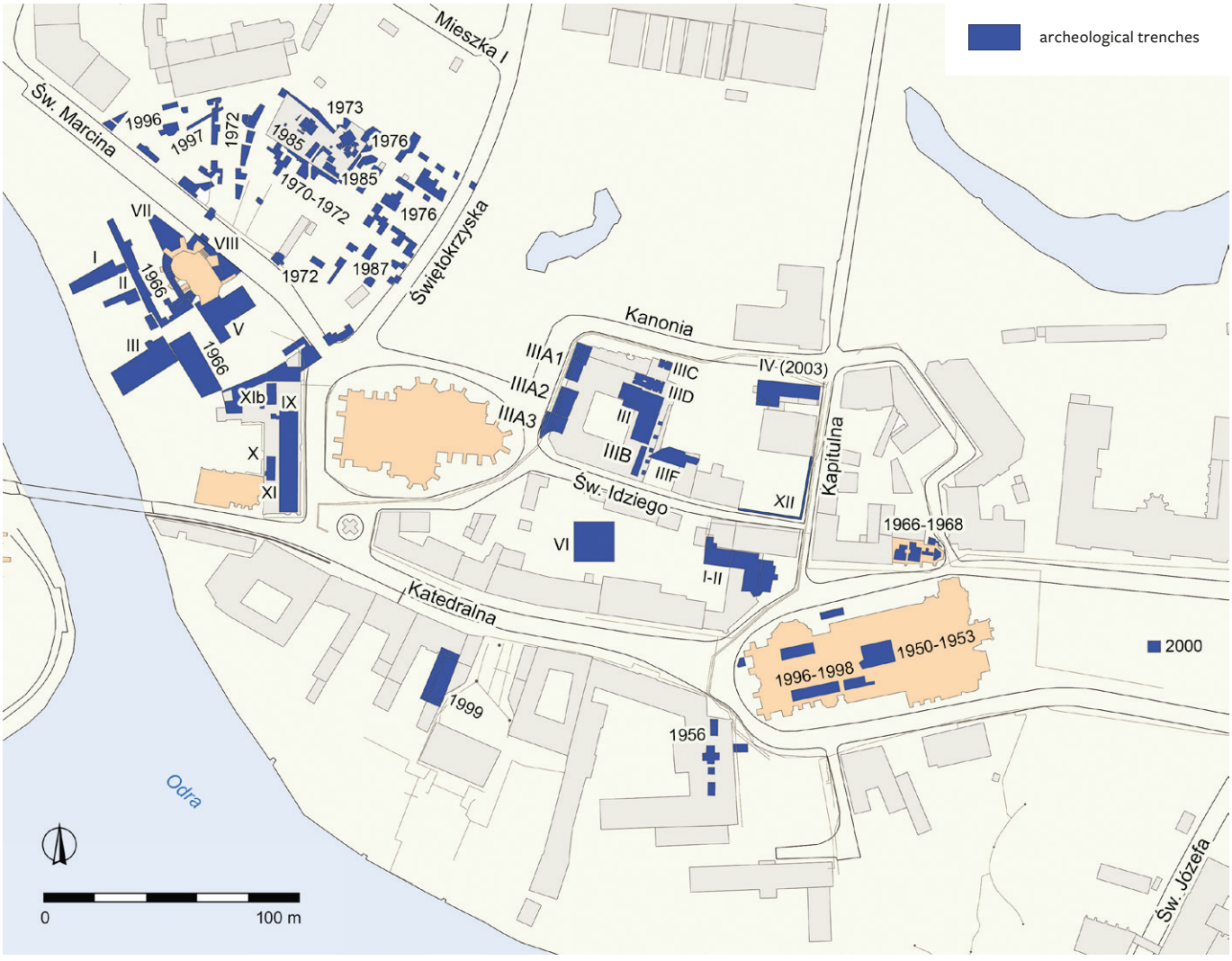

Fig. 2. Wrocław Ostrów Tumski. Archaeological trenches – a plan. Created by K. Chrzan and A. Pankiewicz.
Obr. 2. *Wrocław Ostrów Tumski. Plán lokality s vyznačenými zkoumanými plochami. Vypracovali K. Chrzan a A. Pankiewicz.*

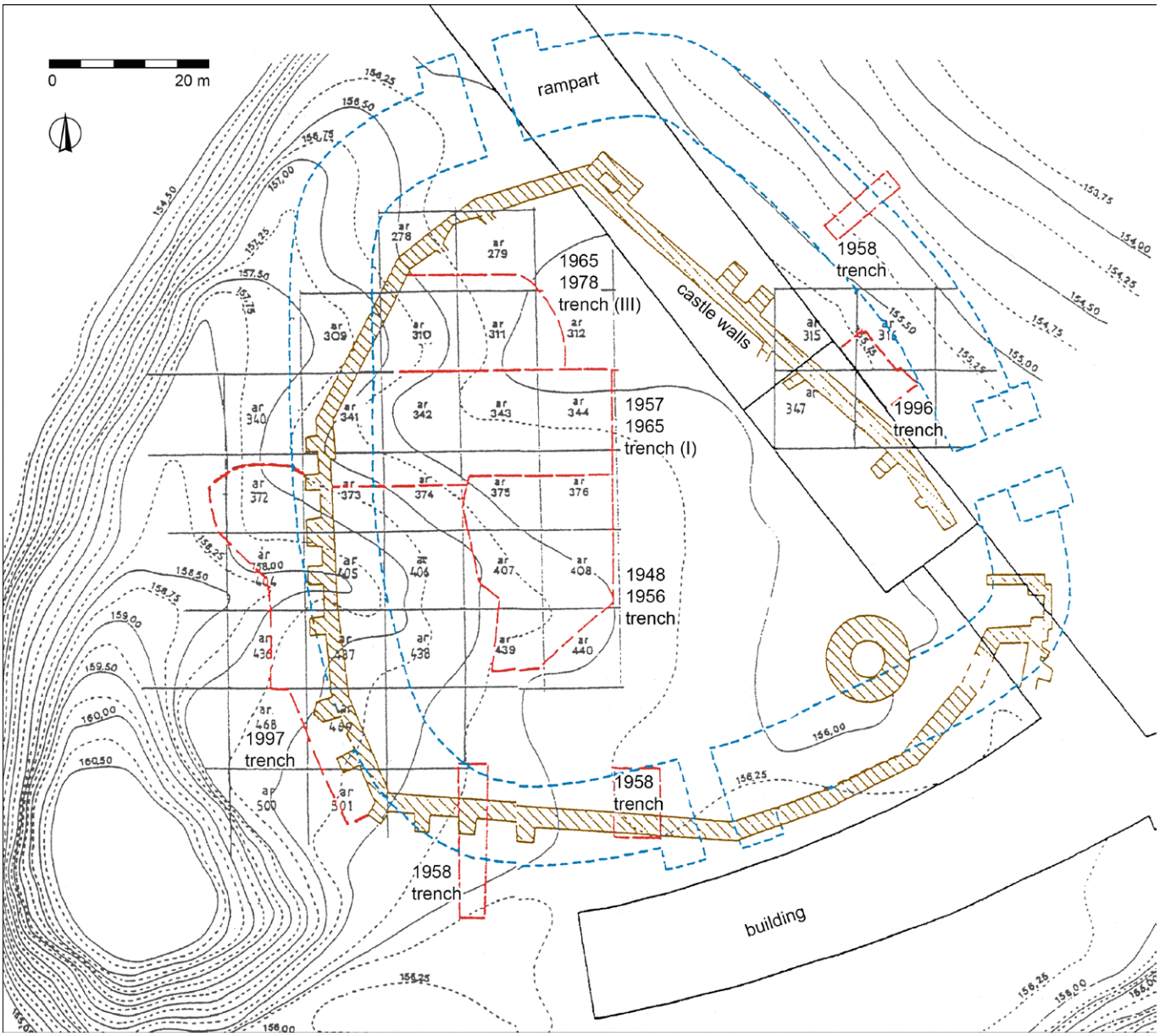

Fig. 3. Opole Ostrówek. Archaeological trenches. From Gediga 2000, Fig. 1.
Obr. 3. *Opole Ostrówek. Plán lokality s vyznačenými zkoumanými plochami. Podle Gediga 2000, obr. 1.*

discovered in Poland. Therefore, it should be assumed that they occurred in a secondary deposit as a result of later interventions and actions.

The finds from the Wrocław stronghold occurred either in the 11th–12th century layers or in the secondary deposit (trenches VII and IIIF). The preserved rattles from Wrocław were carefully made and covered with olive (Fig. 6a) or dark green glaze (Fig. 6b). Both have a small opening in the wall. The third specimen (Fig. 6c) is covered on both sides with dark glaze. The presence of glaze inside questions the unequivocal definition of the object as a rattle fragment. It was originally described as a vessel fragment (Tab. 1) and it cannot be excluded that the glaze got inside through the opening during glazing.

Glazed 'stars'

In the collections from Wrocław and Opole, only two such 'stars' have been discovered, and to this day, only the Wrocław specimen has survived (about one-third of the artefact). It was found in the central part of the stronghold in Ostrów Tumski in the layer dated at the turn of the 11th century. The item was deposited next to dwelling building No. 2 (Tab. 1). It is difficult to determine if it was part of the household equipment or was thrown away because it was damaged. The initial impression of the Wrocław 'star' is that it appears to have been produced quite carelessly. The glaze covering is uneven (Fig. 7a) although the technical details appear to show the opposite. The body is made of light clay with a selected admixture. In the course of macroscopic observation, attention is drawn to the strong 'compaction' of the clay paste from which the object was made. The microscopic BSE image confirms the definite domination of the grain skeleton over the silt binder, which we assume was a deliberate procedure (see below *Early medieval glazing techniques...*). It cannot be excluded that the condition of the preservation of the artefact is the result of secondary firing.

Fig. 4. Glazed Easter eggs-rattles (a–i, m) and limestone Easter eggs (k, l) from Wrocław (a–e) and Opole (f–m) strongholds: a – trench I, layer D, square J; b – trench I, layer F, building No. 4 (smokepit); c – trench I, layer H1, squares 41, 42; d – trench I, layer M, between buildings No. 5 and 3; e – IIIF trench, layer B5–C3, squares 3, 5; f – trench I, layer A4, are 344, m² 6f; g – trench I, layer C1, are 342, m² 9g, outside the building No. 19; h – trench 1948–1956, layer E3, are 407, m² 6h; i – trench 1948–1956, layer A1, are 376, m² 2b; j – trench 1948–1956, layer C3, are 407, m² 6g, building No. 6; k – trench 1948–1956, layer D2, are 375, m² 9a, building No. 14; l – trench I, layer D2, are 375, m² 9a, building No. 14d; m – trench 1948–1956, layer A4, are 408, m² 2h; photo by K. Jaworski, A. Pankiewicz, S. Siemianowska, Archive of Instytut Archeologii i Etnologii Polskiej Akademii Nauk (IAE PAN) in Wrocław.

Obr. 4. *Glazovaná keramická vajíčka – chřestítka (a–i, m) a vajíčka z vápence (k, l) z výzkumů na wrocławském (a–e) a opolském hradě (f–m): a – sonda I, vrstva D, parcela J; b – sonda I, vrstva F, dům č. 4 (udírna); c – sonda I, vrstva H1, čtverce 41, 42; d – sonda I, vrstva M, mezi domy č. 5 a 3; e – sonda IIIF, vrstvy B5–C3, čtverce 3, 5; f – sonda I, vrstva A4, ar 344, m² 6f; g – vrstva C1, ar 342, m² 9g, vně domu č. 19; h – sonda 1948–1956, vrstva E3, ar 407, m² 6h; i – sonda 1948–1956, vrstva A/1, ar 376, m² 2b; j – vrstva C3, ar 407, m² 6g, dům 6; k – trench 1948–1956, vrstva D2, m² 9A, dům č. 14; l – sonda I, vrstva D2, m² 9A; m – trench 1948–1956, vrstva A4, ar 408, m² 2h; foto K. Jaworski, A. Pankiewicz, S. Siemianowska, Archiv Instytut Archeologii i Etnologii Polskiej Akademii Nauk (IAE PAN) ve Wrocławi.*

A ceramic star-shaped pendant or mace discovered in Opole Ostrówek is covered with aquamarine-golden glaze. As with the Wrocław specimen, the layer of glaze is thick and rough in places. The Opole 'star' has a diameter of about 4.5 cm and is characterised by seven points and a funnel-shaped opening with an outlet with diameters of 2 cm and 1.2 cm (Fig. 7b). The 'star' was discovered by the hearth in house No. 9, in a layer dated from the last quarter of the 11th century to the beginning of the 12th century (Tab. 1).

Ceramic 'stars' are also exceedingly rare artefacts in Poland and Central Europe. The specimens from Wrocław and Opole are the only ones known in Silesia. Occasional specimens occur on sites in northern and central Poland and were discovered in Kruszwica, Giecz and Czersk, as well as in cemeteries in Lubień and Ostrów Lednicki (Fig. 1). Their function has not yet been clarified. The provenance is also problematic (Kaczmarek 1998, 557–559; see below also *The problem of provenance...*). It is assumed that they could be used as a pendant or small mace.

Glazed pottery

The literature on the subject mentions finds of glazed pottery in the Wrocław stronghold (Ostrowska 1960, 48; Kaźmierczyk et al. 1974, 259; Auch 2016). In the course of the current analyses, 152 pottery fragments with traces of glaze have been identified with the vast majority of them crucibles. It is difficult to distinguish crucibles from glazed pottery, especially with fragmentary material. Admittedly, there is no doubt in the case of pear-shaped crucibles with a specific shape. Nevertheless, almost none of the crucible fragments from Ostrów Tumski in Wrocław differ from ordinary pottery. They can be identified by scorch marks and deformation of the surface as a result of high temperature. They are marked by a specific glaze on the surface, which is usually irregular and creates multi-coloured stains and marks of various thickness, often on the inner surface, sometimes on the inner and outer surfaces, and exceptionally on the sherd's fracture. The study of these 31 pottery fragments confirm that they are related

Site	Context of find	Inv. No.	State of preservation	Description of the find
WOT	trench I, layer F, squares 9–10, building No. 4 (smokepit)	95d/74	complete	Easter egg rattle made of light pottery mass, without a clear admixture, empty inside, rattling; a hole in the lower part; covered with dark green glaze, partially exfoliated; decorated with a brown, spirally wound thread
WOT	trench I, layer D, square J	39e/72	complete	Easter egg rattle; a hole in the lower part; glazed surface heavily exfoliated; decorated with a 'feather' ornament (yellow thread), poorly preserved
WOT	trench I, layer B, squares a–c	5d/72	fragment	the find is lost, remains of yellow glaze on the surface
WOT	trench I, layer H1, squares 41, 42	225g/75	fragment of the lower part	Easter egg rattle made of bright pottery mass; hole in the lower part; covered with dark glaze, partially exfoliated; bright thread; 'feather' ornament
WOT	trench I, layer M, between the buildings Nos. 5 and 3	65d/78	fragment	Easter egg rattle made of bright pottery mass; hole in the lower part; covered with dark glaze, partially exfoliated; bright thread; 'feather' ornament
WOT	trench I, layer M	170c/76	fragment	the find is lost
WOT	trench III, layer B5	125j/85	fragment	the find is lost
WOT	trench IIID, layer C1	133e/87	fragment	the find is lost
WOT	trench IIIF, layer B5–C3, squares 3, 5	227a/2001	fragment	fragment of an Easter egg rattle made of pottery mass, without a clear admixture, empty inside, covered with brown opaque glaze, partially exfoliated, decorated with a yellow wrapping thread, wound around the central part; 'feather' ornament
WOT	trench III, layer B7, west of the building No. 2	99/84	fragment	fragment of glazed 'star'; strong 'compaction' of the clay paste, covered with a thick layer of glaze; possibly burned out
WOT	trench V, layer 4, square i	229/50	complete	knobbed rattle, made of light pottery mass, without a clear admixture, hole in one place, dark green glaze
WOT	trench VII, layer 1, square i	92a/59	complete	knobbed rattle, made of light pottery mass, without a clear admixture, hole in one place, olive green glaze
WOT	trench III, building No. 1, homestead 4	117d/83	fragment	fragment of glazed vessel, made on a potter's wheel; fine admixture, grey colour; greenish glaze, only from the outside
WOT	trench IIIF (pillar No. 2), layer B4	45/2001	fragment	fragment of knobbed rattle (?), made of light pottery mass, with a fine-grained admixture, covered on both sides with black-brown glaze
OO	trench 1948–1956, layer E3, are 407, m^2 6h	1981/52	complete with minor cavities	small Easter egg rattle made of pottery mass, with a fine-grained admixture, empty inside, rattling; a hole in the lower part; covered with black glaze, partially exfoliated; decorated with a yellow thread; 'feather' ornament
OO	trench 1948–1956, layer C3, are 407, m^2 6g, building No. 6	1987/52	fragment of the lower part	fragment of an Easter egg or a rattle made of pottery mass, with a fine-grained admixture; oxidative burnout; empty inside; a hole in the lower part; covered with green glaze, cracked
OO	trench 1948–1956, layer A/1, are 376, m^2 2b,	2007/52	fragment of the lower part	fragment of an Easter egg or a rattle made of pottery mass with medium-grain mineral admixture; covered with black glaze (in reflected light), visible dark green in microscopic and strong light; cracked; variable burnout
OO	trench I, layer A4, are 344, m^2 6f	1198/60	complete with minor cavities	small Easter egg rattle made of pottery mass, with a fine-grained admixture, empty inside, rattling; a hole in the lower part; covered with black glaze, partially exfoliated; decorated with a yellow thread; 'feather' ornament
OO	layer C1, are 342, m^2 9g, out of the building No. 19	235/61	complete	small Easter egg rattle made of pottery mass, with a fine-grained admixture, empty inside, rattling; a hole in the lower part; covered with black glaze, partially exfoliated; decorated with a yellow thread; 'feather' ornament
OO	trench 1948–1956, layer D2, m^2 9A, building No. 14	1983/52	complete	lime Easter egg covered with olive-brown glaze (body) and decorated with a decoration painted in the form of geometric and plant motifs
OO	trench 1948–1956, layer A4, are 408, m^2 2h,	2017–2018/52	complete	small Easter egg rattle made of pottery mass, with a fine-grained admixture, empty inside, rattling; a hole in the lower part; covered with two-colour glaze; on a dark background, a bright ornament in the form of a straight line and waves is wound up
OO	trench I, layer D2, m^2 9a,	2592/52	complete	lime Easter egg covered with olive-brown glaze (body) and decorated with a decoration painted in the form of geometric and plant motifs
OO	without exact location, excavations in 1930–1931	?	complete	Easter egg rattle made of clay; on a bright background, a dark 'feather' ornament
OO	without exact location, excavations in 1930–1931	?	complete	Easter egg rattle made of clay; green and yellow glaze; 'feather' ornament
OO	trench 1948–1956, are 407, layer D1, m^2 10j, out of the building No. 3	542/54	fragment	small fragment of a rattle or Easter egg covered with greenish glaze
OO	trench 1948–1956, are 407, layer D1, m^2 10j, out of the building No. 3	1258/54	fragment	small fragment of a rattle or Easter egg covered with glaze
OO	trench 1948–1956, are 408, m^2 4c, layer B2	1996/52	fragment	small fragment of a rattle or Easter egg covered with a thick layer of black glaze
OO	trench 1948–1956, are 407, layer A3, m^2 10, building No. 2	2014/52	fragment	small fragment of a rattle or Easter egg covered with a thick layer of glaze
OO	trench I, plot IV, layer E7, m^2 7g	3847/54	complete	knobbed rattle, hole in one place, empty inside, green glaze
OO	without exact location, excavations in 1930–1931	?	complete	knobbed rattle, hole in one place, empty inside, glazed (?)
OO	without exact location, excavations in 1930–1931	?	complete	knobbed rattle, empty inside, glazed (?)
OO	trench III, are 311, layer E5, m^2 7b	48b/68	fragment	fragment of knobbed rattle, glazed
OO	trench 1948–1956,are 408, layer C2, m^2 14, building No. 9 by the hearth	229/54	complete	seven-pointed glazed 'star' covered with aquamarine golden glaze; the shape of the opening is funnel-shaped, with the outlet diameters of 2 cm and 1.2 cm

Tab. 1. Catalogue of glazed finds (Easter egg-rattles, knobbed rattles, lime Easter eggs, 'stars') from Wrocław Ostrów Tumski and Opole Ostrówek. WOT = Wrocław Ostrów Tumski, OO = Opole Ostrówek.

Tab. 1. *Katalog glazovaných předmětů (keramických vajíček – chřestítek, chřestítek z výčnělky, keramických vajíček z vápence a „hvězdiček" z Opole Ostrówka a Wrocławi, Ostrowa Tumského. WOT = Wrocław Ostrów Tumski, OO = Opole Ostrówek.*

Dimensions (cm)	Chronology	Chemical composition of the glaze	Fig.	References
h: 4.3; ø: max 3.5	turn of the 11th century	undefined	4b	Kaźmierczyk et al. 1976, 189, Fig. 9c
h: 4.1; ø max 3.3	1st half of the 13th century	undefined	4a	Kaźmierczyk et al. 1974, 276, Fig. 10f
undefined	13th century	undefined	-	not published
undefined	3rd quarter of the 11th – 1st quarter of the 12th century	undefined	4c	not published
undefined	2nd quarter of the 11th century (?) or 2nd half of the 11th century (according to Moździoch 2000)	undefined	4d	Kaźmierczyk et al. 1980, 145, Fig. 59
undefined	2nd quarter of the 11th century	undefined	-	not published
undefined	2nd quarter of the 12th century	undefined	-	not published
undefined	3rd quarter of the 11th century	undefined	-	not published
2.5 × 1.5 thickness of the fragment 0.6	3th quarter of the 11th – 2nd quarter of the 12th century	lead glass coloured with iron oxides - black body, ornament - stained with tin and iron	4e	Siemianowska 2015, 264, 273–274, 278
3 × 1.5 × 1.5	turn of the 11th century	high lead alkaline glass	7a	not published
w: 4.7; h: 4	11th – 12th century	undefined	6b	Kóčka, Ostrowska 1955, 274, Table 77b
ø 4	uncertain chronology, Early and Late Middle Ages	undefined	6a	not published
thickness of the fragment 0.8	turn of the 11th century	high lead glass	6a	not published
undefined, thickness of the fragment 0.4	12th century (in the main trench)	undefined	6c	Lisowska 2015, 224; published as a fragment of a vessel, no figure
ø max. 3; h: 3.9	11th century (after 1060 – according to Gediga 2000)	high lead glass; black coloured with iron oxide, yellow with tin oxide	4h	Bukowska 1958; Bukowska-Gedigowa, Gediga 1986; Gediga 1970; Ślusarski 2004
undefined	turn of the 11th century	high-lead glass, alkali-free, coloured with iron and copper oxides	4j	Bukowska 1958; Bukowska-Gedigowa, Gediga 1986; Ślusarski 2004
undefined	turn of the 12th century	high-lead glass, alkali-free, coloured with copper oxides	4i	Bukowska 1958; Bukowska-Gedigowa, Gediga 1986; Ślusarski 2004
ø max. 3; h: 3.8	middle of the 12th century	high lead glass; black coloured with iron oxide, yellow with tin oxide	4f	Bukowska 1958; Bukowska-Gedigowa, Gediga 1986; Ślusarski 2004, 104
ø max. 3; h: 4.3	turn of the 11th century	high lead glass; black coloured with iron oxide, yellow with tin oxide	4g	Bukowska 1958; Bukowska-Gedigowa, Gediga 1986; Ślusarski 2004
ø max. 3.6 h: 5.6	3rd quarter of the 11th century	undefined	4k	Hołubowicz 1956
ø max. 3.5 h: 6	12th century	undefined	4m	Bukowska-Gedigowa, Gediga 1986, Fig. 76:29; Gediga 1970; Ślusarski 2004, 104–106
undefined	3rd quarter of the 11th century	undefined	4l	Hołubowicz 1953; 1956
undefined	undefined	undefined	-	Hilczerówna 1950, 11, Fig. 3; Hołubowicz 1956, 255, Fig. 103; Ślusarski 2004, 103
undefined	undefined	undefined	-	Hilczerówna 1950, 11, Fig. 3; Ślusarski 2004, 103
undefined	3rd quarter of the 11th century	undefined	-	Bukowska-Gedigowa, Gediga 1986, 150; Ślusarski 2004, 104
undefined	3rd quarter of the 11th century	undefined	-	Bukowska-Gedigowa, Gediga 1986, 150; Ślusarski 2004, 104
undefined	middle of the 12th century	undefined	-	Bukowska-Gedigowa, Gediga 1986; Ślusarski 2004, 104
undefined	12th century	undefined	-	Bukowska-Gedigowa, Gediga 1986
ø max. 4.6	uncertain chronology, Early and Late Middle Ages	undefined	6d	Ślusarski 2004
undefined	12th century	undefined	-	Hilczerówna 1950, 18, Fig. 28
undefined	12th century	undefined	-	Hilczerówna 1950, 18
undefined	Early Middle Ages	undefined	6e	Bukowska-Gedigowa, Gediga 1986
ø 4.5	turn of the 11th century	undefined	7d	Bukowska-Gedigowa, Gediga 1986

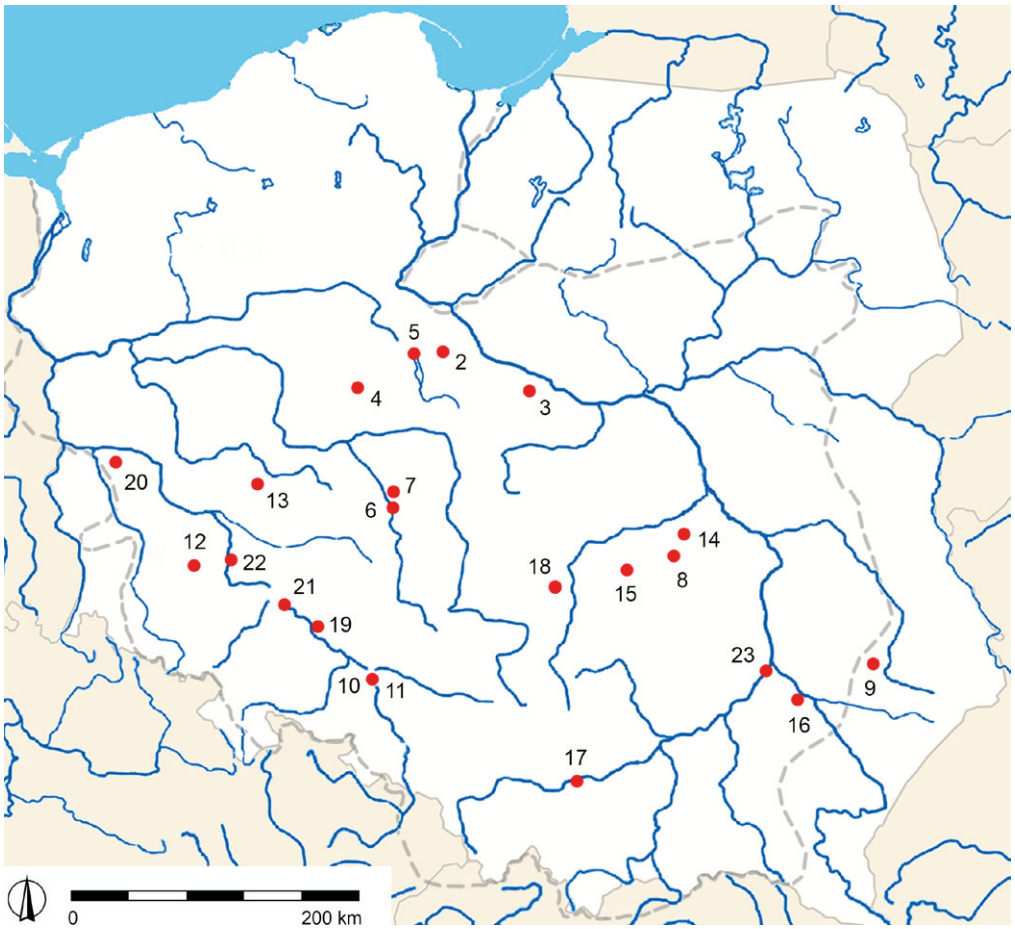

Fig. 5. Occurrence of knobbed rattles in the area of Poland: 1 – Barwino, 2 – Byczyna, 3 – Sokołów, 4 – Ostrów Lednicki, 5 – Kruszwica, 6 – Kalisz, 7 – Kokanin, 8 – Radom, 9 – Sąsiadka, 10 – Opole, 11 – Nowa Wieś Królewska, 12 – Lipiny, 13 – Łoniewo, 14 – Wola Bierwiecka, 15 – Końskie, 16 – Nisko, 17 – Kurdwanów, 18 – Lubień, 19 – Ryczyn, 20 – Pleśniewo, 21 – Wrocław, 22 – Bytom Odrzański, 23 – Sandomierz. From Ślusarski 2004, Map 2.

Obr. 5. *Výskyt chrastítek s výčnělky na území Polska: 1 – Barwino, 2 – Byczyna, 3 – Sokołów, 4 – Ostrów Lednicki, 5 – Kruszwica, 6 – Kalisz, 7 – Kokanin, 8 – Radom, 9 – Sąsiadka, 10 – Opole, 11 – Nowa Wieś Królewska, 12 – Lipiny, 13 – Łoniewo, 14 – Wola Bierwiecka, 15 – Końskie, 16 – Nisko, 17 – Kurdwanów, 18 – Lubień, 19 – Ryczyn, 20 – Pleśniewo, 21 – Wrocław, 22 – Bytom Odrzański, 23 – Sandomierz. Podle Ślusarského 2004, mapa 2.*

to non-ferrous metallurgy (Pankiewicz et al. 2018a, 321–329, Fig. 2–6, Tables 1–6; Pankiewicz, Siemianowska 2018a, 151, Fig. 3). Similar traces have also been identified in other Central European sites, which leaves no doubt regarding their purpose (e.g. Varadzin, Zavřel 2015, 391–394, Figs. 15.1–10; Zavřel et al. 2019). In only one case did the examined fragment probably originate from glazed pottery. This is a sherd of a vessel made of fine clay paste and fired light grey. The vessel was covered with a brownish-green glaze of uniform colour and consistency only on the outer surface (Fig. 7c). This fragment was discovered in a dwelling building, on a level dated at the turn of the 12th century.

The oldest fragments of glazed pottery from Opole are assumed to originate from layer complex E, dated from the end of the 10th century to the second quarter of the 11th century, which raises doubts (see fragment above). Włodzimierz Hołubowicz (1956, 121–123) associates the occurrence of this type of vessel with the 11th century, noting that there are more of them in the later layers. Nevertheless, it can be assumed that the oldest containers of this type appeared in Opole around the mid-11th century, which would coincide with the time of the start of production of this type of vessel in the borderland of Silesia and Lesser Poland. However, this pottery did not widely spread there until the end of the 11th century (Auch 2016, 239–240).

The examined fragments of the early medieval pottery from Opole Ostrówek are typical forms of the 11th-/12th-century early Polish pottery. The fragments are from slow wheel-thrown specimens made of clay paste tempered with an admixture of fine-grained stone chippings and sand. Their outer surface is covered with an intense olive-green glaze. Sometimes, the range of glaze is limited only to the upper part of the vessel. These are fragments of the bellies of bulky vessels decorated with a frieze ornament in the form of surrounding grooves with an additional decorative motif of a wavy line or rows of diagonal cuts. Forms with a cylindrical neck frequently appear in the collections of glazed vessels from Opole (Hołubowicz 1956, 121–122; Auch 2016, 80–88, Plate 9a–f).

The identification of glazed pottery and crucibles was less problematic in the Opole assemblage than in Wrocław as the vast majority of sherds described in the inventories as glazed were negatively verified because, in terms of morphology, stylistics and technology, they corresponded to late medieval or early post-medieval pottery. According to Jerzy Olczak (1968, 76–77), more than 200 fragments of early medieval glazed pottery come from excavations in Opole Ostrówek. Only five fragments were found during the archival query due to the lack of access to all separated artefacts from this site.

Results of glaze examination

The samples of glazes covering Wrocław and Opole pottery, examined in terms of chemical composition, are characterised by a low-temperature high-lead formula, both alkaline and non-alkaline, depending on the type and function of a given object (see Tab. 2 and 3 also Siemianowska et al. in print, Table 2). High-lead glazes are based on two components, namely sand and lead oxide. Nevertheless, when analysing and comparing the chemical composition of individual samples, especially the proportions of lead oxide in relation to silica, a fundamental difference can be observed between pottery and other glazed objects.

All the examined Easter egg rattles were covered with high-lead, non-alkaline glaze (a layer of liquid glass) with highly stable lead oxide (PbO) content at the level of 75.38–77.12%. The silica content ranged from 16.49% to 27.25% (average 21%).

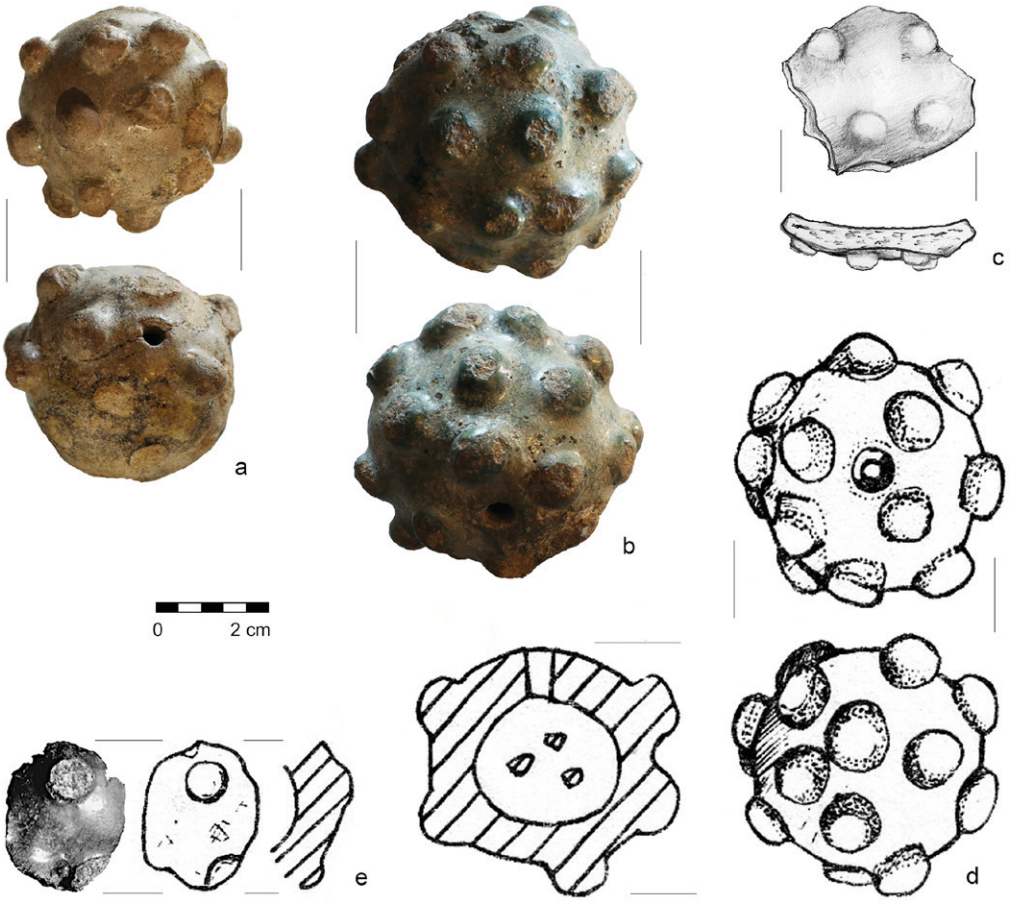

Fig. 6. Glazed knobbed rattles from Wrocław (a–c) and Opole (d) strongholds: a – trench VII, layer 1; b – trench V, layer 4; d – trench 1948–1956, layer E7, are 407, square IV, m² 7g; e – trench III, layer E5, are 311, m² 7b; a–b – photo by A. Pankiewicz, c – drawing by A. Surwiłło, d, e – according to Bukowska-Gedigowa, Gediga 1986, Fig. 76.

Obr. 6. *Skleněná chřestítka a chřestítka s výčnělky z výzkumu wrocławského hradu (a–c) i opolskiego (d): a – sonda VII, vrstva 1; b – sonda V, vrstva 4, c – sonda IV. vrstva B2 (4. čtvrtina 12. – 1. čtvrtina 13. století); d – sonda I, parcela IV, vrstva E7, m² 7g, ar 407, e – sonda III, ar 311, vrstva E5 m² 7/b; a–b – foto A. Pankiewicz, c – kresba. A. Surwiłło, d, e – podle Bukowské-Gedigowé, Gedigy 1986, obr. 76.*

The dark glass (the main colour) was sometimes coloured with iron oxides (Fe_2O_3) with a content of 4.5%, and the green glass with copper oxides (CuO) with a content of 2.5%. The ornament (white or yellow thread) was made of a glass mass of a similar formula but with the addition of tin oxides (SnO_2) and a value varying from 1.44% to 7.95%. The glass covering the finished products can be described as fairly 'clean', with no other or minimum amounts of admixtures (e.g. Al_2O_3 at the level of 0.3%). No differences were found between the chemical composition of glazes from Wrocław and Opole.[5]

The Wrocław 'star' has an alkaline lead glaze, in which the content of lead oxide (PbO) ranges from 58.79% to 71.47% (average 68%), silica (SiO_2) from 26.46% to 33.18% (27.5% average), potassium (K_2O) from 1.138% to 5.915% (average 2%), and iron oxide (Fe_2O_3) from 0.066% to 0.73% (average 0.7%). It is assumed that the variable proportions of the main components of the glass mass are the result of secondary firing rather than careless mixing because minimum amounts of the remaining components are present (Tab. 2). This proves there was a different glazing technique used for Easter egg rattles, where the PbO content is higher and glazed pottery, which has a higher proportion of aluminium oxide (Al_2O_3).

Research on the chemical composition of glazes on early medieval pottery shows that these are high-lead glazes with an average PbO/SiO_2 ratio ranging from 1.8 to 4.4, which demonstrates a high share of lead oxide (PbO) in the glaze, ranging from 57.7% to 75% and the proportion of aluminium oxide (Al_2O_3) from 4.03% to 6.5% (see Tab. 3). The content of alkaline oxides (K_2O and Na_2O) in the glazes in question is a maximum of 1.2%, and for alkaline earth metal oxides (CaO) is 0.5–3.5%. These glazes were dyed with iron compounds, usually in the amount of 1.4–3.3%, which occurs in the raw pottery materials used and gives an olive colour with various shades of yellow, orange and green. The mere presence of lead compounds also gives the glazes a green hue (see Auch 2016, 104). At this point, it is worth noting the slight differences in the composition of glazes, which are perceptible among the pots discovered in Wrocław and Opole. The PbO/SiO_2 ratio in the glazes from Wrocław is much lower than those in the Opole finds (see Tab. 3). This may result from a relatively small number of analyses and/or the state of preservation although it may indicate a different provenance of the examined items.

Serial analyses of early medieval pottery from Racibórz-Ostróg also shows that the average PbO/SiO_2 ratio there ranges from 2.26 to 3.68; an average of 3.24 (Siemianowska et al. 2017). In Dąbrowa Górnicza-Łosień and Strzemieszyce Wielkie (Fig. 1), this ratio ranges from 3.4 to as high as 7.0; an average of 4.77 (Auch 2012, Table 6; 2016, Table 7).

The formula of high-lead non-alkaline glasses based on two parts lead and one part sand is known from early medieval written sources (Heraclius 1873 – *De coloribus et Artibus Romanorum*, 10th–11th century). The range of this type of glazes essentially coincides with the general range of lead glasses in the early Middle Ages that were most numerous in Central and Eastern Europe from the 11th to the 13th century (see Mecking 2013, 647–651; Wajda 2013, 100; Dekówna 2015; Pankiewicz et al. 2017, 3–35; Černá, Tomková 2017, 202–204; Siemianowska 2020). Heraclius' work also includes a description of glazing and the preparation of glazes. He mentions preparing a vessel's surface with a suspension of wheat flour and water, which was boiled, cooled and applied to the vessel's surface. Powdered lead was then applied to it, without the addition of colouring oxides (see Auch 2016, 107). Although in terms of chemical composition, early medieval glasses and glazes

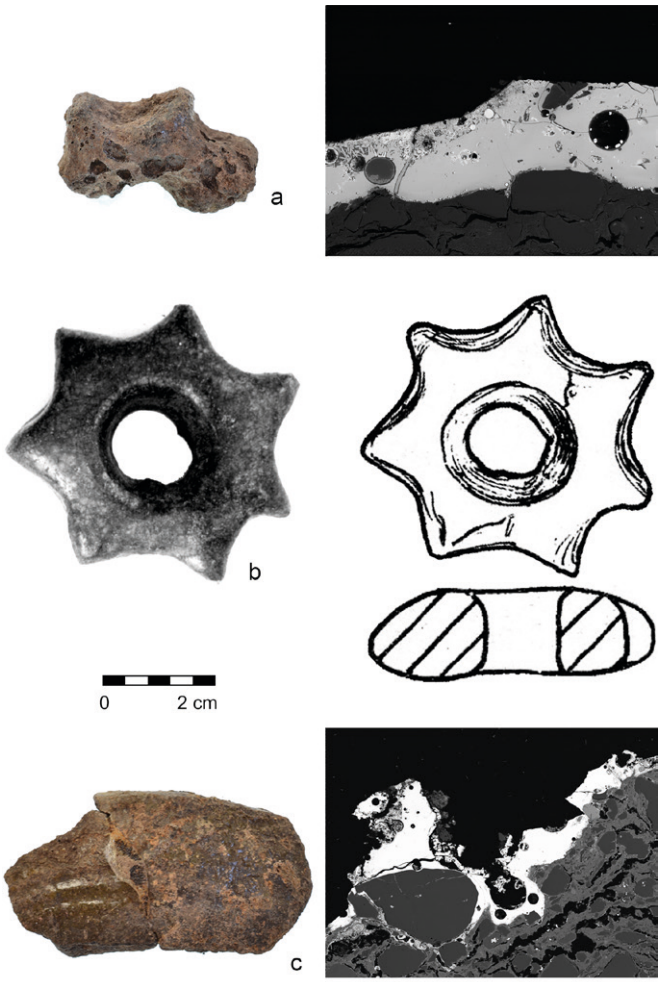

Fig. 7. Glazed 'stars' and ceramics from Wrocław (a, c) and Opole (b) strongholds: a – trench III, layer B7; photo of the find and BSE image of the glaze layer; b – trench 1948–1956, layer C2, are 408, m² 14, building No. 9; c – trench III, layer B2, building No. 1, homestead 4 (turn of the 11th/12th century); a–c – photo by S. Siemianowska, b – according to Bukowska-Gedigowa, Gediga 1986, Fig. 66, Archive of IAE PAN in Wrocław.

Obr. 7. *Skleněné „hvězdičky" a keramika z výzkumů wrocławského (a, c) a opolského hradu (b): a – sonda III, vrstva B7; fotografie předmětu a snímek BSE vrstvy glazury; b – sonda 1948–1956, ar 408, vrstva C2, m² 14, dům 9; c – sonda III, vrstva B2, dům 1, usedlost 4 (11. /12. století); a–c – foto S. Siemianowska, b – podle Bukowské-Gedigowé, Gedigy 1986, obr. 66, foto archiv IAE PAN ve Wrocławi.*

are very similar, the technologies used in their production were completely different (see fragment below).

Theophilus Presbyter also mentions staining vessels with glaze: *"They likewise make earthenware basins and small vessels and other fictile vases, painting them in this manner. They take all kinds of colours, grinding them singly with water; and mixing with each colour a fifth part glass of the same colour, very finely ground by itself with water, they paint with it circles or arches or squares, and in the beasts, birds, or leaves, or any other thing they may wish. After these vases have been painted in this manner, they place them in the furnace used for window (glass) and applying a fire of dry beech-wood below them until they are surrounded by the flame; and thus, the wood being taken out, they close the furnace. The same vases can also be decorated in places with gold leaf, or with ground gold or silver, if they wish, in the above mentioned manner"* (from Hendrie 1847, 135–137).

Lead glass-based techniques were therefore common in the Early Middle Ages. Depending on what the final product was supposed to look like, they differed in the nuances of individual ingredients and how individual products were glazed.

Early medieval glazing techniques in the light of research on artefacts from Wrocław and Opole

When analysing the chemical composition and BSE images of the samples of early medieval pottery (vessels, Easter eggs, rattles, stars), significant differences are perceptible (manifested both in the composition and microscopic images) that prove the use of different glazing techniques and possibly confirm the different provenance of the artefacts. With the Easter egg and knobbed rattles, the ceramic product was thoroughly pre-dried and then fired to the so-called biscuit, thus consolidating the structure of the clay pastes (Auch 2016, 50, Siemianowska et al. in print). It was then covered with liquid glaze, which was probably facilitated by the hole in the rattle and fired again (Siemianowska et al. in print). A similar method was used for the production of the Wrocław and probably the Opole 'star'. This is evidenced by a homogeneous relatively thick layer of glaze on the aforementioned objects, which does not interact with the ceramic substrate (Fig 7a). In the case of the ceramic 'star', an intentional selection of a slightly plastic clay paste was also found, which was probably used to prevent the glass coating from penetrating the ceramic body.

However, glazed pottery was fired in one stage. The early medieval glazes covering the pottery are characterised by a very thin layer with varied colours while microscopic images of the examined samples show a strong mixing at the border of glaze and clay: the glaze layer penetrates the structure of the vessel (Fig 4b). This proves that the glaze, most likely in the form of a powder or a suspension, was applied to a dry or slightly dried body and then fired.

The interaction between the body and the glaze also manifests itself in the presence (or lack of) of aluminium oxides (Al_2O_3) in the glaze chemical composition. These are present in trace amounts in non-vessels, while the glazes covering vessels are characterised by a content of 2% to 12% (Tables 2–3, see also Auch 2012, Tables 6–7, Auch 2016, Table 7; Wajda 2013; Siemianowska 2015, 278; Siemianowska et al. 2017; Siemianowska et al. in print, Table 2).

The problem of provenance and distribution of glazed objects

During the first post-war studies of the centre in Opole, the researcher at that time – Włodzimierz Hołubowicz (1956, 121–123) – formulated a hypothesis about the local origins of the glazed vessels discovered there. Apart from the finds of this type of pottery, the argument proving the local origins of glazing was assumed to be the common presence of lead used in the glazing process and the presence of an identical potter's mark on glazed and unglazed vessels. However, the researcher did not completely rule out the foreign provenance of some of the vessels, drawing attention to the specimens made of light clay, which, in his opinion, could have been imported from Rus'. These views were supported by Jerzy Olczak (1968, 77). Characterising the alleged glass workshop in Opole, he stated that the glazing of the vessels could also be related to the activity of glass manufacturers.

New light has been shed on the problem of the origins of glazed pottery from Opole by research on glazed pottery produced in the borderland of Lesser Poland and Silesia. The local origins of these vessels are confirmed by the concentration, individual design and microscopic analysis of the clay paste composition (Auch 2016, 86–94, 238). Their location in the vicinity of lead extraction and smelting centres (Rozmus 2014, 225–245; Auch 2016, 29–30), where oxide was an excellent component of vessel glazing, is not coincidental. Considering the proximity of these glazed vessels production centres to Opole (a distance

Find	'star' Inv. No. WOT 99/84							
Chemical type of glass	High lead alkaline glass							
Component / Inv. No.	**VI-52-1**	**VI-52-2**	**VI-52-3**	**VI-52-4**	**VI-52-5**	**VI-52-6**	**VI-52-7**	**VI-52-8**
K_2O	**1.889**	**1.859**	**2.802**	**2.713**	**1.138**	**5.915**	**5.649**	**5.743**
CaO	0.158	0.283	0.173	0.149	0.216	0.36	1.401	1.02
SnO_2	0.048	*	0.042	0.046	*	*	0.048	*
P_2O_5	0.074	0.061	0.061	0.036	0.085	0.09	0.266	0.124
SO_3	*	*	*	*	*	*	*	*
Cl	*	*	*	*	*	*	*	*
PbO	**69.351**	**68.61**	**68.092**	**68.205**	**71.474**	**58.789**	**61.195**	**57.842**
Ag_2O	*	*	*	*	*	*	*	*
Sb_2O_5	0.024	*	0.035	*	0.048	0.093	*	0.017
BaO	0.035	0.09	0.065	0.103	0.157	0.041	0.019	0.073
Cr_2O_3	0.007	0.001	*	0.008	*	0.009	0.024	*
Na_2O	0.077	0.091	0.144	0.131	0.022	0.413	0.373	0.453
SiO_2	**27.392**	**27.298**	**27.647**	**27.684**	**26.464**	**32.67**	**29.86**	**33.179**
Al_2O_3	**0.224**	**0.258**	**0.25**	**0.193**	**0.222**	**0.801**	**0.595**	**0.795**
MgO	0.014	0.013	*	0.002	0.02	0.192	0.218	0.136
As_2O_3	*	0.03	*	0.03	*	*	*	0.079
SrO	0.054	*	*	*	*	*	*	0.02
Fe_2O_3	**0.881**	**0.686**	**0.931**	**0.642**	**0.065**	**0.733**	**0.652**	**1.007**
MnO	0.027	0.049	0.066	0.022	*	*	0.051	0.108
CoO	0.012	*	0.06	*	*	*	0.028	0.041
NiO	*	0.015	*	*	0.123	*	*	*
CuO	0.508	0.358	0.243	0.333	0.22	0.123	0.089	0.042
ZnO	*	*	*	*	*	*	*	*
TiO_2	0.095	0.103	0.018	0.087	0.132	0.153	0.107	0.227
Total	**100.871**	**99.805**	**100.629**	**100.384**	**100.385**	**100.382**	**100.574**	**100.908**
PbO/SiO_2	**2.53**	**2.51**	**2.46**	**2.46**	**2.7**	**1.8**	**2.05**	**1.74**

Tab. 2. Results of analyses of the chemical composition of glaze on the surface of the 'star' from Wrocław Ostrów Tumski; * = component not found.

Tab. 2. *Výsledky analýz chemického složení glazury na povrchu „hvězdičky" z Wrocławi, Ostrowa Tumského; * = sloučenina nezjištěna.*

of approximately 100 km as the crow flies, Fig. 1) and many similarities between the glazing technology of products and the glaze formula from the centres located in the area of Dąbrowa Górnicza and Opole, it could be concluded that the specimens discovered in Ostrówek are imports from the Lesser Poland-Silesian borderland. However, upon closer examination of both assemblages, some differences can be identified. In Opole, vessels with cylindrical necks dominate the glazed specimens. Although cylindrical necks occur among the vessels from the Dąbrowa Basin, the forms with an S-shaped profile prevail. The ornamentation of glazed vessels from this area is also highly varied and includes, for example, plastic patterns, stamping or rouletting motifs, not found in Opole. It is believed that the ornamentation of some of them could have been inspired by Byzantine design, although other regions with similar stylistics are also mentioned (Rozmus 2014, 225–244, Figs. 231–238; Auch 2016, 99–101). There are also differences in the chemical composition of the glaze. The basic ingredients of the formulas of these glazes are remarkably similar. However, with the vessels from Opole, the lower proportion of lead oxide (PbO: 60.2–74.96%), with a relatively higher proportion of silica (SiO_2: 16.9–25.2%) and iron oxide (Fe_2O_3: about 2%) is noticeable. In the case of the analysed vessels from Dąbrowa Górnicza-Łosień and Strzemieszyce Wielkie, they were 71.5–81% (PbO), 12.8–18% (SiO_2) and about 1% (Fe_2O_3) (Tab. 3, see also Auch 2012, Table 6; Auch 2016, Table 7). However, when comparing the results of the analyses of the chemical composition of the glazes and the macroscopic features of pottery (vessel form, glaze colour) from Ostrówek in Opole with Racibórz-Ostróg, greater similarities are perceptible, which suggests that they could have been produced in one workshop.

Glazed pottery from Opole could have been a local product or come from a so-far unrecognised workshop in Silesia. To date, there are no traces of the local pottery-glazing workshop in Opole-Ostrówek. However, the concept of Włodzimierz Hołubowicz, supported by Jerzy Olczak, on glazing pottery vessels in glass workshops, has not been confirmed. As shown, the techniques for glazing vessels differed from the techniques used by glass manufacturers. Moreover, the verification of traces of the glass workshop in Opole showed that it was likely to be temporary and mainly produced glass jewellery, probably from semi-finished products (Pankiewicz, Siemianowska 2017).[6]

The small number of glazed vessels in relation to the Wrocław centre is noticeable. In the huge collection of approximately 300,000 pottery fragments from this site, only one sherd was intentionally covered with glaze. This is not the result of the level of research. Previous material science queries (Rzeźnik 1995) and more recent studies (Pankiewicz 2015) did not reveal the presence of this type of pottery. Such a small percentage of glazed vessels in Wrocław does not provide any grounds for the local production of them in this centre.

Occasional fragments of glazed pottery also come from Niemcza, located about 50 km south of Wrocław (Fig. 1; Pankiewicz, Siemianowska 2018b, 241, Figs. 2, 3e–f, Table 1). In contrast to the Wrocław vessel, the glaze covering it constituted

a distinct layer differing from the vessel's body. The composition of it, however, resembles both the specimens from the Lesser Poland-Silesian borderland (Inv. No. 292/64) and Wrocław pottery (Inv. No. 56/64). The last sample is solely characterised by a higher content of aluminium oxide (Al_2O_3). However, the actual set of substances forming the glaze on vessels is the same at all the sites in Poland. Differences in the glaze formula relate more to the contribution of individual components and can only be assessed based on a larger number of analyses. Minor discrepancies are perceptible in one assemblage of pottery and even in one sherd (Tab. 3, see also Auch 2016, Tables 7, 40, 70; Pankiewicz, Siemianowska 2018b, Table 1). Therefore, the determination of the place of origin of the pottery based on single analyses of glazes cannot be reliable and petrographic studies of clay paste in vessels from Wrocław, Opole and Niemcza would be required.

In Lesser Poland, where the issue of the distribution of glazed vessels has already been recognised to some extent, the concentration of this type of product was mainly observed near the production centres and only exceptionally at larger distances (Auch 2016, 237, Fig. 119). The presence of a workshop, which also produced glazed pottery in Lower Silesia, but not in Wrocław, cannot be ruled out.

The problem of locating places where glazed Easter egg rattles were produced is probably the most widely discussed issue in the literature concerning glazed objects from Poland. Two theories dominate this discussion. The first is that these products are imports from the territory of Rus'. Strict stylistic analogies of Polish and Rus'[7] specimens were indicated, as well as the concentration of rattles and Easter eggs in the eastern part of the Polish territory and along the trade routes with Rus' (e.g. Hilczerówna 1950; Kaczmarek 1998, 557; Siemianowska 2008, 69–74, Fig. 2). The second theory assumes that they were produced in early medieval Poland, in glass production centres, among which the most frequently mentioned are Kruszwica and Opole (Olczak 1968, 77, 131–146). The local origins would also be evidenced by a clear grouping of this type of products within the aforementioned centres and their high frequency in Poland (Ślusarski 2004, 81–82). The high chemical composition of the glaze covering the objects, which is typical of a large area of Central and Eastern Europe, as mentioned above, contributes little to the explanation of this problem. The method of manufacturing and glazing the Easter egg rattles, which was characteristic of advanced glass workshops, indicate their foreign origins (Kaczmarek 1998, 557; Siemianowska et al. in print).

Find	Fragment of the vessel						
Glass colour	Olive green	Olive green	Olive green	Olive green	Olive green	Greenish	Greenish
Component / Inv. No.	OO – 6/49/2013	OO – 142/49/2013	OO – 204/50/2013 (a)	OO – 204/50/2013 (b)	OO – 04/50/2013 (c)	WOT – 117d/83 (a)	WOT – 117d/83 (b)
K_2O	0.409	1.029	0.895	0.619	0.451	0.577	0.588
CaO	0.503	3.529	2.741	0.720	0.680	0.997	1.421
SnO_2	*	0.012	*	*	*	0.038	0.031
P_2O_5	0.036	0.247	0.268	0.102	0.115	0.140	0.116
SO_3	0.138	*	0.095	0.002	0.392	*	0.028
Cl	*	*	*	*	*	0.086	0.040
PbO	**74.964**	**60.203**	**65.294**	**70.847**	**63.649**	**57.717**	**64.328**
Ag_2O	*	*	*	*	*	*	*
Sb_2O_5	0.056	*	*	0.002	*	*	*
BaO	0.114	0.048	0.059	0.057	*	0.064	0.085
Cr_2O_3	*	0.038	*	0.01	0.009	0.009	0.006
Na_2O	0.085	0.104	0.157	0.061	0.169	0.416	0.376
SiO_2	**16.977**	**25.202**	**22.703**	**19.361**	**23.798**	**31.39**	**27.345**
Al_2O_3	**4.036**	**6.533**	**4.525**	**5.156**	**6.562**	**4.527**	**3.496**
MgO	0.316	0.757	0.512	0.479	0.634	0.458	0.483
As_2O_3	*	*	*	*	*	*	*
SrO	0.127	0.100	0.134	0.133	0.131	*	0.025
Fe_2O_3	**1.723**	**1.843**	**2.074**	**1.397**	**2.446**	**3.270**	**2.161**
MnO	*	*	0.224	0.04	0.059	*	0.058
CoO	0.061	*	*	0.091	*	0.019	0.034
NiO	0.112	*	*	0.042	*	0.004	0.045
CuO	*	0.07	*	*	0.014	*	0.008
ZnO	*	0.023	*	*	0.196	0.294	0.476
TiO_2	0.188	0.311	0.314	0.439	0.285	0.295	0.170
Total	**99.845**	**100.051**	**99.995**	**99.558**	**99.589**	**100.300**	**100.318**
	4.4	**2.4**	**2.9**	**3.7**	**2.7**	**1.8**	**2.3**

Tab. 3. Results of analyses of the chemical composition of glazed vessels from Opole Ostrówek and Wrocław Ostrów Tumski.
WOT = Wrocław Ostrów Tumski, OO = Opole Ostrówek; * = component not found.

Tab. 3. *Výsledky analýz chemického složení glazury na raněstředověkých nádobách z Opole Ostrówka a Wrocławi, Ostrowa Tumského.*
*WOT = Wrocław Ostrów Tumski, OO = Opole Ostrówek; * = sloučenina nezjištěna.*

The situation is slightly different for glazed knobbed rattles. Due to the specificity of the clay paste from which they were made (fine-grained white clay), their Rus' provenance was sometimes indicated (Hilczerówna 1950; Kaczmarek 1998, 557). The range of their occurrence, mainly covering the Polish lands and the lack of any prototypes in Rus', appears to confirm the local genesis (Dzik 2016).[8] The technology of applying the glaze on most of the specimens by immersing the finished product in a layer of liquid glass, along with the clay paste, does not indicate local origin. Apart from the specific form, the feature of knobbed rattles is usually the lack of or the rare occurrence of additional decoration by way of a coloured thread covering the glaze. These decorations do not resemble Rus' patterns but are much more chaotic (e.g. irregular threads between knobs). It should be remembered that the decoration (or rather the lack of it) is determined in this case by the specific form of the object, which makes it impossible to apply, for example, combed motifs. Without more extensive research of the chemical composition of the clay paste from which this type of rattle was made, it will not be possible to determine the places of production.

Concerning the glazed 'stars' discovered in Poland, it was usually assumed that these were not local products, but imports from the east, from Rus'. This is evidenced by the fact that these forms occasionally occur in Poland and by eastern analogies for such products (Kaczmarek 1998, 557). The research results obtained appear to confirm this interpretation. The determinant may be the technique of glazing 'stars' and Easter egg rattles, pointing to Rus' workshops. The chemical composition of the glaze covering the object is also consistent with the formulas of the glass mass known from the areas of Rus'. However, the problem is more complex. There are no exact Rus' analogies for the discussed group of artefacts although, careful observation of the 'stars' can provide additional data. It is worth noting that the Opole specimen has an 8-shaped hole as if it had been drilled twice. This seemingly insignificant detail may be important in interpreting the genesis of the glazed 'stars'. Their shape and size are remarkably similar to other Opole finds – waste from the production of limestone spindle whorls (Fig. 8). Regarding the double hole in the finished 'star', it cannot be ruled out that it was made of the material that was left over from the production of limestone spindle whorls. The latter, due to their high frequency of occurrence, traces of production in the Opole stronghold (waste, semi-finished products) and because they are based on local deposits of raw materials, can be considered to be local with little doubt (Hołubowicz 1956, 112; Lisowska 2013, 60–62, 136–140, Fig. 36).

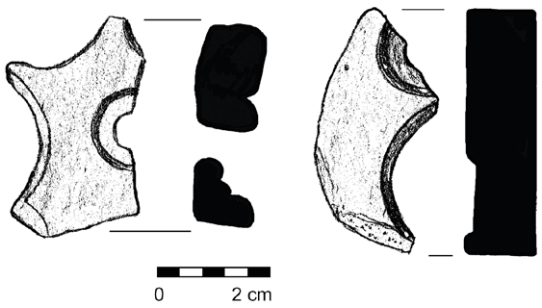

Fig. 8. Opole Ostrówek. Waste from the production of lime spindle whorls. Archive of IAE PAN in Wrocław.

Obr. 8. *Opole Ostrówek. Odpad z výroby vápencových přeslenů. Archiv IAE PAN ve Wrocławi.*

Twenty-one egg models from Opole, and probably including glazed ones, were also made of local limestone. The distinctive character of a glazed limestone Easter egg has already been emphasised above. These differences are also visible in case of other products made of clay and stone. Clay eggs were more squat shaped with dimensions of 4 × 1.6–2.2 cm and 4.6 × 3.3 cm. The limestone models (whole forms) were longer and slender with dimensions of 5.6 × 3.2 cm; 5.5 × 3.0 cm; 5.8 × 3.6 cm; 7.2 × 4.0 cm; 7.8 × 3.8 cm; 7.7 × 4.0 cm; 2.8 × 2.0 cm; 5.4 × 2.9 cm; 6.0 × 4.2 cm; 5.0 × 2.8 cm (Fig. 4, 9g–j).

Egg models from Ostrów Tumski in Wrocław were much less numerous. Only three such products were discovered there, probably originating from Opole or its vicinity (Lisowska 2013, 163–164), as well as single and crude clay 'eggs'. Both models of unglazed clay and limestone eggs (including the glazed specimen) from Wrocław and Opole can, therefore, be considered local products that were not an attempt at copying eastern products.

Products that can be considered to be imitations of glazed knobbed rattles were also found in Wrocław and Opole. Two knobbed rattles with an asymmetrical shape characterised by negligent craftsmanship come from Opole. These specimens even have the required hole for the glazing process but are not glazed. The holes in both items are far too big. The rather inelegant form of the objects indicates that they were never intended to be glazed and were only an imitation of glazed knobbed rattles (Fig. 9e, f). Examples of this type of rattle are also known from other sites in the territory of Poland (Kostrzewski 1968, 216, Plates I: 1, II: 6). In the Wrocław stronghold, three unglazed spherical rattles and a fragment of a fourth were found (Fig. 9a–d; Kaźmierczyk 1995, 144, Fig. 116; Lisowska 2015, 221, Fig. 1b; Bykowski et al. 2004, 137, Fig. 13j). Two of the rattles are decorated with cuts and one with motifs of circles (Fig. 9b), which makes it similar to the knobbed specimens. Other rattles decorated with circles (e.g. a specimen from Gdańsk), knobbed rattles even more strongly and are regarded as imitations (Kostrzewski 1968, 216, Plate I: 2).

These examples do not solve the problem of the provenance of glazed ceramic artefacts in Poland. However, they clearly show that there were two qualities of such objects: a superior version involving glazed specimens, which were not always of foreign origin; and specimen of a lower quality, consisting of unglazed products of local origin.

Social function of glazed products in the light of research on artefacts from Wrocław and Opole

The specific treatment which some of the vessels underwent – the glazing – certainly made them unique. Based on the preserved parts of vessels, it was found out that the clearly visible parts were glazed: the rim, sometimes the upper belly part, sometimes the entire vessel. For wide-rimmed vessels where the interior was more exposed, the inside was glazed with the outside glazed on closed vessels. Only sporadically was there glaze on both sides. Thus, the glaze was a typical decorative element, not a technological one that for example, improved the tightness of the vessels. This was probably the added advantage of these containers, especially when glazed on a large surface. Glazed vessels often have special forms characterised by specific morphology and ornamentation, although there are also items that are distinguished from 'ordinary' ones only by the presence of glaze. The collection of glazed pottery often includes vessels with cylindrical necks (e.g. Opole) or cylindrical vessels (e.g. Strzemieszyce Wielkie). These features make the glazed pottery a unique product, with a specific purpose and were probably expensive. It has been suggested that it could have been used

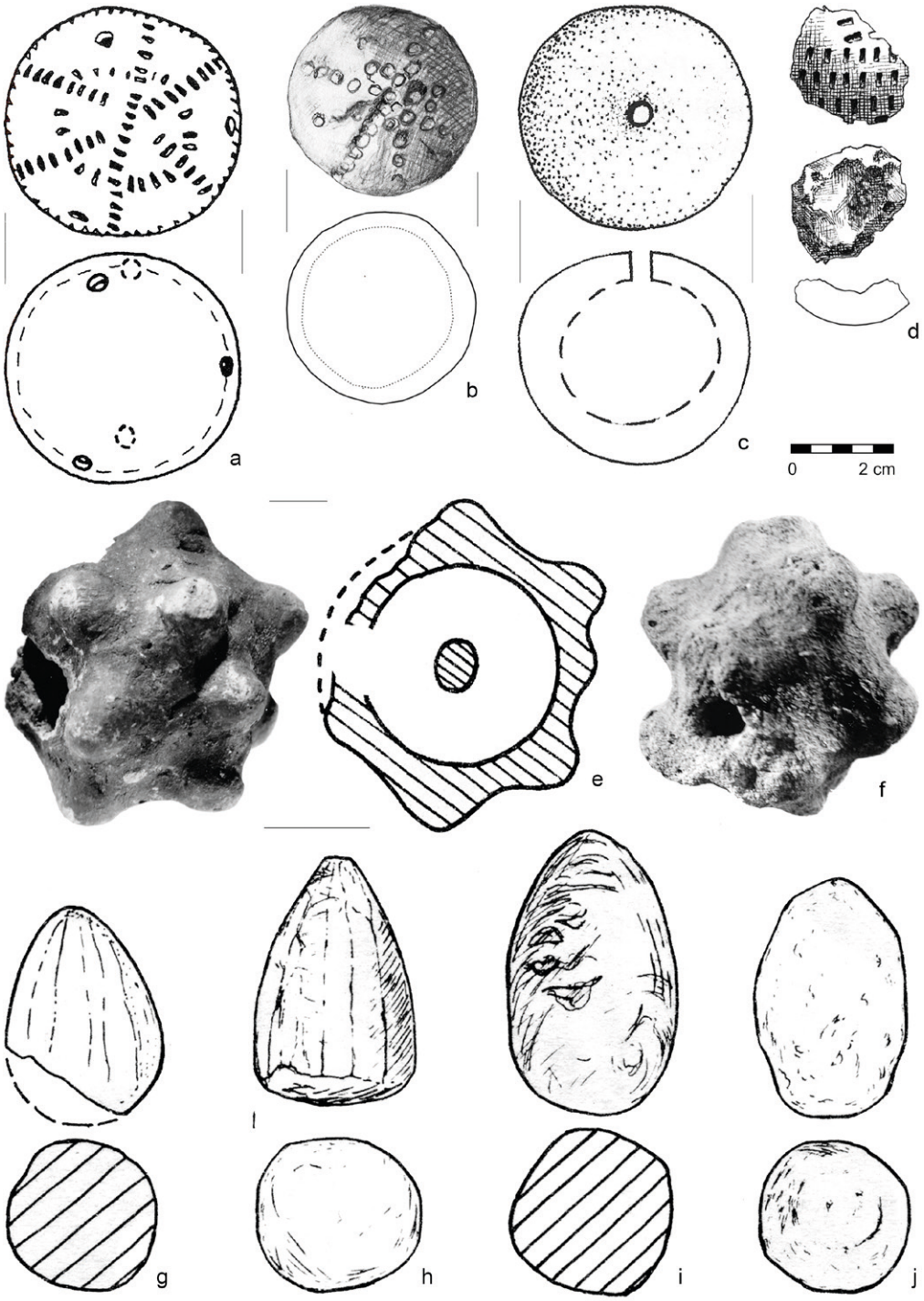

Fig. 9. Unglazed rattles and egg models from Wrocław (a–d) and Opole (e–j) strongholds: a – trench IIIA2, layer B5 (12th century); b – IIIF trench, layer Z1 (mixed up, also late Middle Ages); c – trench IV, layer B2 (4th quarter of the 12th – 1st quarter of the 13th century); d – trench VI, layer II/III (13th century); e – trench 1957–1965, layer A6, are 343, m² 9d; f – trench III, layer A4, are 311, m² 2f; g – trench 1948–1956, layer B (12th century), are 311; h–i – trench III, layer B (12th century), are 311; j – trench 1948–1956, layer B (12th century), are 375; j – a – according to Kaźmierczyk 1995, Fig. 116; b – drawing by A. Surwiłło; c – according to Bykowski et al. 2004, Fig. 13j; d–f – from the Archive of IAE PAN in Wrocław; e, g–j – according to Gediga and Gedigowa 1986, Figs. 75, 116.

Obr. 9. *Neglazovaná chřestítka a modely vajíček z hradů Wrocław (a–d) a Opole (e–j): a – sonda IIIA2, vrstva B5 (12. století); b – sonda IIIF, vrstva Z1 (s příměsí také z pozdního středověku); c – sonda IV, vrstva B2 (4. čtvrtina 12. – 1. čtvrtina 13. století); d – sonda VI, vrstva II/III (13. století); e – sonda 1957–1965, ar 343, vrstva A6, m² 9d; f – sonda III, ar 311, vrstva A4, m²/f; g – sonda 1948–1956, vrstva B (12. století), ar 311; h–i – sonda III, vrstva B (12. století), ar 311; j – sonda 1948–1956, vrstva B (12. století), ar 375; j–a – podle Kaźmierczyka 1995, obr. 116; b – kresba A. Surwiłło; c – podle Bykowského et al. 2004, obr. 13j; d–f – z archivu IAE PAN ve Wrocławi; e, g–j – podle Gedigy, Gedigowé 1986, obr. 75, 116.*

as tableware and for unique grave goods (Hołubowicz 1956, 121–122; Auch 2016, 80–84).

The nature of the collection of glazed pottery from Opole appears to confirm these findings. In Ostrówek, the dominant vessels were those with cylindrical necks with glaze in visible places (often on the rim). The S-shaped forms are represented by only one fragment of the upper part of the vessel (Hołubowicz 1956, 121–122; Auch 2016, 24–26, Plate 9).

The almost complete lack of this type of pottery in Wrocław appears surprising. This deficiency can be partly explained by the limited distribution range of the glazed vessels. These are common in the centres of glazed pottery production in the Lesser Poland-Upper Silesia borderland and Upper Silesia. They are so numerous in some centres that it appears that they constituted a better type of vessel but not a luxury good (Siemianowska 2020). It is also not the result of limited trade contacts between the inhabitants of Wrocław as imports from much more distant regions reached this centre (Moździoch 1990, 58–59; Wołoszyn 2004; Lisowska 2013, 224–226, 242; Pankiewicz et al. 2017, 65–67). However, there may be one more reason for the lack of glazed pottery in the Wrocław stronghold. As previously mentioned, in Ostrów Tumski, only one sherd was discovered which can be classified as glazed pottery. However, several dozen glassware fragments come from

the time when glazed pottery was popular (the end of the 11th to the mid-13th century). Even taking into account that some pieces of glassware come from the same vessel, and some have been negatively verified as late medieval or post-medieval glass products, at least a dozen fragments of various items have survived. These are most likely imports from Kievan Rus', Byzantium and Western Europe (Kaźmierczyk et al. 1974, 261–264, Fig. 9; Pankiewicz et al. 2014; 2018b, 30, 34–35, Fig. 4, Tab. 2; Pankiewicz, Siemianowska 2018a, 154–158, Fig. 4, Tab. 4). Perhaps the inhabitants of Wrocław who had glassware as part of their tableware did not perceive glazed pottery as an exceptionally exclusive product.

In the case of other glazed objects (Easter eggs, rattles), in comparison to the Opole centre, they were also not so frequent in Wrocław. This may also be related to the specific distribution of certain goods. A similar phenomenon was observed in the case of glass jewellery. In Opole, from the end of the 11th to the early 13th century, many more jewellery items, which are considered to be Rus' imports, occurred there (Pankiewicz et al. 2017, 63–68). This does not mean that there were no items of eastern provenance in Wrocław at that time. On the contrary, they are quite numerous and diverse and include everyday items (e.g. common Volhynian slate spindle whorls), elements of weaponry, elements of clothing and widely understood applied arts (see above). These differences may partially result from a different structure of the population living in the Wrocław and Opole strongholds. At the time when Easter eggs and rattles are the most popular, i.e. in the 12th century, the stronghold of Wrocław was already partially inhabited by people related to the bishop's court (Moździoch 2000, 337; Moździoch 2004, 330; Żurek 2006, 730). Although the Easter eggs penetrated Christian rituals, the symbolism of small clay plastic in the later phases of the Early Middle Ages is associated with a sphere of beliefs deviating from the official church doctrine (Hilczerówna 1950, 15–16; 1970, 115; Bukowska 1958; Adamowski 1992; Ślusarski 2004, 91–94; Wrzesińska, Wrzesiński 2000, 109–113; Kajkowski 2020). However, it cannot be stated that there was no demand for such products in Wrocław, which is reflected in the large number of glazed and unglazed Easter eggs and rattles. Finds of painted eggshells are also mentioned (Kaźmierczyk et al. 1977, 234).

It is worth recalling that in the earlier literature on the subject, early medieval Easter egg rattles, apart from the possible sphere of *sacrum*, were often interpreted as children's toys, due to their relatively frequent occurrence in graves. In the recent literature on the subject, this hypothesis is almost completely rejected, and the function of a glazed egg is associated with magic beliefs and rituals. For centuries, the egg has symbolised the embryo, the beginning of the world and each existence, reproductive forces and health. Considering the large number of Easter eggs and limestone egg models in the stronghold of Opole, the search for their role in rituals is probably correct. In addition to the aesthetic and symbolic values they represented, they undoubtedly also had a significant financial value (Adamowski 1992; Kowalski 2007; Ślusarski 2004, 92–93; Gruszczyńska-Ziółkowska, Siemianowska 2017; Kajkowski 2020).

The social role of Easter egg rattles, knobbed rattles and glazed 'stars' is evidenced by the fact that they are usually found on sites of great administrative, commercial or defence importance, undoubtedly of a national nature, located on trade routes or in the immediate vicinity. The discoveries from Wrocław and Opole fully confirm this view (Ślusarski 2004, 89–90; Siemianowska 2008).

Conclusions

There is no doubt that the early medieval glazed objects in Poland were regarded as exceptional artefacts. However, they were not in the same level of demand everywhere, which is illustrated by the example of the two closely related centres of Wrocław and Opole. Glazed vessels did not become popular in the first centre, which is probably due to the distance from places producing this pottery and the stronger demand for glass vessels in the Wrocław stronghold. Glazed Easter eggs and rattles are also less frequent, as specimens without glaze were probably produced for local needs. Thus, the frequency of the occurrence of glazed products was determined not only by commercial ties and the distribution range but probably also by the individual and collective tastes of potential buyers.

When trying to determine the provenance of glazed objects, all categories should be considered individually. Glazed pottery is probably a local product, produced in workshops located in the Silesia and Lesser Poland borderland, or from as yet unrecognised workshops in the Opole region or possibly Lower Silesia. Glazed Easter egg rattles and rarely occurring 'stars' are most likely imports from Rus'. The origins of knobbed rattles, which were also made using this technique, are problematic as they have no analogies in Rus' and occur mainly in Polish territory. To explain the problem of the provenance of these objects, it would be necessary to conduct more extensive research on the composition of the clay paste from which they were made.

However, in the case of Easter egg rattles and knobbed rattles, two different production standards can be observed – a superior one, which includes precisely made glazed products, and one of a lower quality, which includes irregular rattles with knobs and spherical rattles, as well as ceramic and limestone egg models. Some of the latter were covered with glaze, which indicates that some of the Easter eggs were a local product.

Observations of glazed objects from Wrocław and Opole prove that individual products were glazed using different techniques. Easter egg rattles and knobbed rattles were immersed in a layer of liquid glass using typical glass working techniques. Vessels were glazed in a completely different manner and were covered with a suspension with an admixture of lead oxide before firing. In contrast to previous opinions, there is no clear connection between the activity of glass manufacturers and the production of glazed vessels. The production of the latter tends to be associated with the functioning of non-ferrous metallurgy centres, in particular with mining and smelting lead, which was an excellent raw material for glazing vessels.

Despite numerous works devoted to glazed products, and many years of discussion on the technology and production centres, these issues have not been resolved and require further studies.

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Footnotes

1 Several glazed spindle whorls were also discovered in the collections from the Wrocław and Opole strongholds. However, they are excluded from this study because they all come from mixed layers, containing both early medieval and later materials, which raises serious doubts regarding their early dating.

2 Explanation of the descriptions in the table. In Ostrów Tumski in Wrocław, the trenches were divided into 2 × 2 m squares (referred to as 'plots' in the reports). In the individual research levels, the clusters of houses were also described as homesteads. In Ostrówek in Opole, the area of the trenches was divided into ares, then into square meters. The individual metres were marked with numbers and letters in the grid, e.g. m^2 1a, m^2 7g, m^2 9f etc. For a detailed description of the rules of documentation at both sites, see Hołubowicz 1956, 15–35; Kaźmierczyk et al. 1974, 253–253; Kaźmierczyk 1993, 22–24.

3 It is worth noting that in the case of Wrocław Ostrów Tumski and Opole Ostrówek, the warts were attached to the body.

4 Two rattles of this type were found before the Second World War but have since been are lost. It is unknown if these specimens were glazed although it is most likely (Tab. 1).

5 Easter egg rattles have already been the subject of a separate analysis, so the results are presented here. For a detailed description of the chemical composition of this group of glazes, including the share of individual oxides, see Siemianowska et al. in print.

6 https://www.hs-augsburg.de/~harsch/Chronologia/Lspost10/Heraclius/her_col2.html

7 Similar conclusions concern the analysis of the Wrocław artefacts. The activity of glass workshops was probably limited in this centre to the production of jewellery from blanks. A significant number of the glass products from Wrocław Ostrów Tumski were considered as imports (Pankiewicz, Siemianowska 2018a).

8 Attention was also focused on the stylistic similarity of Easter eggs from the territory of Poland and glazed ceramic tiles with a combed feather ornament and glass beads produced in Rus' workshops (Rybakov 1948, 369–363, Fig. 98, 100; Kaczmarek 1998, 557).

9 There are further references and cited discussions.

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Resumé

Glazované předměty se často vyskytují na raně středověkých lokalitách v polských zemích, hlavně v souborech datovaných od sklonku 11. do 1. poloviny 13. století. Je to ovšem velmi nejednotná kategorie artefaktů, v jejímž rámci se vyskytují glazovaná vajíčka – chrastítka, chrastítka s výčnělky i keramické nádoby. Sporadicky se setkáváme s glazovanými modely vajíček, nebo s tzv. hvězdičkami. Ve starší literatuře byly uvedené předměty většinou považovány za výrobky skláren pracujících v areálu některých hradů, liší se však technologií výroby a proveniencí.

Glazované nádoby jsou pravděpodobně domácího původu. Střediska jejich produkce, související s těžbou i zpracování olova byla lokalizována do kontaktní zóny Slezska a Malopolska, jakož i do některých malopolských center. Lze také uvažovat o výrobě této keramiky v jiných částech Horního Slezska, možná v prostoru samotného Opole. Velmi nízká frekvence glazovaných nádob na wrocławském hradě dovoluje soudit, že tato skupina keramiky nebyla vyráběna nikde poblíž.

Na nádoby se nanášela glazura charakteru heterogenní substance na bázi kysličníků olova a vypalovaly se současně s nádobami. Jiný postup se uplatnil v případě polévání keramických vajíček, chrastítek s výčnělky a hvězdiček se středovým otvorem. Tyto výrobky byly nejdříve vypalovány, následně pokryty vrstvou glazury, či v ní byly přímo ponořeny. To vyžadovalo dovednosti zrozené ve sklářských dílnách, v případě keramických vajíček – chrastítek se od sklářů přebíraly i výzdobné motivy. Současně z hlediska formy, výzdobou i technologií výroby připomínají uvedené produkty výrobky z Rusi. Z toho plyne možnost, že šlo přímo o produkci tamějších dílen. Méně zřetelný je původ chrastítek s výčnělky a hvězdiček, ke kterým nenacházíme ruské analogie; vyskytují se především v polských zemích. Problém jejich původu může být v průběhu dalšího bádání řešen např. pomocí analýz surovinové skladby použitých hlín, ze kterých byly zhotovovány.

Glazovaná vajíčka a chrastítka s výčnělky, v menší míře i hvězdičky, lze považovat za výrobky dosti vysoké hodnoty. Staly se součástí standardní hmotné kultury polských zemí v období vymezeném sklonkem 11. a 1. polovinou 13. století. O popularitě těchto předmětů svědčí jejich výskyt v nejdůležitějších centrech piastovské moci, jakož i početné nálezy derivátů v podobě neglazovaných chrastítek a kamenných modelů vajíček.

Pozornost si zaslouží také nerovnoměrná frekvence výskytu glazovaných předmětů ve Wrocławi a v Opoli, s výraznou převahou v posledně uvedené lokalitě. Tuto disproporci lze jen částečně vysvětlit rozsahem distribuce některých artefaktů (např. glazované keramiky) nebo rozvojem obchodních styků. Souvisí patrně také s různým vkusem odběratelů, případně s odlišnou funkcí těchto center.

Přeložil R. Procházka

Contacts

Aleksandra Pankiewicz
Uniwersytet Wrocławski
Wydział Nauk Historycznych i Pedagogicznych
Instytut Archeologii
Szewska 48
PL-50 139 Wrocław
ohlap@poczta.onet.pl

Sylwia Siemianowska
Instytut Archeologii i Etnologii PAN
ul. Więzienna 6
PL-50 118 Wrocław
SylwiaSiemianowska@wp.pl