THE MIGRATION PERIOD IN *IOVIA-BOTIVO* — A 5TH CENTURY GRAVE WITH A TREPANATION

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During systematic research in Ludbreg (Roman Iovia-Botivo*) in 2011, a 5th century grave built of tegulae was discovered within the Roman stratum. The deceased has a trepanation on his skull and was accompanied by a single object, a silver ring buckle. The newfound grave has undergone radiocarbon and radiological analysis. The discovery of this grave has prompted a revision of previous graves of the Migration Period found in Ludbreg, discovered in previous research, as well as the accidental find of a grave found between Ludbreg and Selnik. Available data on these graves have been analysed and contextualized within the complex historical period of Late Antiquity and the Migration Period of northern Croatia. Analysis of the graves in question has shown that Roman* Iovia *ceased to function during the 5th century.*

Key words:
Iovia-Botivo*, Ludbreg, 5th century, Migration Period, Late Antiquity, grave, trepanation, silver ring buckle.*

During more than fifty years of rescue and systematic archaeological research in Roman *Iovia-Botivo* (modern-day Ludbreg), a significant quantity of remains and archaeological artefacts has been found.[1] When we add to this the stray finds that were acquired by the Archaeological Museum in Zagreb (hereafter AMZ) during the 19th century, as well as those acquired by the Varaždin City Museum (hereafter GMV) during the first half of the 20th century, we have a large number of artefacts which significantly complement our knowledge of the functioning of this site from prehistory to the present day. Encouraged by the discovery of a 5th century grave found in 2011 during systematic research of the 'Vrt Somogy' (Somogy Garden) site by the Croatian Conservation Institute, this paper will present an overview and a new contribution to the findings of the newly-arrived population during Late Antiquity and the Migration Period in Roman *Iovia-Botivo.*

The first trial archaeological excavations in Ludbreg were carried out in 1966, while systematic excavation was carried out from 1968 to 1979 by the Archaeological Museum in Zagreb, and then again from 2008 to 2011 by the Croatian Conservation Institute. The excavations provided numerous data on the intensity of life at this site: to a lesser extent during the prehistoric period, while the largest number of finds are from the period of Roman *Iovia-Botivo* and, finally, from the medieval period onwards.[2]

1 Vikić-Belančić 1984, 119–166; Gorenc, Vikić 1984, 64; Sekelj Ivančan 2001.

2 Tomičić 1966, 116–119; Vikić, Gorenc 1978, 69–72; Vikić-Belančić 1984, 119–166; Demo 1986, 29, 44; Pleše 2012, 177–197; 2014.

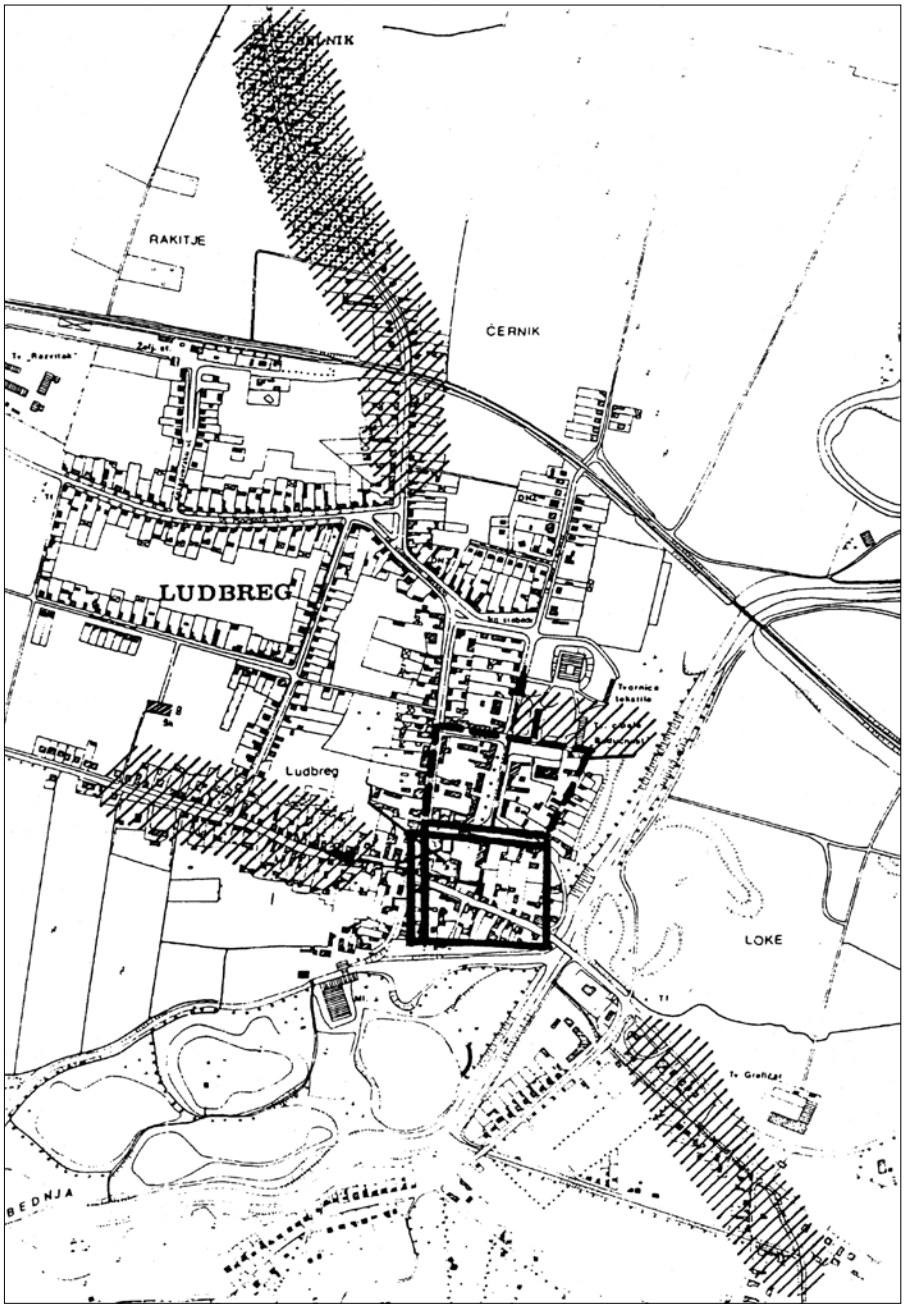

FIGURE 1. Roman *Iovia-Botivo* and the presumed positions of the cemeteries (Sekelj Ivančan 2001).

The excavation conducted confirmed that the Roman city was situated along the left bank of the River Bednja and also confirmed uninterrupted presence during antiquity, from the 1st century to the 5th, of what was then Roman *Iovia-Botivo* (modern-day Ludbreg, Croatia). The city was built according to the usual Roman urban scheme, with the main roads *cardo* (N–S; remains preserved in part to this day in the A. Blažić / ban J. Jelačić street) and *decumanus* (starting in the street passage of 4a A. Blažić Street, north across the courtyard of the Hotel Putnik to the Bacani castle) and public buildings next to them.[3]

Along with the road network that surrounded Roman *Iovia*, on the road leading to Koprivnica the eastern cemetery was formed (on the grounds of an old school of the 19th century, today a bank building), where the remains of incinerated and inhumated graves with ceramic accessories were found.[4] A western cemetery was formed along the Roman road to *Aquae Iasae*. The find of incinerated graves at the position of 'Varoški vrti', brick tombs and stone sarcophagi, indicate a duration for the necropolis of several centuries.[5]

3 Vikić-Belančić 1984, 119–166; Gorenc, Vikić 1984, 64.

4 Gorenc, Vikić 1984, 62; Sekelj Ivančan 2001, 198, while according to another author, this necropolis is located at the location of the old road and the old bridge leading to Koprivnica (Tomičić 1997, 29).

5 Vikić-Belančić 1997, 54.

FIGURE 2. Positions of the Migration Period graves within the presumed walls of Roman *Iovia-Botivo* (after Vikić Belančić 1984; Pleše 2012).

The northern necropolis is defined by the discovered graves built of bricks from the early and later (sic!) period of the Roman Empire.[6] All necropolises are positioned, according to the usual template of the Roman period, outside the urban area (Fig. 1).

The finds from the Migration Period are not numerous when compared to the Roman, but they are certainly significant for interpreting the events that took place in *Iovia* at the very end of antiquity, during the barbarian invasions of Pannonia in the final decades of the 4th century and throughout the 5th.

To be able to interpret and examine a broader context of the end of antiquity in *Iovia-Botivo*, it is necessary to present the findings from the Migration Period (Fig. 2).

Grave 1/1952

The first such find in Ludbreg is a skeletal burial with destroyed tomb architecture built of *tegulae*.[7] This tomb was accidentally discovered in 1952 at 23 Ivo Lola Ribar Street (today Vatroslav Lisinski Street) and was found near another Roman-era grave, also constructed of *tegulae*.[8] It should be noted that there are doubts about the exact location of this grave(s). One group of authors claims that the grave was found on the northern edge of modern Ludbreg, along the road to Selnik, i.e. outside the narrower (presumed) area of ancient *Iovia-Botivo*,[9] while another

6 Gorenc, Vikić 1984, 62; the authors do not precisely determine what 'later' means, but from the overall view of both authors' published work and the terminology they use, this probably means burials of the 3rd and 4th centuries.

7 Tomičić 1997, 34, n. 69; 1999, 153, n. 69; Rapan Papeša 2012, 427; Štimac-Dedić 2013, 11; in the inventory book of the Varaždin City Museum, S. Vuković entered the following description of this find: *"Ludbreg, 23 I. Lola Ribar Street, a Roman tomb on the land of M. Fosin was found in 1952, destroyed by the workers digging the sand"*. Furthermore, the information from the GMV inventory book mentions (besides the aforementioned grave) other finds: *"a Roman brick with a fluted semicircle, a fragment of a Roman brick, a Roman brick with a child's footprint, a Roman brick with a dog's footprint and a child's"*. We thank M. Šimek, a senior curator at GMV, for this information.

8 Fulir 1969, Map 2, no. 10; Simoni 1984, 73. Here it should be noted that the second tomb mentioned is known in the literature according to the description of M. Fulir (1969, Map 2, no. 10).

9 Fulir 1969, Map 2, no. 10; Tomičić 1997, 34; 1999, 153. Fulir (1969, Map 2, no. 10) mentions another Roman grave built of bricks not far from this grave. This information can also be found in the Decree of the Institute for the Protection of Cultural Monuments in Varaždin of 1966. For this information we thank M. Šimek, a senior curator at GMV.

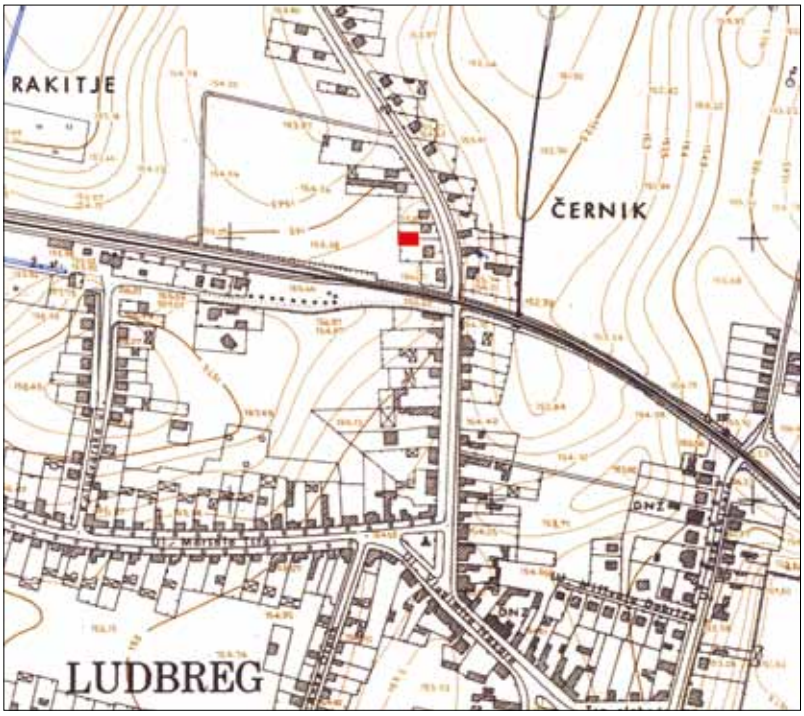

FIGURE 3. Position of grave 1/1952 (ODK Ludbreg).

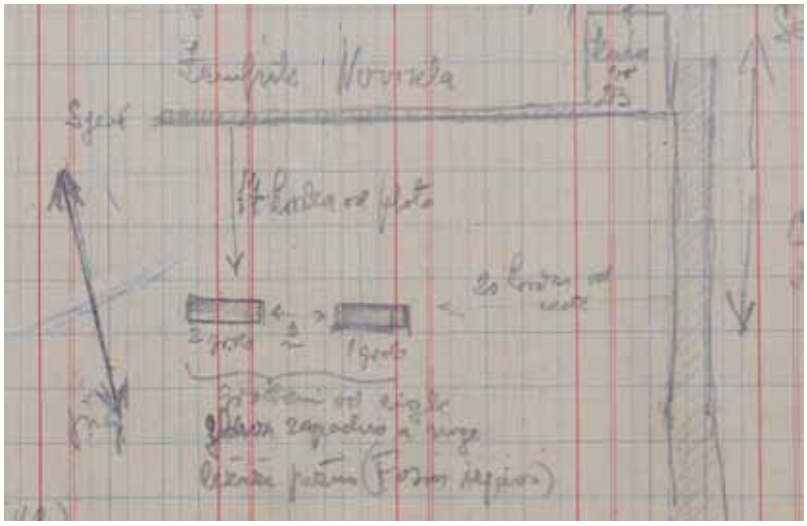

FIGURE 4. Sketch from the notebook of S. Vuković depicting the position and the circumstances of the find from 1952.

group of authors claims that the tomb was found inside the (presumed) walls of the Roman (presumed) city, near the baths or today's parish church of the Holy Trinity.[10] However, the latter assumption is not based on facts and therefore cannot be accepted.[11]

The only available information on the exact spot is found in the notebook of S. Vuković (GMV), who documented the circumstances of the find of two graves (the grave in question and a Roman-period grave, found two metres apart), based on the information that was given to him by M. Fosin. The orientation of both graves was west (head) to east (legs), or more precisely WSW–ESE. Unfortunately there is no information as to precisely which grave is the grave in question, and which is the Roman-period grave (grob 1 / grave 1 or grob 2 / grave 2) (Figs 3, 4).[12]

The deceased was buried with a double-edged sword found broken in two (GMV, inv. no. 3727),[13] a late-Roman bell-shaped cup

10 Migotti 1994, 52–53; Šiša Wiewegh 2004, 306; Rapan Papeša 2012, 427.

11 We thank the senior curator, Marina Šimek, for the information from the GMV archives.

12 For the information from the documentation of GMV, S. Vuković's notebook and for the scan of the sketch from S. Vuković's notebook, we thank Lovorka Štimac-Dedić, a curator at GMV, on her great effort in order to provide us with these.

13 For exact dimensions, see Simoni 1994, 111; Rapan Papeša 2012, 427; Štimac-Dedić 2013, 26 (cat. no. 63.1), 27 (cat. no. 63.2).

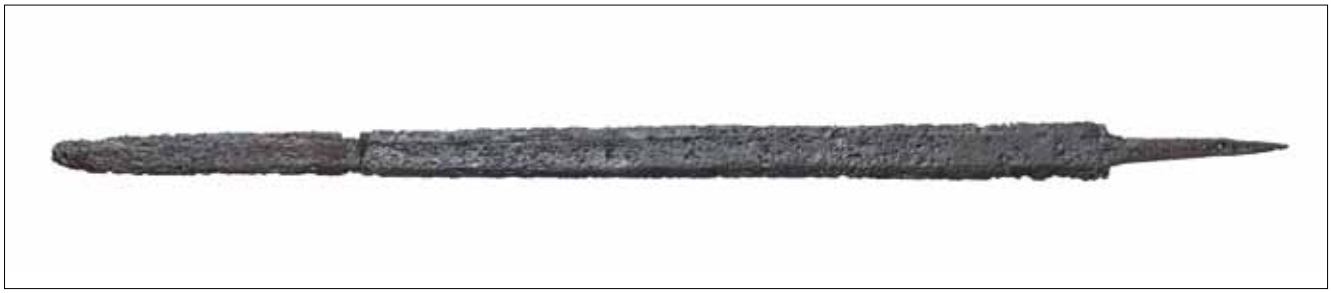

FIGURE 5. Grave 1/1952. Double-edged sword (photo by A. Švoger).

FIGURE 6. Grave 1/1952. Bell-shaped cup (photo by A. Švoger).

with an accentuated opening (GMV, inv. no. 3728)[14] and (allegedly) a massive gold ring, which was lost.[15] It has been determined by the preliminary analysis of the skeletal remains that the deceased (with the sword and a bell-shaped cup as a grave good) was a male between 30 and 40 years of age.[16] Unfortunately, no data on the dimensions and appearance of the ring exist in the GMV documentation. The only original document that mentions the ring is the Institute for the Protection of Cultural Monuments in Varaždin's decree on the preventive protection of Ludbreg as a whole, of 1966.[17] According to the above findings, the grave is dated to the end of the 4th century or the 5th (Figs 5 and 6).[18]

The entire inventory of the grave finds, along with parts of the tomb architecture, is today kept in Varaždin City Museum.

Grave 2/1976

Another find dated to the Migration Period is a female skeletal grave found at 2 Petar Preradović Street, i.e. in the southernmost part of the yard of the former police station, during the archaeological excavations in 1976.[19] From the report of the archaeological excavation,[20] and in an overview of the excavations in Ludbreg (1968–1979),[21] it is possible to conclude that the grave in question was found a few metres southeast of the bath area in the 'Somogy Garden', in the northeastern part of trench 30 (4 x 2 m, north-south direction) at a depth of 160 cm. This burial was inhumed in the Roman-period stratum.[22] That is, the grave pit was dug out in the Roman archaeological layers (*intramuros*), negating the functionality of its original purpose in the late-Roman period. A three-fold wire bracelet and two small beads of greenish glass paste were found in the grave.[23] The deceased was buried

14 For exact dimensions, see Simoni 1994, 111; Rapan Papeša 2012, 427; Štimac-Dedić 2013, 11, 26 (cat. no. 63.1), 27 (cat. no. 63.2).

15 Simoni 1984, 73, Fig. 2 (the captions under Figures 1 and 2 in the paper have been mistakenly interchanged); Sokol 1986, 56; Migotti 1994, 52–53; Simoni 1994, 111, cat. nos 142a and 142b; Sekelj Ivančan 1995, 121, no. 143; Tomičić 1997, 34; Vikić-Belančić 1998, 488; Tomičić 1999, 153; Šiša Wiewegh 2004, 306, 310, Fig. 1; Gračanin 2011, 60–61, 307; Rapan Papeša 2012, 427, Fig. 62; Štimac-Dedić 2013, 11, 26 (cat. no. 63.1), 27 (cat. no. 63.2).

16 We must thank Lovorka Štimac-Dedić of GMV, who provided us with this information, and Željka Bedić of the Anthropological Centre of the Croatian Academy of Sciences and Arts, who made a preliminary analysis of the skeleton.

17 In the archives of GMV, the description of the tomb inventory, along with the ring and the sword, documents a ceramic vessel. It is obvious that this is a mistake, because the vessel was made of glass. We thank the senior curator, Marina Šimek, for the information from the GMV archives.

18 Simoni 1984, 73; Tejral 2011, 232–236; Rapan Papeša 2012, 427.

19 All addresses noted in the publications and excavation reports from 1968 to 1979 refer to the addresses of residential buildings, i.e. to the accompanying land parcels.

20 Vikić-Belančić, Gorenc 1979.

21 Vikić-Belančić 1984, 142.

22 Vikić-Belančić, Gorenc 1979; Vikić-Belančić 1984, 142; Nemeth Ehrlich 1986, 120.

23 Vikić 1976, 83; Vikić-Belančić 1984,142, 162, T. 6: 2.; Gorenc, Vikić 1984, 68; Simoni 1984, 73, Fig. 2 (it should be noted here that the captions under Figures 1 and 2 in the aforementioned paper (Simoni 1984) have been interchanged by mistake); Nemeth Ehrlich 1986, 120; Sokol 1986, 56; Vikić-Belančić 1997, 61, Fig. 13; Tomičić 1997, 34; Vikić-Belančić 1998, 489, no. 19; Tomičić 1999, 153. The type of glass beads is from group XII, nos 108–122 (after Tempelmann Maczyńska 1985, 35, T. 2).

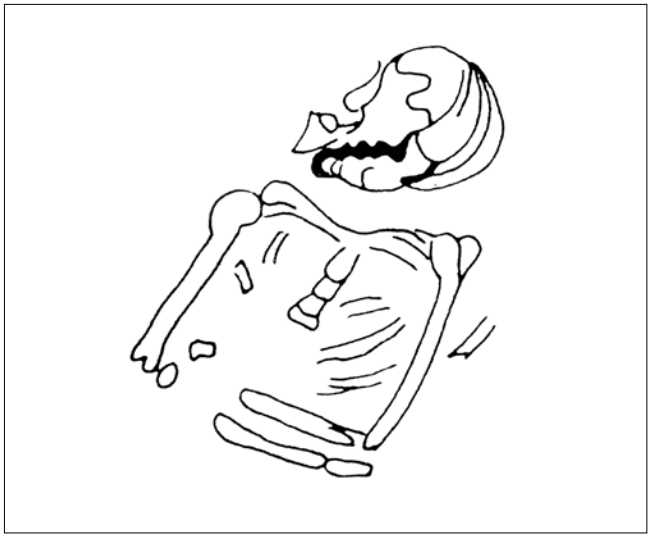

FIGURE 7. Grave 2/1976. Female grave of the Migration Period (Vikić-Belančić, Gorenc 1979).

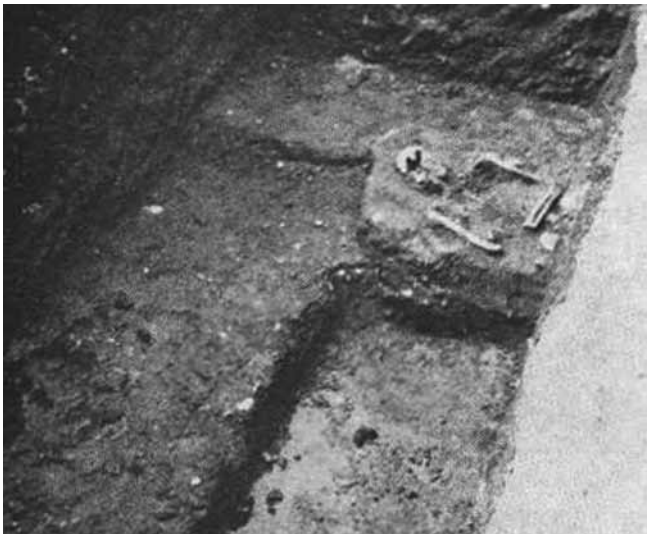

FIGURE 7A. Position of the grave 2/1976 during the excavation (Vikić-Belančić, Gorenc 1979).

FIGURE 7B. Position of the grave 2/1976 during the excavation (Vikić-Belančić, Gorenc 1979).

FIGURE 8. Three-fold bracelet and two beads found in grave 2/1976 (photo by I. Krajcar).

along an axis of west-northwest (head) to east-southeast (legs).[24] The finds from the grave are characteristic of this period, but unfortunately a more precise dating is not possible, because both finds can be broadly dated to the period of the 5th century, and beads of this type can be found from the Roman period to the Middle Ages (Figs 7, 7a, 7b and 8).[25] The osteological remains have not been anthropologically analysed.

24 The orientation of the grave is not noted in the available publications. It was therefore determined by the available photographs and drawings from the field research report (Vikić-Belančić, Gorenc 1979). According to the ground plan of trench 30 from the 1976 (appendix 13) field research report, it can be seen that the published photograph (Vikić-Belančić 1984, T. 6, Fig. 2) is actually a photograph not of grave 2/1976, but of the grave found in trench 19 during the 1973 campaign (Vikić-Belančić, Gorenc 1979, 3; T. V. Fig. 11). Additional confusion was created by the statement by B. Vikić-Belančić that this grave (trench 17) was discovered in 1975, instead of 1973 (Vikić-Belančić 1984, 142). As both graves are mentioned in the same passage (Vikić-Belančić 1984, 142), it can be deduced that the photos were interchanged in the publication. By comparing the photographic and plan documentation in the field-research reports, it can be concluded that Figures 3 and 4 of the publication (Vikić-Belančić 1984, T. 6, Figs 3, 4) correspond to the factual circumstances of the discovery of grave 2/1976, and not grave 3/1978 (trench 32), to which these photographs are attributed. It should also be noted that this mistake was repeated in the 1997 and 1998 publications (Vikić-Belančić 1997, 61, Fig. 13; 1998, 489).

25 Although Tempelmann Maczyńska (1985, 35) dates this type of bead to the first half of the 5th century, this type of bead can be found in numerous sites, from the Roman period to the Middle Ages, so precise dating of the beads is not possible.

Grave 3/1978

The third grave, also dated to the Migration Period, was found in the garden of 10 Preradović Street (trench 32/78, 6 x 2 m) during the 1978 excavation.[26] A skeletal burial with a grave offering (find)[27] was found at a depth of 100 cm. This grave (according to the published literature and an entry in the excavation report) was also buried within the Roman archaeological stratum.[28] As with grave 2/1976, the grave pit was dug out in the Roman archaeological layers within the walls of *Iovia*, negating the functionality of its original purpose in the Late Roman period. The orientation of the grave cannot be determined, because the photographs and documentation in the excavation reports[29] and in the publication do not correspond to the actual state of the findings.[30] It should be noted that the human osteological material has not been analysed (Fig. 9).

FIGURE 9. Photo of grave 3/1978 during excavation (Vikić-Belančić, Gorenc 1984).

Grave 4/1976

The fourth burial which can be dated with caution to the time of the Migration Period was allegedly found in 1976 in trench 31/76.[31] As before, it is not possible to confirm with certainty the exact place of the find of this grave, nor its position. Specifically, B. Vikić-Belančić states in her earlier paper[32] that the trench in question was located at 19 A. Blažić Street (modern-day Ban J. Jelačić Street) in the basement of a private residential building, while in a 1997 paper she placed the trench in the yard of the former police station at 2 Preradović Street.[33] Furthermore, in the paper of 1997, Vikić-Belančić exhaustively analyses the graves dated to the Migration Period and provides information about a knife dated to the 5th century as a grave find. But it is not clear from the text in which grave this knife was found; in the grave of trench 32/78 (grave 3/1978), or the grave of trench 31/76 (the grave under consideration here). In the paper of 1979, Vikić-Belančić explicitly states that the tomb of trench 32/78 was dated to the Migration Period, while in a later publication she indirectly claims that the grave contained no grave goods.[34] Therefore, this grave should be approached with great caution. The problem would be solved by a revision of this find, but this, unfortunately, is not (currently) possible.

Grave 5/2011

The fifth and last known burial dated to the Migration Period was found in 2011 during systematic archaeological excavations in the very centre of modern-day Ludbreg ('Somogy Garden'). During the excavations, building 2 was largely uncovered. The building was erected around a rectangular, uncovered courtyard and defined on the west side by a porch with a colonnade of 12 pillars. The courtyard was defined by corridors on all four sides. Unfortunately, it was only possible to fully uncover the south wing with five rectangular rooms, interconnected by a well-preserved door. In the easternmost, fifth room of the south wing, a skeletal burial with a tomb built of 21 *tegulae* was found (Fig. 10).

The grave is located in the south-east corner of the room in question, between the southern part of the east wall and the parallel, subsequently extended wall. The tomb, built along a north-south axis, is trapezoidal in shape (the width of the lower part 32 cm, the width of the upper part 50 cm, the length 195 cm, average depth 30 cm). One whole *tegula* was used for the upper and lower sides, and four for the east side. For the western side of the grave the partition wall was partially used, in the southern part, while the northern part of this tomb was built of two *tegulae*. The floor was made of 5 *tegulae*. Unfortunately, the cover was (most likely) destroyed by modern construction interventions, so it is not possible to confirm with certainty how it was constructed. After the

26 Vikić-Belančić 1979, 238; 1984, 143, T 6, 3–4; Gorenc, Vikić 1984, 68; Nemeth Ehrlich 1986, 120; Vikić-Belančić 1997, 61; 1998, 489. In the publications of 1997 and 1998 (Vikić-Belančić 1997; 1998) the author states that this trench (6x2 m) was excavated in 1976, while in the excavation reports the author states that this trench was excavated in 1978 (Vikić-Belančić, Gorenc 1979).

27 Vikić-Belančić 1979, 238; 1998, 489; in neither publication does the author state what kind of grave find it is.

28 Vikić, Gorenc 1978, 69; Vikić-Belančić, Gorenc 1979.

29 Vikić-Belančić, Gorenc 1979.

30 See n. 23.

31 It is interesting that B. Vikić (1976, 83), in her publication of 1976, does not mention the grave in trench 31, but mentions it (along with graves 30/76 and 32/76) in her later publications, of 1997 and 1998, on the problematics of Ludbreg in antiquity (Vikić-Belančić 1997, 61; 1998, 489). This grave is not mentioned in the excavation reports of 1976 (Vikić-Belančić, Gorenc 1979).

32 Vikić-Belančić 1984, 142.

33 Vikić-Belančić 1997, 61. There is additional confusion in the information because the GMV documentation states that, at this address, a Roman grave with a necklace and coins of Constantine I was discovered. However, these finds do not exist in GMV. We would like to thank M. Šimek, the senior curator of GMV, for the information from the GMV archives.

34 Vikić-Belančić 1979, 238; 1984, 162.

FIGURE 10. Situation after the 2011 archaeological campaign at 'Somogy Garden' with the position of grave 5/2011 (marked in red) within the architecture of Roman *Iovia-Botivo* (Croatian Conservation Institute Archive).

FIGURE 14. Position of the ring buckle inside the grave 5/2011 (photo by T. Pleše).

FIGURES 11.–13. Grave 5/2011 (photo by T. Pleše).

Ring buckle	Ring (Frame)	Pin	Total
Weight	14,22 g	10,48 g	24,10 g

TABLE 1. Grave 5/2011. Weight of the ring buckle.

	Ring (Frame)	Pin
Lenght	25,17 mm	34,55 mm
Height of the pin (max.)	–	15,11 mm
Width of the pin (thickest part)	–	7,57 mm
Width of the inner edge at the top of the "trapezoid"	16,82 mm	–
Width of the inner edge at the bottom of the "trapezoid"	12,43 mm	–

TABLE 2. Grave 5/2011. Dimensions of ring-buckle parts.

FIGURE 15. Grave 5/2011. Photo of the silver ring buckle (Croatian Conservation Institute Archive).

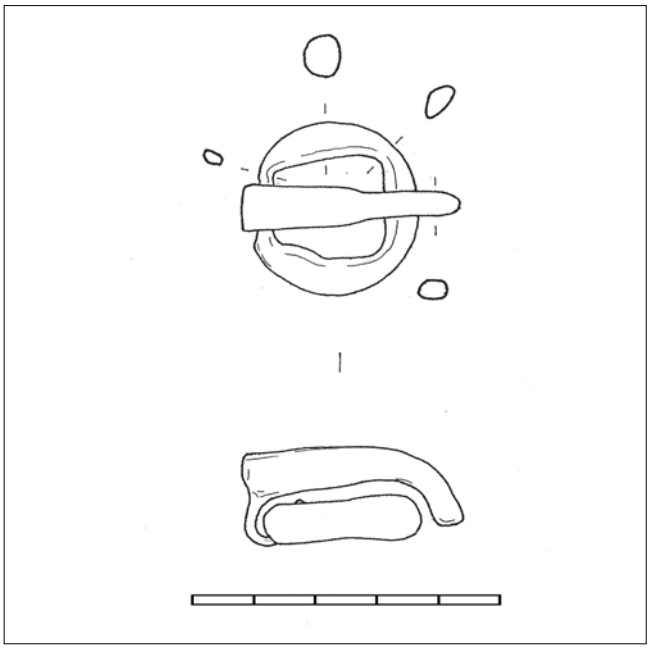

FIGURE 16. Grave 5/2011. Drawing of the silver ring buckle (Croatian Conservation Institute Archive).

discovery of the grave architecture, it was only possible to confirm eight pieces of broken *tegulae*. Most of the tegulae used to build the grave architecture were decorated with geometric motifs made by fluting.[35] The deceased was laid in the grave along an axis of north (head) to south (legs) (Figs 11–14).

The deceased was accompanied by a single find, a silver ring buckle found in the pelvis area (Figs 20 and 21).

The ring buckle from grave 5/2011 typologically belongs to the Migration Period. The frame of the ring buckle is circular on the outer edge, while the inner edge has a trapezoidal shape. The pin of the buckle is wider at the base and tapers towards the top. The cross section of the base of the pin is oval (almost round). In the part where it bends towards the top, the pin narrows on the vertical sides, and the cross section is oval. On the part of the buckle ring where the pin is attached, there are grooves that have been worn by belt straps or were intended for the application of the buckle plate (Tables 2 and 3).

According to the results of the radioactive carbon analysis of the skeleton (during the anthropological analysis a rib fragment having been taken for radiocarbon analysis), the grave can be dated to the period of the 5th century.[36]

35 Pleše 2014.

36 The radiocarbon analysis was done by Beta Analytic Radiocarbon Dating Laboratory, Miami, USA (Lab. no.: Beta–340918); 1 Sigma calibrated result: Cal AD 410–430; 2 Sigma calibrated result: Cal AD 390–540.

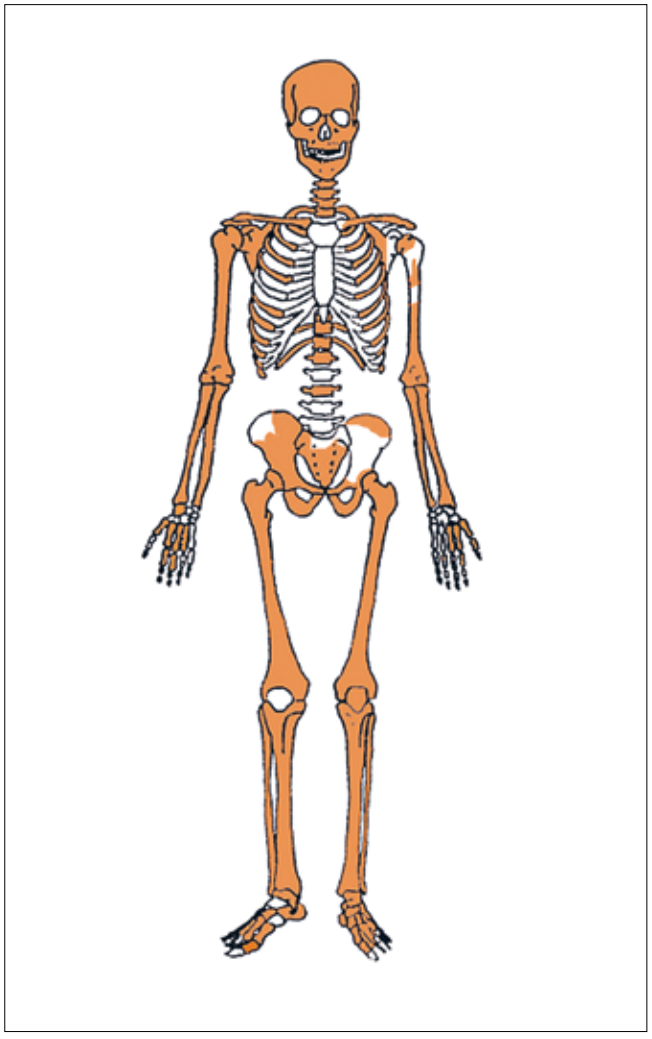

FIGURE 17. Grave 5/2011. Schematic showing the preserved skeletal elements of the individual buried in grave 5/2011 (made by M. Novak).

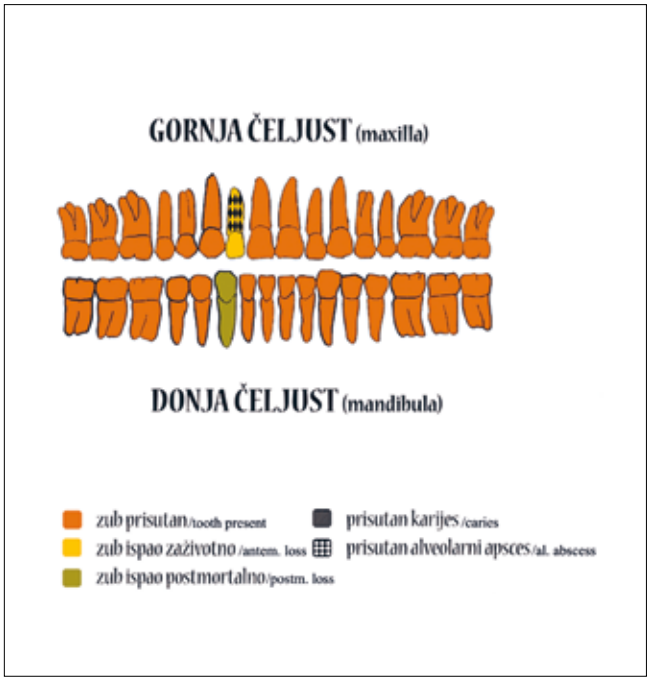

FIGURE 18. Grave 5/2011. Schematic showing the preserved teeth of the individual buried in grave 5/2011 (made by M. Novak).

The anthropological analysis of skeletal and dental remains

A comprehensive anthropological analysis of skeletal and dental remains belonging to the individual buried in grave 5/2011 was conducted at the osteological laboratory of the Anthropological Centre of the Croatian Academy of Sciences and Arts, in Zagreb. After cleaning, a complete inventory of preserved and present bones, joints and teeth was conducted. The sex and the age at death of the individual analysed were established using methods described by Buikstra & Ubelaker, and Klales,[37] anthropometric measurements were conducted according to protocols proposed by Martin & Saller,[38] while all observed pathologies were recorded according to criteria described by Aufderheide & Rodríguez-Martín, and Ortner.[39]

The bones are light brown in colour, excellently preserved with some minor postmortem cortical damage. The skeleton is almost complete, with only the sternum, one right rib, three vertebrae, the right patella, several small hand and feet bones, and fragments of the left humerus and both innominates missing (Fig. 17). All teeth are present except the second right maxillary incisor and the second right mandibular incisor (Fig. 18).

Grave 5/2011 contained the remains of an adult male aged over 50 years at the time of death. The reconstructed height of this individual (based on the maximum length of the right femur) is 175.5 cm.[40] Various pathological changes were recorded on the skeleton: 1) mild osteoarthritis on the shoulders, the elbows, the hips, the knees, C5 and C7, T6, T7, T11 and T12, and L1 vertebrae;[41] 2) benign cortical defect at the site for *latissimus dorsi* muscle attachment of the right humerus;[42] 3) Schmorl's node on T8 ver-

37 Buikstra, Ubelaker 1994; Klales 2020.

38 Martin, Saller 1957.

39 Aufderheide, Rodríguez-Martín 1998; Ortner 2003.

40 Trotter 1970.

41 Osteoarthritis is one of the most common types of arthritis, also known as degenerative joint disease (White, Folkens 2005). Vertebral osteoarthritis is characterized by the destruction of the articular cartilage in a joint and discs in the neck and lower back, accompanied by bony lipping (osteophytes) and spur formation adjacent to the joint (White, Folkens 2005).

42 Benign cortical defects usually manifest as narrow elongated depressions with smooth cortical edges and irregular bottom located at sites for muscle attachments (Silverman, Coley, Kuhn 1993).

FIGURE 19. Grave 5/2011. Left side of the cranium with clearly visible trepanned aperture (photo by V. Vyroubal).

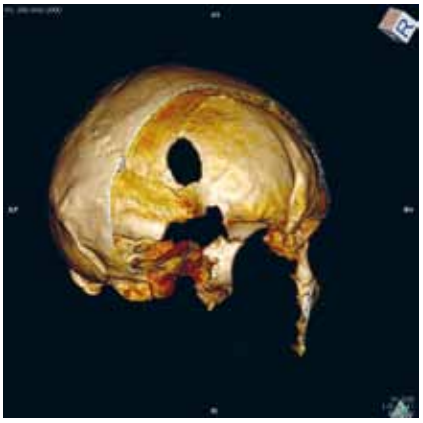

FIGURE 20. Grave 5/2011. CT scan of the cranium: view of the trepanned aperture from the endocranial (inner) side (CT scan by M. Čavka).

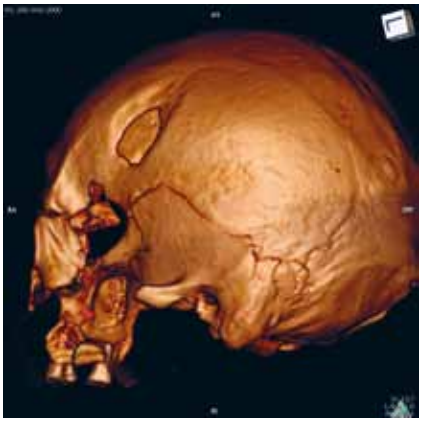

FIGURE 21. Grave 5/2011. CT scan of the cranium: view of the trepanned aperture from the ectocranial (outer) side. The edges have a broad, shallow bevel which is typical of the scraping technique (CT scan by M. Čavka).

tebra;[43] 4) antemortem tooth loss and alveolar abscess;[44] 5) linear enamel hypoplasia;[45] 6) trepanation on the left side of the cranium.

The occurrence of osteoarthritis is usually associated with advanced age, but also with chronic mechanical stress and physical activity.[46] In the case of the individual from Ludbreg the generalized occurrence of this pathology on all major joints and the majority of vertebrae was most probably caused by a combination of somewhat longer than average life-span[47] with intense physical activity. The occurrence of benign cortical defect at the site for *latissimus dorsi* muscle attachment of the right humerus of this individual is an additional indicator of intense physical activity. And, finally, the presence of a Schmorl's node on the T7 vertebra is another indicator of mechanical load of the spine, i.e. hard physical labour.

Besides the pathological changes associated with intense physical activity, the Ludbreg skeleton also exhibits some dento-alveolar pathologies, such as antemortem tooth loss and alveolar abscess. The presence of these pathologies in the individual under study is most probably a result of a combination of advanced age and inadequate oral hygiene. The presence of linear enamel hypoplasia on anterior teeth strongly suggests that this individual suffered from poor health during his childhood caused by an episode of physiological stress which might have had a significant negative impact on his immune system later in life. Such episodes of physiological stress could have been caused by a synergistic effect of various biological and socio-cultural factors ranging from malnutrition, infectious and non-infectious diseases, anaemia, vitamin-C deficiency, and other conditions.

The most interesting detail recorded on the Ludbreg skeleton is a neurosurgical intervention on the left side of the cranium. An oval-shaped aperture 43 x 31 mm in size is located on the left side of the coronal suture (two thirds of the defect is located on the left parietal bone and one third on the frontal bone) (Fig. 15). The opening breached all three bone layers, and *dura mater* was most certainly exposed during the procedure (Fig. 16). Obvious signs of healing are present: the edges around the opening are smooth, remodelled, and of uniform thickness, while the *diploë* is not visible; possible indicators of infection are absent. This is a neurosurgical intervention (trepanation) that was conducted most probably for a therapeutic reason such as head injury. The morphology of the aperture indicates that the procedure was conducted using the scraping technique (Fig. 17). Everything points to the fact that the procedure was successful and the individual survived for a prolonged time period.[48]

43 Schmorl's node is a herniation of the intervertebral disc, penetrating into the vertebral body; it can appear on any vertebra but tends to concentrate in the lower thoracic and lumbar regions (Ortner 2003). It mostly appears as an indentation around the midline of the vertebral plate.

44 Alveolar abscess is one type of periapical lesion. It appears as a result of an infection when tooth pulp is exposed to pathogens caused by caries, wear or tooth breakage (Hillson 1996; Freeth 2000). As the infection spreads, a cavity in the alveolar bone appears. It fills with pus, and in time a hole is created for the pus to discharge.

45 Linear enamel hypoplasia occurs in the form of transversal lines on the surface of tooth crowns. Such deformities are defects in dental development (Goodman, Rose 1991; White, Folkens 2005) and as such are good indicators of subadult stress (long-term metabolic stress, and/or a stressful event that caused it) (Aufderheide, Rodríguez-Martín 1998).

46 White, Folkens 2005.

47 Bioarchaeological analyses conducted on numerous late-Roman/medieval skeletal assemblages from continental Croatia indicate that the average life span for adults during these periods was between 30 and 40 years. A very small proportion of individuals studied lived beyond the age of 50; for more details, see Šlaus 2002; Bedić, Novak 2010; Carić *et al.* 2019.

48 For a more comprehensive description of the Ludbreg trepanation, as well as more detailed literature reviews dealing with this subject in archaeological contexts, see Novak *et al.* 2013.

The archaeometallurgical analysis of the silver buckle

Non-destructive chemical analysis of the buckle was carried out using a portable energy-dispersive X-ray fluorescence spectrometer (pXRF)[49]. The artefact was not cleaned prior to the analysis, and the technique analyses the surface of the artefact, with penetration depth of up to 200 μm. Some elements (iron, tin, lead) tend to appear more abundant on the surface, while others (copper, zinc) tend to appear depleted. Furthermore, the instrument is not calibrated for arsenic, and the shape of the samples is somewhat irregular in nature, which is unfavourable for the analytical geometry. Due to these limitations, the results should be considered semi-quantitative.[50] The hand-held analyser's limits of detection for quantified elements are considered to be at best around 1000 ppm (0.1 wt%).

The two parts of the buckle are compositionally very similar, and were conceivably made from the same batch of alloy. The silver used for the production of the buckle was likely obtained through cupellation, the refining process in which the noble metal is extracted from argentiferous lead ores, most frequently galena (PbS), by first smelting the ore to collect the silver in a matrix of metallic lead, and then oxidizing the lead into lead oxide – litharge – and hence separating it from the less reactive silver.[51] This was the most common way to obtain silver which could produce very high-purity metal[52]: cupelled silver could reach a purity of around 98.5–99.7 wt% silver.[53]

The buckle has a high silver content, with minor concentrations of iron, copper, zinc, tin, lead and bismuth also present. These are common impurities of cupelled silver and, if below 1 wt%, are generally not considered to be intentional additions.[54] However, any base metal present in amounts above that concentration likely indicates an artificial addition to the alloy.[55]

Pure silver is very malleable, which is certainly not an advantageous attribute in the production of a functional item such as a buckle. In the samples studied, copper (3.4–4.9 wt%) was added to the silver due to its beneficial effect on the performance characteristics of the metal; adding copper to silver was a standard practice, as it increases the hardness and strength of the object.[56] Due to the depletion of copper on the surface, it is likely that its concentration is somewhat higher in the bulk of the alloy.

Gold is also present in concentrations above 1 wt% (1.8 wt%, and 2.1 wt%, respectively). In this case, it is more plausible that the gold was a constituent of the ore, and was recovered together with silver during cupellation.[57] Furthermore, gold concentrations are good indicators of the type of ore used.[58] Gold in amounts from 0.1–0.8 wt% indicates galena as the likely silver source.[59] Higher gold concentrations are often found in ancient silver objects, and are usually associated with the use of lead carbonate – cerrusite ($PbCO_3$) – which is a weathering product of galena, and is often found close to the earth's surface.[60] The gold is unaffected by the weathering, which dissolves lighter metal ions, and in this way gold concentrations become higher.[61]

However, gold concentrations can appear enriched on the surface;[62] this should be taken into consideration when discussing the potential silver source, due to the analytical technique used. Another possibility, which cannot be dismissed at the present time, is that perhaps the item was gilded, or, even more likely, that scrap gilded silver was remelted for the production of the buckle.[63] Unfortunately, in order to check whether the gold concentrations are homogenously present throughout the bulk of the artefact, a destructive analysis would have to be conducted.

The presence of other impurities likely implies the added copper was not pure: zinc (0.8–0.9 wt%), whose presence also depends on the smelting conditions, could likely be an impurity in the copper source used.[64] The presence of tin (0.9–1 wt%) could indicate bronze might have been added to debase the silver, potentially due to specific recycling practices, or lack of fresh copper. Another possibility is that tin and copper are two constituents of a polymetallic or mixed copper-silver ore.[65] However, it is very likely that the tin concentrations are exaggerated, as the spectral lines of tin and silver (silver Kβ and tin Kα line) somewhat overlap.[66]

Bismuth oxidizes towards the end of the cupellation process,[67] so its remaining amounts testify to the cupellation technique performed (assaying or large-scale cupellation, the latter a safer

49 The analysis took place at the Archaeological Museum in Zagreb in 2013, using UCL Institute of Archaeology's Innov–X Systems model Delta Premium 4000 portable X–ray fluorescence instrument, fitted with a gold tube and a silicon drift detector with a resolution of approximately 150 eV FWHM (full width half maximum) for 5.9 kV X-rays (on an AISI 316 standard). The analysis was conducted with one beam at 40kV, 30.5 mA, for a 20-second live-time count in the Alloy Plus mode, which uses an Al filter and a 'fundamental parameters' algorithm for quantification.

50 The results are presented as an average of three measurements of each point. The precision of the instrument was assessed by comparing three measurement points of certified reference materials, and was found to be acceptable (CV below 5% for major elements, and below 20% for minor). The accuracy of the portable ED-XRF was assessed by analysing four certified reference bronze materials; absolute and relative errors were calculated for all of the measurements, and were below 5% for major elements and below 20% for minor elements.

51 Tylecote 2002, 45, 89.

52 Bayley 2008, 133; Hughes, Hall 1979, 323–324; Pernicka 2014, 259; Tylecote 2002, 87, 89.

53 Tylecote 1987, 140.

54 Gale, Stos-Gale 1981, 106; Pernicka 1987, 640; Wanhill 2003, 4.

55 Bayley, Crossley, Ponting (eds.) 2008, 56; Hughes, Hall 1979, 332; Kassianidou 2003, 199; Pernicka, Bachman 1983, 596.

56 Meyers, Sayre 1971, 31; Wanhill 2003, 4.

57 Metcalf, Northover 1986, 36; Meyers, Sayre 1971, 31; Pernicka, Bachman 1983, 593; Pernicka 1987, 641.

58 Craddock 2014, 1086; Eshel *et al.* 2018, 215; Metcalf, Northover 1985, 166–8.

59 Birch *et al.* 2020, 114.

60 Craddock 2014, 1085; Scott 1990, 43.

61 Craddock 2014, 1091.

62 Hrnjić *et al.* 2020, 16, 19.

63 Hughes, Hall 1979, 334.

64 Meyers, Sayre 1971, 32; Yang *et al.* 2009, 174.

65 Birch *et al.* 2020, 114.

66 Kruse, Tate 1992, 297.

67 L'Héritier *et al.* 2015, 63.

Area	Fe	Cu	Zn	Ag	Sn	Au	Pb	Bi
Frame	0.6	3.4	0.9	91.2	1.0	1.8	1.1	0.1
Pin	0.7	4.9	0.8	89.3	0.9	2.1	1.0	0.2

TABLE 3. Grave 5/2011. Average compositional values of the frame and pin of the buckle. All elements are given in weight %, and normalized to 100%.

choice to avoid silver loss, and likely used in this example), rather than its initial amount.[68] Lastly, although low concentrations of lead (1 wt%) could be an impurity of the copper source (leaded bronze?), it is much more likely that it is present as a residue from cupellation.[69]

Summing up, the buckle is made from a good-quality, high-silver alloy, and could have been used to communicate the individual's achieved or ascribed social status and identity.[70]

This silver ring buckle is typologically related to the buckles that are characteristic of stage D2a of the phase of Untersiebenbrunn/Hochfelden (after Bierbrauer) dated in the range 400/410–420/430.[71] But as this type of buckle, depending on the context, can be dated generally to the 5th century (even the 6th century; see below), such narrow dating (D2a phase) cannot be applied.

Examples of ring buckles of this type (whose inner edge of the loop has a trapezoidal shape) are quite rare. The most similar (in detail) typological parallel to the Ludbreg silver ring buckle[72] is the ring buckle with a buckle plate from Mahlberg,[73] although this find belongs to the Alamannic cultural horizon and the context is chronologically much later (480–510). If we take into account other silver *Riemenschnalle* with a circular inner edge and incised ornaments on the pin, the number of similar ring buckles is, however, much higher.[74]

These *Riemenschnalle* appeared during period D1, confirmed in the treasure of Valea-Stramba, in Transylvania,[75] and are very numerous during period D2;[76] for example, the well-dated finds from Mödling,[77] Keszthely-Ziegelei[78] and Bríza.[79] Grave 5/2011 in Ludbreg is built of *tegulae*, and the only artefact found is from the D2 period,[80] the whole grave bearing similarities to, and influences of, the Marossentana-Cherniakov culture.[81] This can (according to Tejral and Tica) be attributed to the so-called *foederatus*-phase graves.[82]

A bronze ring buckle of the 5th century is kept in the Medieval Collection of the AMZ.[83] Unfortunately, the only known information about this buckle is the location where it was found, which is the wider area of modern-day Sisak. Although there is no data on the circumstances of the finding of this ring buckle, typologically it is relatively possible to compare it with the ring buckle found in Ludbreg. It should be noted that this buckle, together with another bronze ring buckle found at Kuzelin[84] (but somewhat smaller: 2.4 x 2.2 cm), is a rare comparative example found in northern Croatia.

The discovery of five skeletal graves in the area of Roman *Iovia-Botivo* (modern-day Ludbreg) is indicative for the interpretation of the settlement's historical development in the time of the transition from the Late Roman period to the early Middle Ages. If it is to be assumed that all the listed findspots of the graves are accurate, it can be assumed that the urban area of Roman *Iovia* ceased to function in its original purpose during the 5th century. It should be noted here that these four graves (*intramuros*) are not a sufficient sample to confirm a cemetery. Unfortunately, (for now) it is not possible to conduct radiocarbon analyses of the first four graves, the results of which would enable the determination of the exact time sequence of the burials and their eventual historical contextualization.

Unlike the four graves found previously, the position of the grave found in 2011 was precisely determined, and it was possible to analyse it. This grave was found in the south-east corner of the easternmost room of the south wing of building 2. It can therefore be concluded that this space had ceased to function in its original purpose at the time of the burial.

Although the deceased was buried *more Romano*, his location within Roman *Iovia-Botivo* and the ring buckle that he wore suggest that he was buried during the turbulent years of the Migration Period. This assumption is confirmed by the related ring buckles dated to the same period.

68 L'Héritier *et al.* 2015, 65.

69 Gale, Stos-Gale 1981, 107; Wanhill 2003, 4.

70 We would like to thank Prof. Marcos Martinón-Torres for valuable feedback and suggestions regarding the analytical analysis of the silver buckle.

71 Bierbrauer 1991, 581, 582; 1994, 134–140. For a detailed overview of the Untersiebenbrunn/Hochfelden phase, see Tejral 1988; Kazanski 1996 (with bibliography).

72 Here we must draw attention to the opinions of some authors on the utilitarian differences between buckles without buckle plate attached and buckles with buckle plate. For the difference between the two, see Vinski 1989, 10.

73 Quast 1997, 187, Fig. 194, 188.

74 *Cf.* Bóna 1991, 117, Fig. 45, T. XXVI (Magyar Nemzeti Múzeum); Tejral 1988; Kazanski 1996; Tejral 2011, 31–32.

75 Tejral 1997, fig. 10.7.

76 For the general parallels of this widespread type of buckle *cf.* Anke 1998; Ščukin, Kazanski, Sharov 2006; Tejral 1988; 1997; 2002; 2007; Ivanišević, Kazansky 2009.

77 Tejral 1988, fig. 16.

78 Tejral 1988, fig. 23.

79 Tejral 1997, fig. 17.11.

80 Which was widespread in the D2 period throughout the Pannonian plain.

81 Tejral 2012, 117.

82 Tejral 2012, 117; Tica 2017, 157, f. 340.

83 Simoni 1989, 115, 123 (no. 41, 131, T. 5: 7); Rapan Papeša 2012, 422, Fig. 28. Some authors believe that this ring buckle is rather affiliated with a Roman provincial tradition of Late Antiquity (Rapan Papeša 2012, 418).

84 Sokol 1998, 36 (no. 95, inv. no.189/97).

When we analyse all the graves of the Migration Period found in the area of modern-day Ludbreg, grave 1/1952 stands out from the other graves presented. The grave inventory accompanying the deceased is characteristic of the male Germanic population outside the borders of the Empire, and at the end of the 4th century and during the 5th century this type of grave appears within the Empire. The very fact that he was buried outside the presumed area of Roman *Iovia-Botivo*, and that he was buried next to another Roman-period tomb, supports the assumption that the deceased respected the Roman customs and the tradition of burial outside the city walls. Regardless of the fact whether the deceased had on him a gold ring or not (which, according to Grane[85] and Rapan Papeša,[86] could possibly identify him as a *foederatus*), the remaining context of the burial of this warrior, probably Germanic, implies that, at least at the time of death, he was a Roman ally. Male graves with sword from the 5th century that can be compared to this one are found in *Singidunum* (which grave also had a bell-shaped glass cup),[87] Lengyöltóti,[88] Szirmabesényö,[89] Wien-Leopoldau,[90] Horgos,[91] Artánd,[92] Tarnamera[93] etc. According to Tejral, the new culture of the Danubian-Eastern Germanic cultural complex is represented by so-called *foederati* graves in Late Antique settlements from the late 4th century onwards[94] and the Ludbreg grave discussed here falls into that category. But, according to Tejral, swords are also widespread during the so-called Hunnic era.[95] Additional argument can be found in the fact that groups of *foederates* had been present in Roman service in Pannonia since 380.[96] So it is to be concluded that *Iovia-Botivo* was still functioning as a Roman city at the time of this burial. Further analysis of the bones by C14 method would probably date this grave more precisely, and the contextualization of the burial would be more accurate.

Other graves (graves 2/1976, 3/1978, 4/197697 and 5/2011) were all found within the presumed city walls of *Iovia-Botivo* and confirm the fact that the original purpose of this part of the Iovian area was lost during the 5th century.[98]

The opinion of some authors, according to which the graves found in trenches 30/76 and 32/78 (grave 2/1976 and grave 3/1978) should be dated to the time of the Avaro-Slavic invasion of the 7th century, should certainly be mentioned here. Their opinion is that those graves should be dated to the time of the Avaro-Slavic invasion due to the presumed existence of an early Christian Episcopal See in *Iovia*,[99] which for them is an argument for the continuity of functioning of the Roman city during the 5th century, and those graves can not be attributed to the Migration Period of the 5th century.

Grave 2/1976, at least, can in no way be attributed to the period of the Avaro-Slavic invasion, because the finds from this grave (bracelet and beads) can only be related to the period of the Migration Period, i.e. to the 5th century.

Earlier opinions (based on the above-mentioned burials) on the cessation of the original function of the excavated part of *Iovia-Botivo* during the 5th century are further confirmed by the new find of grave 5/2011. A precise interpretation of grave 5/2011 was made possible by modern radiocarbon analyses of human osteological material and radiological analyses of the ring buckle itself, which date this burial to the period of the 5th century.

Events in Ludbreg during the 5th century are supported by the historical data on the formations of Hun *foederates* and the small number of Alatheus's and Saphrac's Huns that mainly settled and resided in the area of *Pannonia Savia*[100] (and *Noricum* and *Raetia*) until 427. In those years, during the reign of Emperor Valentinian III (425–455), the formations of the Hun *foederates* were pushed out of part of the Pannonian area by the Imperial forces, thus (briefly) formally returning that territory under control of the Roman emperor.[101] This brief Roman control of the area ended with the recognition of the *de facto* Hunnic conquest of the region and was formalized in 433, when *Pannonia Savia* and the possessions north of the River Drava were recognized as a part of the rising Hunnic Empire.[102]

An elderly man was interred in the grave found during the archaeological excavations in Ludbreg in 2011. During his lifetime he survived a complex neurosurgical procedure, and was buried in the very centre of ancient *Iovia-Botivo*, during the 5th century. The modest quantity of objects found in this grave was compensated for by their quality – a find of a silver ring buckle.

This finding, as well as a review of previous findings of this period, provides a new foothold, we hope, for understanding the horizon of the transition from Late Antiquity to the Migration Period in the Drava river area of Roman Pannonia. Hopefully, it will provide some help in future interpretations of this complex archaeological-historical problematic of northern Croatia in particular and Roman Pannonia in general.

85 Grane 2007, 179.

86 Rapan Papeša 2012, 418.

87 Ivanišević, Kazansky 2009 (Cemetery IV, Grave 2), but much richer in grave goods.

88 Tejral 1988, fig. 22.19.

89 Tejral 1988, fig. 25.1 ; 2002, pl. 2.1.

90 Tejral 1988, fig. 42.9,10 ; 2002, pl. 2.12, 3.11, 6.3, 2007, figs 12:3,5; 24:1; 25:11; Anke 1998, pl. 50, 51.

91 Tejral 2007, figs 6, 9.

92 Tejral 2002, pl. 6.6 ; 2007, fig. 15.3.

93 Tejral 2007, fig. 23.1.

94 Tejral 2012, 116–117.

95 Tejral 2002, 503, 504.

96 Zos. 5.37.1; Gračanin 2005, 25; 2006; Tejral 2015.

97 Again we must stress extreme caution when taking this grave into consideration. For the explanation, see above (grave 4/1976).

98 The same opinion is presented by Vikić-Belančić (1984, 142, 162), but only considering graves 2/1976 and 3/1978.

99 Gregl, Migotti 2004, 139, 140.

100 Priscus, *Fr.* 7; Mócsy 1974, 350.

101 Mócsy 1974, 350; Gračanin 2005, 24, 25, 36; 2011, 67, 220, 275.

102 Cassiod, *Var.* 11, 1, 9; Mócsy 1974, 350.

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