

ROMAN-PROVINCIAL PEACOCK PLATE BROOCH FROM OSICE, HRADEC KRÁLOVÉ DISTRICT¹

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Abstract: The article comprehensively evaluates the find of a zoomorphic (peacock) enamelled plate brooch of Roman origin. The brooch is dated to the 2nd century AD. The artefact was made of a copper alloy with a high proportion of zinc. It is ancient brass – the so-called aurichalcum. The peacock motif was one of the popular decorative elements in Roman antiquity, and in the case of a brooch, it can be associated with the symbolism of luxury, prosperity and wealth.

INTRODUCTION²

Roman-provincial plate brooches are not very often found in the territory of East Bohemia. The most recent comprehensive publication of Bohemian finds of these brooches comes from the pen of E. Droberjar and is dated 2016, but it does not include finds from East Bohemia. Among the small number of enamel brooches from the territory of East Bohemia, we lack zoomorphic brooches. One such brooch was found at a Roman period

settlement site in Osice (Hradec Králové district) in November 2020. The brooch was handed over to the collection of the Museum of Eastern Bohemia in Hradec Králové by Z. Mitáš. The evaluated brooch, which falls within the category of Roman imports, comes from a multicultural site (Fig. 1), which has been monitored for a long time by amateur collaborators using metal detectors. Metal finds show that the site was inhabited throughout the Roman Period.

The primary aim of this article is to comprehensively evaluate and interpret an interesting and rare find in the territory of Bohemia. Our attention is not only focused on the standard typological-chronological analysis, but also brings archaeometric findings and reflections on the meaning of the brooch in the Roman and barbarian environments.

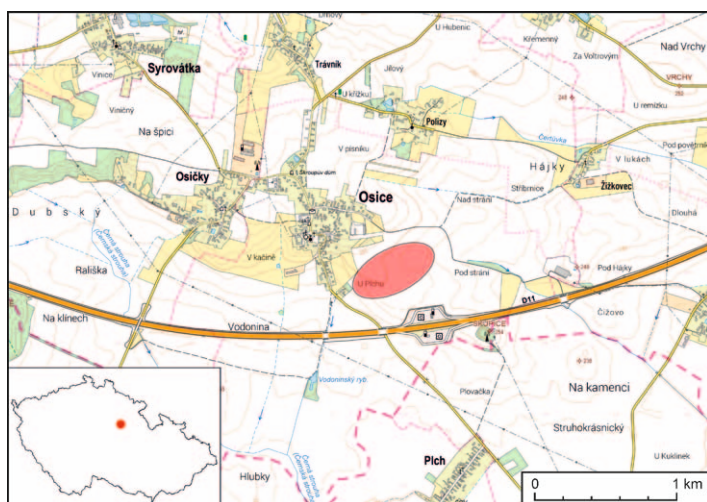


Fig. 1. Osice (Hradec Králové district). Location of the Roman Period settlement site (created by P. Čechák, background map by Czech Office for Surveying, Mapping and Cadastre, ČÚZK).

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² The team of authors dedicates this text to the dear jubilarian Ján Rajtár, who is one of the most prominent experts on the issue of Roman-barbarian relations in Central Europe. His recommendations and ideas have always been a great inspiration to us!

Description

Brass brooch stylised in the form of a peacock. The head is turned right. The crest atop the head is broken off, the wing is divided into six cells, in three of which the enamel is preserved. The tail feathers are indicated by engraving. There are two circular cells on the tail and on the wing. On the reverse side there is the preserved pin holder and an eyelet for the spring. The pin and the spring are broken off. Dimensions: 30 × 19 mm, weight: 5.8 g, Inv. No. A95042. Storage place: Museum of Eastern Bohemia in Hradec Králové (Fig. 2).

ARTEFACTUAL ANALYSIS

Peacock-shaped brooch from Osice site (Fig. 2) is consists of an oval body with a wing. It is divided into six triangular cells originally filled with enamel. The enamel fill was preserved in three of them and is red in colour. On the wing and on the tail, there are two other small circular cells that bore the enamel decoration. The body is connected with distinctive tail feathers, indicated by engraving. At the other end is a tiny neck with an upright head facing right. The crest, which we know from several brooches of this form (e.g. *Gaspar* 2007, Taf. 94: 2123, 2124; *Gugl* 1995, Taf. 19: 145; *Hattatt* 2007, fig. 220: 1171), is unfortunately broken off. A completely identical brooch was found in the Roman city of Virunum in the province of Noricum. The Austrian specimen allows us, with a certain degree of tolerance, to reconstruct the colour range of the enamel, with which also the cells of the brooch from East Bohemia could have been filled. In accordance with our find, a red enamel has been preserved here, still supplemented with a green enamel. The zoomorphic brooch is dated to the 2nd century AD (*Gugl* 1995, 46, 93, Taf. 19: 145). Another very close analogy has to be sought in Luxembourg (*Gaspar* 2007). Another brooch, also dated to the 2nd century, is listed in *R. Hattatt's* catalogue (2007, 361, fig. 220: 1171) without detailed localisation. Brooches from the sites of Augst and Baden are similar in shape to our find. *E. Ettlinger* (1973, 30, 125, Taf. 14: 21, 28: 6) places them in the middle of the 1st century AD. *E. Riha* (1979, 200, 201, Taf. 67: 1738) assigned the brooch from Augst to her type 7.25, which comprises various forms of flat zoomorphic brooches decorated with enamel. This group is dated to the 2nd century AD. In *M. Feugère's* classification, we observe some similarities in shape with brooches of Feugère types 29a22a and 29a22b. These brooches are reported from the French sites of Etaples and Verault, Mont-Berny, and from Bologna in Italy (*Feugère* 1985, 410, fig. 60). The French researcher anchors his type 29 group of brooches chronologically only in a very general way. He points to the beginning of the appearance of various forms of zoomorphic brooches in the middle of the 1st century and continuation into the 2nd century (*Feugère* 1985, 393, 394). The peacock brooch from the Zugmantel *castellum* is more elaborate than the brooch from Osice. Nevertheless, we consider it a suitable parallel. Its wing is decorated with dark blue enamel. The brooch is dated to the 2nd century (*Böhme* 1972, 40, 41, Taf. 27: 1049). Two brooches in the form of peacocks date from the period when Roman settlement flourished on the site of the former Titelberg *oppidum*. One of the brooches bears green enamel, the other has survived without it. Brooches that were found out of context are dated as early as the 1st century (*Gaspar* 2007, 50, Taf. 94: 2123, 2124). In the author's classification, they correspond to type 56, which is supposed to be characterized by metal inlay (*Gaspar* 2007, 50). The catalogue item No. 2123 is mentioned to bear green enamel, which is, however, characteristic of brooches type 57 (*Riha* 7.25) dating to the 2nd century (*Gaspar* 2007, 50, 217).

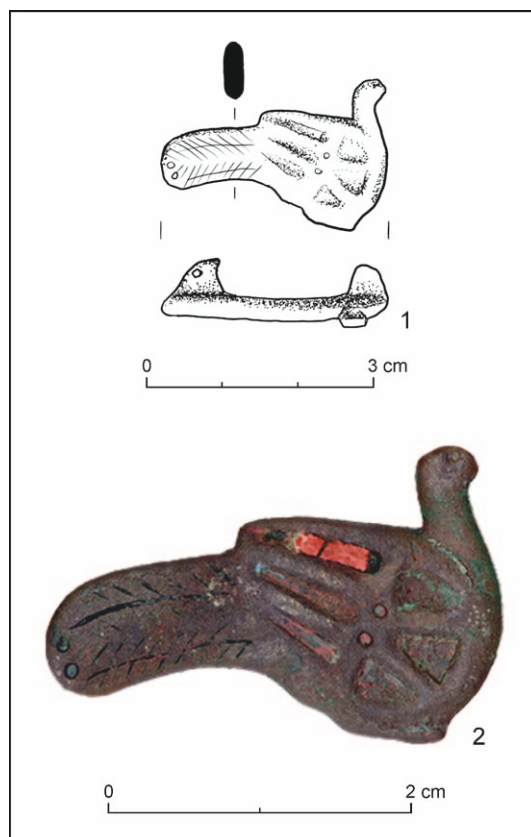


Fig. 2. Osice (Hradec Králové district). 1 – drawing documentation of the brooch; 2 – obverse side of the brooch with remains of enamel (drawing by H. Oláhová, photo by J. Souček).

Zoomorphic enamelled brooches developed in the Roman-provincial environment in the last third of the 1st century. The finds from both military and civilian environments testify to their popularity throughout the 2nd century. They were still popular with Germans at the beginning of the 3rd century (Zeman 2017, 94). Due to the circumstances of finding, we have to understand the brooch from Osice as a find without a closer knowledge of the context. The presented parallels make it possible to place the optimum of its popularity in the 2nd century AD. However, we are unable to answer whether its archaeologisation could have taken place at the beginning of the 3rd century.

ANALYSIS OF ENAMEL AND ELEMENTAL COMPOSITION OF METAL

In the case of enamel, it is a popular decorative technique that has been documented in various variations from ancient times to the present day. The best-known enamel techniques include *cloisonné* (in added compartments) and *champlevé* (in sunken cells). It is a crushed glass powder coloured with the help of appropriate metal oxides, which is fused to the metal surface under high temperatures. The oldest evidence of enamel comes from Cyprus – these objects are products of the Mycenaean culture and are dated to the 13th century BC. In Hellenism, we can already follow up the use of the *cloisonné* technique in the Mediterranean area and in the northern Black Sea region (Urbanová 2015, 21–23). At that time, this was only an accessory technology, when small details on gold jewellery were decorated with the help of enamel. Only in the environment of the La Tène Period can we talk about the true rise of *champlevé* enamel decoration. In the context of the Western and Central European La Tène cultural sphere, exclusively red enamel appears, in contrast to the territory of today's Serbia, where we can also encounter blue and yellow (Dizdar 2014, 103). Enamel decoration appears both on personal ornaments – brooches and belts, and on functional objects – fittings, spurs, parts of horse harness, rivets. Enamel decoration became also popular in the Roman-provincial environment, where it is most often used to decorate small objects such as brooches, belt or horse harness fittings, seal boxes, etc. Exceptionally, it can also be found on larger objects, for example on bronze vessels (Pelpel/Vernou 2019). The *champlevé* technique is typical for the Roman-provincial environment. This technique is characterized by troughs or cells that are engraved or cast into the surface of objects. In contrast, *cloisonné* uses compartments added to the surface of objects by soldering thin metal strips onto the base (Bateson 1981, 81, 82). At the same time, the colour palette is also expanding, so we can most often find blue, red and white. Green, yellow, yellow-brown and orange are less frequent (Henderson 1991, 69–72). Finds of objects with enamel decoration are concentrated in the territory of Roman provinces. Numerous finds of enamel brooches or belt fittings are also known from the Barbaricum (for more details, see Droberjar 2016; Elschek 2017). The issue of workshops for the production of enamelled objects is not yet resolved, as we lack direct evidence of this production activity. For example, workshops can be assumed in the region around the city of Cologne, whose territory was a renowned glassmaking centre. We can also think about the existence of workshops in Trier and Mainz (Riha 1979, 30; Sedláčková 2020, 75). Evidence for the production of enamelled artefacts is also known from Dacia, from the sites of Ilişua and Tibiscum (Benea 2016, 782, 786, Abb. 6: 3, 4).

Roman glasses were made from the natron mineral (rich in sodium), which had the function of a flux. Another raw material was sand, which also contains calcareous shells. Natron-based glasses are typically low in K₂O and MgO (usually less than 1.5%) and low in P₂O₅ (usually < 0.2%). The chemical composition of the glass or enamel in the brooch from Osice was determined by the LA-ICP-MS³ method and is shown in Table 1.

Based on the results in the table, it seems that this type of glass is not involved. However, higher contents of the discussed oxides are described in the literature for Roman red glasses and are usually associated with

³ The major, minor and trace element contents of sample were determined using the LA-ICP-MS (laser ablation-inductively coupled plasma-mass spectrometry) system consisting of Agilent 7900 quadrupole (Q)-ICP-MS (Agilent Technologies Inc., USA) coupled with an Analyte Excite Excimer 193 nm LA system (Photon Machines, USA), equipped with a two-volume HelEx ablation cell. The gas system of the Laser includes Nitrogen for purging of the laser beam path and Helium carrier gas. Agilent 7900 Q-ICP-MS was equipped with standard nickel sampler and skimmer cones and a quartz torch with a 2.5 mm injector. The applied laser fluence was 4.71 J/cm² with a laser pulse rate of 10 Hz. A typical analysis consisted of 20 s of background acquisition (gas blank), 60 s of sample ablation, and 60 s of wash-out time. The Iolite 4.0 software package was used for data reduction to estimate trace element concentrations, analytical errors, and detection limits. The internal standardization was based on Si concentrations determined by the SEM-EDS. NIST 612 glass reference material and Corning B were used for external calibration.

Table 1. Chemical composition of glass – major, minor and trace elements from LA-ICP-MS.

	Na ₂ O	MgO	Al ₂ O ₃	SiO ₂	SO ₃	P ₂ O ₅	K ₂ O
wt%	12.59	2.54	2.63	55.77	0.2	1.1	1.78
	CaO	TiO ₂	MnO	Fe ₂ O ₃	CuO	PbO	–
wt%	8.13	0.19	0.73	1.7	0.84	10.09	–
	Li	B	V	Cr	Co	Ni	Zn
ppm	5.3	188	31	20	30	25	369
	As	Rb	Sr	Y	Zr	Ag	Sn
ppm	48	5.0	675	6.2	70	10	2407
	Sb	Ba	La	Nd	Hf	Bi	U
ppm	1537	292	6.7	6.7	1.8	3.2	0.9

Table 2. Elemental composition of metal analysed by SEM/EDS (wt%).

	Cu	Zn	Pb	Sn
wt%	77.8	20.2	1.2	0.1

additions of vegetable ash to natron glass during the production process. These additions were apparently supposed to ensure the reducing conditions of melting by the introduced carbon contained in plant ash (*Bandiera et al. 2020*).

The PbO and CuO content in the enamel is also interesting. According to these oxides, the glass can be classified



Fig. 3. Detail of preserved enamel; image obtained with an Olympus SZX9 stereo microscope.

into the so-called low-copper, low-lead group of glasses. This designation is based on the literature dealing with the red glass of archaeological artefacts (*Freestone et al. 2003*). In the cited text, two basic types of red glass coloured with copper are distinguished: (a) low-copper low-lead glass with values of max 4% copper oxide and 10% lead oxide and (b) high-copper high-lead glass with 5–12% copper oxide and 20–40% lead oxide. The second group of glasses is referred to as the so-called high-copper high-lead glass, also referred to as the “sealing wax” red variety. Lead ensures good fusibility in the glass and reduces the viscosity of the glass. In this case, copper is related to colour and opacification (Fig. 3).

In glass, copper as opacifier can occur in two modifications – as elemental copper (Cu⁰) or as dendritic Cu₂O crystals. The presence of Cu₂O is typical of the high-copper high-lead type glasses mentioned above, while elemental copper is found in glasses with a CuO content < 5 wt% and rather higher Fe₂O₃ content (2–5 wt%). In our case, smaller particles with a size of lower hundreds of nm are evident in the enamel (Fig. 4).

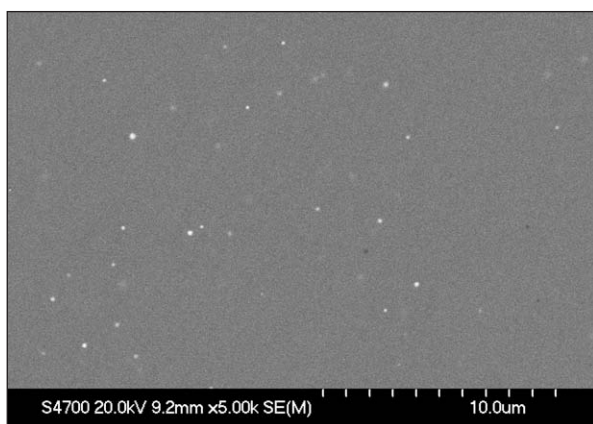


Fig. 4. Copper particles in the form of Cu° contained in the glass (white points), the size of the larger ones is approximately 250 nm. Image obtained with a Hitachi S-4700 scanning electron microscope.

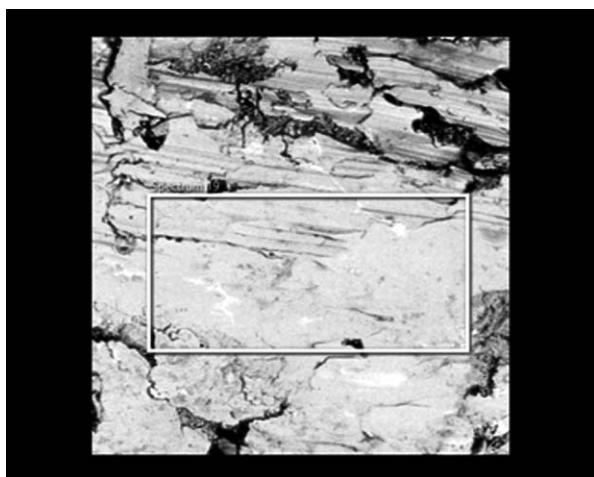


Fig. 5. Detail of the analysed area. Image obtained with a TESCAN Vega 3 LMU scanning electron microscope.

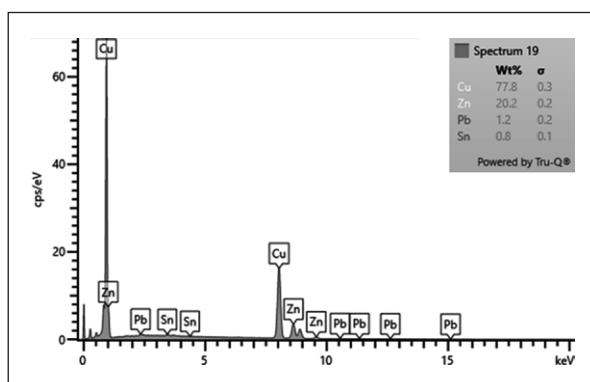


Fig. 6. Basic values of elemental composition. Material analysis was conducted using a TESCAN Vega 3 LMU scanning electron microscope with an Oxford Instruments INCA 350 energy dispersive analyser.

The method that was chosen to identify the represented particles was Raman spectroscopy.⁴ With this method, Cu_2O can be well identified, but the Cu° phase will not be clearly visible. In our case, Cu_2O was not found, but the sample spectrally coincides with samples in which metallic copper was determined as the opacifier based on other methods.

Due to the formation of copper particles in the glass, reducing conditions are required during melting. To create proper conditions in the glass melt, other reducing agents, such as iron, tin or antimony, are also added. In the enamel we evaluated, the higher iron content is particularly noticeable.

Also interesting is the study of elements which are present in smaller quantities. On the basis of the manganese and antimony contents, the Roman glass types Rom-Sb or Rom-Mn are often assumed (depending on the antimony- or manganese-based decolouriser used). Provided that these elements were not introduced with a raw material containing lead, copper or iron, it can be assumed that the enamel is a mixture of these two glasses and therefore the raw materials were recycled; glass recycling in the given period is also mentioned by M. Davis and I. C. Freestone (2018, 117). However, zinc (369 ppm) or tin (2407 ppm) are also present in larger amounts in the enamel, which could indicate the use of copper alloys and/or different copper alloy waste products as the source of a copper-rich raw material. If we consider the option that antimony also was introduced with a raw material related to the production of bronze, then we can lean towards the type of glass from the Levant (Rom-Mn). The determined higher contents of CaO and Al_2O_3 would also correspond to this glass (data compared with Fig. 6 in Davis/Freestone 2018, 118).

The object was made of a copper alloy with a high proportion of zinc ≈ 20 wt% (Fig. 5; 6; Table 2). It is ancient brass – the so-called *aurichalcum*, which could contain from 5 to 28 (30) wt% zinc in the alloy. Depending on the proportion of zinc, the colour of the resulting alloy also changed: brass with a content of more than 15 wt% is characterized

⁴ The Raman spectroscopy method was applied to study opaque glass particles. Raman spectra were measured with a Thermo Scientific Raman dispersive spectrometer – model DXR Microscope, equipped with an Olympus confocal microscope. The excitation source was a 532 nm Nd:YAG laser with an input power of 10 mW, and a grid of 900 notches/mm was utilised. As a detector, a multichannel thermoelectrically cooled CCD camera was used. The samples were measured at 50 $\times$ magnification with a measurement footprint of approx. 1 μm through the aperture of a 50 μm pinhole. Omnic 9 (Thermo Scientific) was employed to process the spectra obtained.

by a bright golden colour, which was used to imitate gold. In our territory, we find artefacts with a higher proportion of Zn as early as the late La Tène Period (*Bursák et al. 2022*, 2, 3). After all, the best quality ancient brass was already produced in the Augustan era, when the zinc content could even reach 28 wt%. Brass is supposed to have been produced by cementing copper with zinc minerals (*Craddock 1998; Rehren 1999*). In the 1st century AD we still encounter finds with a higher proportion of Zn, but already in the second half of the 1st century, the proportion of Sn gradually begins to increase to 2 wt% (*Rehren 2002*, 150). In the course of the 2nd and 3rd centuries, the zinc content in brass begins to decrease, and already in the 3rd century, it is possible to observe a significant decrease in the concentration of zinc in brass down to 5–7 wt% (*Frána/Droberjar 2004*, 444). This fact can be explained either by the lack of raw material resulting from the depletion of zinc deposits or by political-economic instability in the Roman Empire. At the same time, a trend in the recycling of non-ferrous metals can be observed, both in the barbarian territory and in the Roman-provincial environment, which may have had a significant effect on reducing the concentration of Zn (for more details, see *Čistáková/Beneš 2024; Vích et al. 2020*).

The brass alloy of the brooch from Osice also contains a small amount of tin (Sn $\approx$ 0.8 wt%) and approximately 1.2 wt% of lead. Lead may occur in the brass alloy as an impurity element from the ores, or it may have been added to the brass alloy intentionally as an alloying element. The alloy of the brooch from Osice can be classified into group No. 17 (Zn from 15 to 20 wt%; Pb from 1 to 10 wt%) after *Riederer (1999, 200)*. The composition of the material presented corresponds to alloys dated to stage B1, which are characterized by a very high proportion of zinc (from 15 to 20 wt%) and a low proportion of Sn and Pb (*Bursák et al. 2022*, 5). Artefacts with an increased zinc content (from 12.9 to 19.2 wt%) are also known from the collection of finds from Boršov; compared to our brooch, however, they contain a higher percentage of tin (on average 2.4 wt%) and lead (on average 2.8 wt%; *Vích et al. 2020*, 176). At the same time, it is appropriate to mention a similar composition of two enamel brooches from Xanten: No. 3628 with Zn 17 wt% and Sn 1 wt%, and No. 12200d5 with Zn 13.5 wt%, Sn 1.5 wt% and Pb 1.5 wt% (*Rehren 2002*, 149–151). This proves that even during the 2nd and at the beginning of the 3rd century, we can encounter relatively pure brass with a high zinc content, just as in the case of the brooch from Osice.

COMMENTS ON THE PEACOCK MOTIF

In the Roman world, the depiction of the peacock is one of the popular motifs with various interpretations (for a clear overview, see *Toynbee 1973*, 250–253). This bird was primarily associated with the goddess Hera/Iuno and is also one of her main attributes (*Arnott 2007*, 343, 344). However, it acquires a whole range of meanings during the Roman imperial period, from a symbol of luxury, happiness, wealth-prosperity to connection with the propaganda of the Roman empresses, eternity, or eschatological issues. It then found its application in early Christian art as well. We must not forget that peacock was also one of the delicacies offered at the opulent feasts of the Roman elites (comprehensively *Arnott 2007*, 344; *Anđelković/Rogić/Nikolić 2011; Mynott 2018*, 97, 101, 103, 104, 123, 370; *Pukanczová 2022*, 59–61).

The question is what meaning the depiction of a peacock may have had in the case of Roman provincial plate brooches. The motif was certainly not chosen by chance, so one can also think about a targeted choice of decoration and its symbolism (cf. *Neustupný 2010*, 83–91). The brooch as a clothing accessory could have expressed the wearer's opinion, taste and perhaps even attitude towards life. This assumption can be substantiated in the case of some brooches associated with Roman deities, e.g. with Roma, Mars (*Hoss 2015*, 202, Abb. 4: b, c) and Serapis (*Kuzmová 1997*, 81, 82; 2001, 121, 122, Abb. 2; 3). However, in the case of a peacock image, the situation is more complicated. Although the peacock represents an animal associated with Iuno, we do not have any strong argument for a direct connection of this type of peacock-shaped brooches with the aforementioned deity. However, for the purpose of consideration, we cannot rule it out.

Nevertheless, it is clear that already in ancient Greece this bird was very rare and widely admired for its beauty and exoticism (*Arnott 2007*, 343, 344). It was thus associated with a luxurious lifestyle. This tradition continues further into the Roman Empire, including the provinces (*Arnott 2007*, 344; *Mynott 2018*, 135). Peacocks can therefore be seen figuratively as a symbol of exotic beauty, wealth and luxury. This aspect could also be emphasized in the case of clothing accessories. But it is surprising that the brooch from Osice belongs to the group of common brooches, which were widespread mainly in the territory of the Gallic provinces and in the Rhineland. However, it stands out in that it was made of brass, which in its lustre remotely resembles

gold, and also the colourful decor could have been impressive in combination with brass. Hypothetically, in the expansion of these brooches we thus can see a reflection of the lifestyle of the highest ranking Roman elite, who had easier access to peacocks than the general population of the Rhine and Danube border provinces.

What meaning might the brooch have had in the Upper Elbe region during the Roman Period? Certainly, different from the imperial environment. Enamelled plate brooches do not belong to common finds of Roman-provincial brooches in this environment, so one can only consider its difference from commonly worn specimens. However, what meaning the barbarians attributed to the representation of the peacock remains unknown.

CONCLUSION

The Roman-provincial Riha 7.25 type brooch from Osice in the form of a peacock is an interesting find, proving the production of high-quality brass objects with a high zinc content (≈ 20 wt%) still in the 2nd century AD. In East Bohemia, it is one of the few imported objects with preserved enamel. Based on the increased contents of CaO and Al_2O_3 , we rather suppose a Levantine origin of the glass. In the Roman world, the peacock symbolized luxury, happiness, wealth and prosperity. It is also associated with the goddess Iuno and with the propaganda of the Roman empresses, eternity, or eschatological issues. In the territory of the Roman Empire, these brooches can be evidenced from the Rhineland, Noricum and Gaul. The described brooch falls into the category of zoomorphic plate brooches, which do not deviate in any way from the usual provincial repertoire. What role this object played in the barbarian environment remains an unanswered question. The peacock symbolism is typical only for the territory of the Empire.

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Pukanczová 2022

A. Pukanczová: *Kovové římské prsteny v českých a moravských sbírkách (exempláře bez bližších nálezových kontextů)*. Manuscript of the unpublished Master thesis stored at the Faculty of Arts of the Masaryk University. Brno 2022.

Římsko-provinciální destičkovitá spona ve tvaru páva z Osic, okr. Hradec Králové

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Souhrn

Článek komplexně hodnotí nález destičkovité zoomorfní (paví) spony zdobené emailem římského původu. Spínadlo bylo nalezeno při prospekci s detektorem kovu v Osicích ve východních Čechách. Identická spona z římského města Virunum v provincii Norikum (Gugl 1995, 46, 93, Taf. 19: 145) náš nález datuje do 2. století našeho letopočtu. Tuto dataci můžeme podepřít dalšími nálezy spon stylizovaných do podoby páva z lokalit Augst a Zugmantel (Böhme 1972, 40, 41, Taf. 27: 1049; Riha 1979, 200, 201, Taf. 67: 1738). Zobrazení páva patří v římském světě k oblíbeným motivům s různými výklady (k tomu přehledně Toyne 1973, 250–253). Tento opeřenec byl primárně spojován s bohyní Hérou/Iuno a patří rovněž k jejím hlavním atributům (Arnott 2007, 343, 344). Jeho význam však získává v době římského císařství celou řadu směrů od symbolu luxusu, štěstí, hojnosti-prosperity až po spojení s propagandou římských císařoven, věčnosti, eschatologickými otázkami. Své uplatnění poté nachází i v raně křesťanském umění. Spona – doplněk oděvu mohla vyjadřovat názor nositele, jeho vkus a snad i životní postoje.

Červený email studované zoomorfní spony lze charakterizovat jako tzv. low-copper – low-lead glass (s obsahem PbO 10 %; specifikace dle Freestone et al. 2003). Ramanova spektroskopie přispěla k určení kaliva (fáze Cu^o) ovlivňujícího optické vlastnosti emailu (barvu i zakalení). Nutné redukční podmínky pro získání červené barvy byly zajištěny přidávkou redukčního činidla s obsahem železa a zřejmě i přidávkou rostlinného popele. Podle vyšších obsahů CaO a Al₂O₃ usuzujeme spíše na levantský původ skla (data srovnána s Davis/Freestone 2018, 118).

Předmět byl vyroben ze slitiny mědi s vysokým podílem zinku ≈ 20 hm. %. Jedná se o antickou mosaz- tzv. aurichalkum, která mohla obsahovat od 5 do 28 (30) hm. % zinku ve slitině. V 1. století n. l. se stále setkáváme s nálezy s vyšším podílem Zn, ale již v 2. polovině 1. století postupně začíná narůstat podíl Sn na 2 hm. % (Rehren 2002, 150). V průběhu 2. a 3. století obsah zinku v mosazi začíná klesat a již v 3. století je možné pozorovat výrazné snížení koncentrace zinku v mosazi až na 5–7 hm. % (Frána/Droberjar 2004, 444). Mosazná slitina u spony z Osic obsahuje také menší množství cínu (Sn ≈ 0.8 hm. %) a přibližně 1.2 hm. % olova. Vysoký podíl zinku v případě spony z Osic svědčí o tom, že i v průběhu 2. století se setkáváme s relativně čistou mosazi s vyšším obsahem zinku.

Obr. 1. Osice (okr. Hradec Králové). Poloha sídliště z doby římské (sestavil P. Čechák, mapový podklad ČUZK).

Obr. 2. Osice (okr. Hradec Králové). 1 – kresebná dokumentace spony; 2 – lící strana spony se zbytky emailu (kresba H. Oláhova, foto J. Souček).

Obr. 3. Detail dochovaného emailu; snímek získán pomocí stereomikroskopu Olympus SZX9.

Obr. 4. Částice mědi ve formě Cu^o obsažené ve ve skle (bílé body), velikost u větších z nich je cca 250 nm. Snímek získán skenovacím elektronovým mikroskopem Hitachi S-4700.

Obr. 5. Detail analyzované plochy. Snímek získán elektronovým rastrovacím mikroskopem TESCAN Vega 3 LMU.

Obr. 6. Základní hodnoty prvkového složení. K materiálové analýze byl použit elektronový rastrovací mikroskop TESCAN Vega 3 LMU s energiově disperzním analyzátozem Oxford Instrument INCA 350.

Tabela 1. Chemické složení skla – hlavní, vedlejší a stopové prvky z LA-ICP-MS.

Tabela 2. Elementární složení kovu analyzované pomocí SEM/EDS (wt%).

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