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КАМСКОЙ
АРХЕОЛОГО-ЭТНОГРАФИЧЕСКОЙ
ЭКСПЕДИЦИИ**

Выпуск XII

**Средневековая археология Восточной Европы:
от Камы до Дуная**

Сборник научных трудов
к 50-летию юбилею Н.Б. Крыласовой



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Настоящим выпуском продолжается серия научных изданий ПГППУ «Труды Камской археолого-этнографической экспедиции». Настоящий сборник посвящён 50-летию юбилею доктора исторических наук, профессора Натальи Борисовны Крыласовой, одной из активных сотрудниц экспедиции. Публикуются материалы по археологии различных территорий Восточной Европы эпохи Средневековья, отвечающие научным интересам Н.Б. Крыласовой.

Сборник будет интересен специалистам по истории, искусству и археологии Восточной Европы, преподавателям и студентам профильных факультетов вузов, научным работникам, сотрудникам музеев и всем, кто интересуется историей и культурой таинственной эпохи Средневековья.

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Настоящий сборник продолжает серию изданий «Труды Камской археолого-этнографической экспедиции Пермского государственного гуманитарно-педагогического университета», основанную в 2001 г.

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Авторы сборника – коллеги и друзья юбиляра – публикуют на его страницах статьи, в той или иной степени связанные с основными направлениями научных исследований Н.Б. Крыласовой. Статьи авторов из Уфы, Казани, Санкт-Петербурга, Тюмени, Перми, Йошкар-Олы, Будапешта отражают и обширные дружественные связи Н.Б. Крыласовой.

От имени авторов сборника, а также всех школьников, студентов и аспирантов, которых привели в археологию творческий задор, исследовательский и педагогический талант и доброта души Натальи Борисовны, мы поздравляем её с юбилеем и желаем ей многолетнего и успешного продолжения её педагогического и научного творчества, новых открытий, добрых и последовательных учеников и вечной любви к науке и своим друзьям и коллегам!

Редакционная коллегия

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ARCHAEOLOGICAL EVIDENCE FOR LEATHERWORKING IN THE HUNGARIAN CONQUEST PERIOD (10TH C.)

The study describes the finds uncovered in Grave 33 of the burial ground investigated at Sárbogárd–Tringer-tanya and offers a new assessment of the grave goods, with a particular focus on the remains of a leather belt and leather purse as well as the remnants of a leather garment, whose tenth-century use could thus be conclusively demonstrated in the period's archaeological legacy. The examination of the archaeological finds by a conservator specialising in leather provides many new insights into the leatherworking of the ancient Hungarians of the tenth century. The leather remains were first examined in 2013 in the leather conservation laboratory of the National Conservation and Conservator Training Centre of the Hungarian National Museum. Tenth-century leatherworking was practiced on a much higher level than earlier believed. The finds from Sárbogárd provide evidence that the tanners of the tenth century were familiar with tawing and, also, that the various leather articles whose workmanship surpassed the more simple objects made as part of a home craft industry were created by highly skilled leatherworkers.

Keywords: archeology, Tenth-century leatherworking, Hungarian Conquest period, Carpathian Basin

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АРХЕОЛОГИЧЕСКИЕ СВИДЕТЕЛЬСТВА КОЖЕВЕННОГО ДЕЛА В ПЕРИОД ВЕНГЕРСКОГО ЗАВОЕВАНИЯ (X в.)

Исследование описывает обнаруженные в погребении № 33 могильника Шарбодард-Трингер-тания кожаные предметы X века (кожаный ремень и кошелек, а также фрагменты кожаной одежды). Изучение этих археологических находок специалистом в области реставрации кожаных изделий представляет много новых взглядов на кожевенное дело древних венгров X века. Кожаные артефакты были впервые рассмотрены в 2013 году в лаборатории по сохранению кожи Национального учебного центра по реставрации Венгерского национального музея. В результате сделан вывод о том, что кожевенное дело X в. находилось на гораздо более высоком уровне, чем считалось ранее. Находки из Шарбодард свидетельствуют о том, что кожевенники X века были знакомы с дублением и различными способами обработки кожи и изготовления кожаных предметов, высокое качество изученных предметов указывает на наличие специализированных мастеров, обладающих профессиональными навыками.

Существует мнение, что из-за климатических условий в Карпатском бассейне, археологическое наследие периода венгерского завоевания крайне бедно органическими остатками и, следовательно, о яркой повседневной жизни осталось очень мало свидетельств. Тем не менее, известны находки фраг-

ментов текстильных, кожаных и деревянных изделий, которые сохранились в погребениях. Несмотря на их фрагментарность, они несут огромное количество информации, однако она может быть извлечена из находок только современными методами археометрии и кропотливого изучения особенностей их изготовления.

Чанад Балинт был одним из пионеров комплексного аналитического исследования в археологии периода венгерского завоевания. Он выбрал мультидисциплинарный подход в исследовании могильников периода завоевания [3]. Систематическое изучение остатков текстиля [4], с последующим изданием необычайно хорошо сохранившихся шелковых фрагментов одежды X века [12], обусловило значительный прогресс в нашем понимании повседневной жизни того периода. Продолжая эту линию исследований, два года назад мы приступили к систематическому изучению остатков кожаных изделий X в. из погребения 33 в Шарбодард-Трингер-таня, при этом мы надеялись лучше понять сырьё и технику изготовления одежды, аксессуаров и прочих утилитарных предметов, извлеченных из этого захоронения.

Наши результаты во всех отношениях превзошли ожидания. Настоящее исследование предлагает описание и оценку находок из погребения 33 могильника Шарбодард-Трингер-таня, с особым акцентом на кожаный ремень и кожаный кошелек, а также фрагмент кожаной одежды, чье существование в X веке может быть впервые в венгерской археологии доказано без тени сомнения. Наше исследование – это дань новаторскому методу Чанада Балинта.

Ключевые слова: археология, кожаные изделия X века, период обретения родины венграми, Карпатский бассейн

*Introduction*⁴³

One widely and oft-voiced assertion is that owing to the climatic conditions in the Carpathian Basin, the archaeological legacy of the Hungarian Conquest period is extremely poor in organic remains and thus very little is known about the period's colourful daily life, even though this would be one of the basic tasks of archaeological research. Still, this scarcity of finds has drawn the attention of the period's research to the few fragmentary textile, leather and wood remains that have survived. Despite their fragmentary nature, they offer a wealth of information – however, this information can only be coaxed out of the finds through modern archaeometric analyses and a painstaking attention to the finer details of how they had been made.

Csanád Bálint is one of the pioneers of comprehensive analytical studies that venture beyond imaginative reconstructions of the period's social history based on the meticulous analysis of well-preserved metalwork in the archaeology of the Hungarian Conquest period. He chose an admirably multi-disciplinary approach in his assessment of the Conquest period cemetery uncovered at Szabadkígyós-Pálligeti tábla, published in 1971 [3.]. The systematic study of the textile remains preserved in Conquest period burials [4.], followed by the publication of extraordinarily well-preserved tenth-century silk fragments discovered through a stroke of archaeological luck [12.], brought major advances in our understanding of the period's daily life. Continuing this line of research, two years ago we began the systematic study of tenth-century leather remains. When we began the appraisal of the current condition and the meticulous analysis of the large, well-preserved leather fragments from Grave 33 of the Sárbogárd-Tringer-tanya site, we hoped that we would gain a better understanding of the raw materials and the leatherworking techniques used for the manufacture of the garments, costume accessories and the other utilitarian objects recovered from the burial.

⁴³ This research was realized in the frames of TÁMOP 4.2.4. A/1-11-1-2012-0001 „National Excellence Program”. The research project was funded by OTKA Grant 106369; MTA BTK MÓT Grant 28.317/2012. This paper was supported by the János Bolyai Research Scholarship of the Hungarian Academy of Sciences

Our findings exceeded our wildest expectations in all respects. This study offers a description and a re-assessment of the finds from Grave 33 of the burial ground uncovered at Sárbogárd-Tringer-tanya, with a special focus on the leather belt and the leather purse as well as the fragment of a leather garment whose existence and use in the tenth century could, for the first time, be demonstrated beyond any shadow of doubt in the period's archaeological record. The assessment of the archaeological finds by an experienced specialist in leather conservation has greatly enriched our rather scanty knowledge on the leather art and leatherworking of the tenth-century ancient Hungarians, and we offer our study as a tribute to Csanád Bálint's ground-breaking work.

The site

Sárbogárd-Tringer-tanya lies on the eastern side of the Sárvíz Valley, in the northern part of a northwest to southeast oriented longish hill overlooking the one-time floodplain (*Pl. 1. 2*). The site was discovered during road construction in early March 1961. Work was suspended after the first burials came to light and the Szent István Király Museum of Székesfehérvár was notified about the finds. Alán Kralovánszky excavated the site between March 16 and July 7, 1961: he uncovered thirteen Late Bronze Age inurned burials [14, pp.201-203; 10, pp.33-74], a double pack horse burial dating from the late Roman Age [28, p.141] and two other horse burials, as well as a hundred graves of a tenth–eleventh-century burial ground [6, pp.93-147]. The latter can be regarded as having been completely excavated because the cemetery's layout conformed to the hill's form, extending in a northwest to southeast direction (*Pl. 1. 3*). Nine burials (Graves 92-100) were destroyed on the cemetery's northern side during construction work, but their location was recorded and the human skeletal remains were collected. An almost complete calf burial came to light by the cemetery's northern edge, which the excavator assumed to have been part of the early Árpadian Age burial ground, regarding it as evidence for the cattle cult of the ancient Hungarians [15, pp.171-184; 16, pp.89-99; 17, pp.360-374]. However, the contemporaneity of, and thus the association between, the cemetery and the cattle burial has since been challenged [26, p.111].

The proportion of the sexes was roughly equal (37 male and 29 female burials), and child mortality was quite high (about one-third of the graves contained child burials). Although the proportion of burials with grave goods was fairly low, with finds recovered from no more than 29 per cent of the burials, many typical artefacts of the material culture of the Conquest period and the early Árpadian Age had been deposited in the graves. The earliest finds are represented by the braid ornaments⁴⁴ and the belt mounts [20, p.125], whose counterparts suggest that the cemetery was opened in the earlier tenth century. The end of the cemetery's use-life is indicated by the S-terminalled lockrings found in the outermost graves, whose appearance was dated to the 60s and 70s of the tenth century by Béla Szőke [24, p.87], although some scholars believe that this jewellery type appeared one or two decades earlier [27, p.43; 18, p.104; 19, p.332]. The cemetery was used from the early tenth century to its last third. The earliest graves lay in the cemetery's northern and middle zone and they were without exception west to east oriented with some divergence to the north, while the later burials, dating from the later tenth century, were also west to east oriented, but with divergences to the south.

⁴⁴ The best analogies to the braid ornaments from Grave 24 of the Sárbogárd-Tringer-tanya cemetery are known from Grave 1 of the Dormánd-Hanyipusztá burial ground, dated to the earlier tenth century [21, p.409].

One of the most lavishly outfitted interments in the cemetery was Grave 33 (*Pl. 2. 1-3*), the burial of an elderly man from the community, who was laid to rest with a rich array of grave goods. The grave lay in a smaller area devoid of other burials (*Pl. 1. 3*) and two of the neighbouring graves were the rich burials of women with braid ornaments. The grave cannot be dated more precisely within the earlier tenth century, although its location within the cemetery and the conventional interpretation of cemetery layouts would suggest that it was one of the cemetery's earliest graves. The extraordinariness of Grave 33 was that leather from the man's clothing,⁴⁵ his belt⁴⁶ and his purse had been preserved and had survived, most likely owing to the metal mounts and the iron strike-a-light kept in the purse.

The purse had been attached to the mount-decorated belt by means of a narrower pendent strap sewn to the purse with several stitches (*Pl. 4. 4a*). The lid of the leather purse was decorated with a strongly stylised foliate design perhaps composed of rows of palmettes. The purse lid was framed by a plain narrow band. The surviving piece of leather measured roughly 5 cm by 3.75 cm (*Pl. 4. 1, 3a-b*).⁴⁷

Grave 33 was excavated in the field. Several photos were made alongside a detail drawing. It was then lifted *in situ* and taken to the Szent István Király Museum (*Pl. 2. 4*). After its transportation to the museum, the grave was exhibited *in situ* as part of the permanent exhibition. The artefacts recovered from the burial during the field excavation were conserved and restored, and placed back into the grave with the exception of the leather remains. The burial was completely uncovered in the museum in the early 1970s, but no documentation was made of this work phase.

Description of the leather finds

As mentioned in the above, the photos made during the excavation reveal that there were several relatively larger pieces among the leather remains (*Pl. 6. 1 a-b, Pl. 9. 1-2*). As far as we know, these leather remains were not examined in greater detail either immediately after the excavation or since. The leather fragments were first examined and analysed in 2013, in

⁴⁵ Adhering to the leather remains of the mount-decorated belt lying between the right pelvic bone and the floating ribs on the body's right side were fragments of a thinner leather, presumably the decayed remnants of a leather garment (*Pl. 4. 2a-b*), whose material, colour and thickness differed substantially from the fragments of the leather belt.

⁴⁶ It would appear that the belt had not been deposited in the grave as it was worn: judging from the position of the mounts, it was first wound around the body, then the pendent straps were likewise wound around the body, and finally the strap end was passed through the belt on the body's right side (*Pl. 3. 1-2*). A few belt mounts between the right pelvic bone and the floating ribs on the right side survived embedded into the remnants of the leather belt. The belt's width was 1.8 cm. The remains of a thinner pendent strap with a width of 1.1–1.2 cm were found folded over the belt. The pendent strap was attached to the belt by a thin leather band under the belt, preventing its movement. Traces of two stitches could be noted at the end of the pendent strap, suggesting that the purse had been attached there (*Pl. 4. 4a-b*).

⁴⁷ Kinga Éry reconstructed the design on the purse lid as having a vertical arrangement [6, p.105, Fig. 17], and she published the remains of the leather purse accordingly, with the design in a vertical position [6, p.106, Fig. 2, 4). However, our examination of the surviving belt fragments and of the photos and drawings made during the excavation suggested that the lid of the purse suspended from the short, roughly 2.2 cm long pendent strap differed by some 90° from Kinga Éry's reconstruction (*Pl. 4. 1, 3a-b*). The twisting or turning of the pendent strap seems unlikely in view of its shortness, as can be seen from the detail photo, which also shows that the end of the pendent strap folded over the belt extends to the edge of the purse. The size of the leather purse cannot be determined from the small size of its lid fragment. The flint stones kept in the purse can provide some clues as to its length, assuming that they lay at the bottom. In this case, the purse's inner length was *ca.* 8.5–9 cm. Its width remains unknown.

the leather conservation laboratory of the National Centre for Conservation and Conservation Training of the Hungarian National Museum, where we assessed the material of the recovered leather articles and their manufacturing techniques as well as their condition.

We were especially excited by the prospect of perhaps being able to confirm the assumption that the ancient Hungarians of the Conquest period had produced and used the leather type known as “Hungarian leather”, described in several literary sources from the fourteenth to the eighteenth century. This leather type was scudded with a sharp knife without prior liming and piling in a warm atmosphere, then soaked in an alum-salt solution and thoroughly worked. After drying, it was held over embers and the heated leather was then impregnated with tallow [7, pp.97-98]. The role of this impregnation was to waterproof the alum-tawed leather that was sensitive to water. One advantage of leather worked in the Hungarian manner was that it did not call for large workshop areas or a wide range of materials, and that the entire procedure took about two to four weeks. In contrast, vegetable tanning lasts for several months or over a year in the case of thicker hides that have to be soaked in pits, and thus this procedure called for much larger workshop areas and material resources in addition to being restricted to a particular place.

The current study focuses on the analyses and the assessment of the leather fragments from the straps and the clothing. It was not possible to examine the remains of the purse and thus the description of its manufacturing technique is based on the photo and drawing made during the excavation. The finds were packed in ten bags, of which nine were labelled “Sárbogárd, Tringer tanya, Grave 33”, while one was labelled “Sárbogárd, Tringer tanya, probably Grave 61.195.1.24 (?)”.⁴⁸ It was clear from the first examination of the finds that they were in a much worse condition than on the photos from the 1960s. The belt fragment broke into several smaller pieces and only three of these fragments had the mounts still attached. A few more poorly preserved fragments had been glued to cardboard to prevent their further fragmentation. The bags from Grave 33 were numbered 1 to 9 to ease their identification, while the fragments glued to cardboard from the same bag were distinguished by letters (5/a, 5/b, 5/c. etc.). A macro-photo was made of both sides of each fragment before the start of the analyses, on which the dimensions were recorded. The fragments glued to cardboard were not removed and thus only one side was photographed and their analysis was restricted to their free surface.⁴⁹

The comparison of the leather remains in the bags suggested that the fragments could be divided into three main groups: (a) fragments of the mount-decorated belt, (b) thin leather fragments, probably from clothing, and (c) remnants of a compacted fibrous material. Neither the form, nor the structure of the latter provided any clues as to what it had been used for.

The condition of the leather finds

The survival of the leather fragments in the grave can be ascribed to the fact that copper compounds from the corrosion of the metal mounts penetrating the leather slow the bacterial degradation of protein. Even so, the fragments were in different states of preservation with various forms of damage (decrease of the cohesion of the fibres, fragility, delamination, crumbliness, lack of a grain surface, shrinkage, deformation, discolouration, salting,

⁴⁸ As it turned out, these fragments likewise came from Grave 33.

⁴⁹ The examination and appraisal of the condition of all surviving fragments has been completed; a detailed table with the macrophotos will be published in the final report on the assemblage.

gelatinisation, etc.). A greenish corrosion could be noted on the mounts and the belt remains. Traces of an earlier biodeterioration (mould growth) could be noted on some fragments, which had probably appeared sometime after the excavation; however, this no longer appeared to be active. A few fragments were impregnated with a solution of synthetic consolidant either during the excavation or during subsequent conservation work, which changed the fragments' colour and made their surface shiny.⁵⁰ A few fragments appear to have been packed before the synthetic consolidant had dried: these had scraps of cotton wadding or packaging paper adhering to their surface, covering the original leather surface (*Pl. 6. 1a-b, Pl. 9. 1-2*).

The pH value was not tested for every single fragment because we did not want to reduce their size through sampling; however, the examination of a few smaller scraps revealed that their pH values ranged between 4-7, which can be regarded as acceptable in the case of leather.⁵¹ The measurement of shrinkage temperature (Ts) is often employed to assess the condition of historical leathers; Ts values tend to be lower with the decomposition of protein [13, p.96]. We did not perform this analysis because it often yields misleading results in the case of archaeological leathers. The metal compounds in leather (corrosion products, salts from the soil, etc.) create chemical bonds between the protein chains that decrease shrinkage even in cases when collagen is in a strongly decayed condition.

Assessment of manufacturing techniques⁵²

In order to gain a better understanding of the manufacturing techniques and quality of the leather finds, we recorded their dimensions (distance between the cut edges), we examined their material (colour, possible presence of hair, animal species, tanning), their stitching (evenness, size and form of the stitch holes and their spacing, thread remains, stitch types suggested by the imprints) and the remnants of metal accessories. The identification of the stitch types was based on archaeological and historical analogies[1; 2].

Mount-decorated belt

Small fragments were preserved of the leather belt and the pendent strap looped around it. The animal species could not be determined from the microscopic examination of the remains because the hair follicle pattern of the surface could not be made out owing to the degradation of the surface.⁵³ However, the thickness and the surface compactness suggest that the belt had been made from the hide of a large-bodied species such as cattle or horse. The pendent strap was manufactured from thinner leather; however, a hair follicle pattern typical

⁵⁰ We were unable to identify the consolidant that had been used; however, the dissolution tests performed on smaller scraps indicated that it dissolved in acetone.

⁵¹ We soaked the sample in distilled water (7.0 pH) in a micro-test-tube for eight hours, after which we measured the pH value of the water with a Merck pH indicator paper.

⁵² The educational CD "Leatherworking" was extremely helpful in our study and assessment of manufacturing techniques [25].

⁵³ The hair follicle pattern, i.e. the size and arrangement of the hair holes following the removal of the hair, differs for every species and thus leather finds can be identified through a comparison with samples from known species. In the case of archaeological finds, however, a species identification often runs into difficulties if the surface is strongly degraded, if it is polluted by the soil or corrosion, or if its surface has been treated with a conservation material.

for goat or sheep hides was not visible on this fragment either and it is possible that it was made from the same material as the belt or from the hide of a younger individual of the same species.

The colour of the surviving fragments differed from the reddish-brown and dark brown hue of vegetable-tanned leathers. Their colour was greyish-brown and the section was clearly lighter, having a slightly yellowish hue, raising the possibility of tawing. We performed an alizarin test on a few fibres for determining the alum tawing procedure.⁵⁴ The analyses, performed on samples taken from several fragments, confirmed the presence of aluminium ions. It must here be noted that their presence could not be initially demonstrated on the belt fragments which had earlier been impregnated with a synthetic consolidant; however, following the soaking of the fibres in an acetone solution, the samples yielded a positive reaction similar to the other samples. Since the alizarin test may be interfered by the presence of copper ions, we submitted one sample to instrumental analysis in order to confirm the results.⁵⁵

The width of the surviving belt fragments in their current condition is 16-17 mm. The width of the pendent strap is *ca.* 9 mm, while the width of the small attachment band looped around it is 2 mm. The remnants of another layer could be distinguished on one fragment (Sample 4/b, *Pl. 8. 1a-b*) together with three surviving stitch holes and the thread, which penetrated both leathers. This double-layered fragment and the stitching along the belt's edge suggest that the belt had been fitted with a second layer, perhaps a lining or some reinforcement, which had been sewn onto it. It is noteworthy that the remains of the stitches generally lie under the edge of the mounts adorning the belt, implying that the mounts had been added after the two leather layers had been stitched together because they would otherwise have impeded stitching. In this case, the attachment spike of the mounts had penetrated both leather layers and was bent/hammered afterwards.⁵⁶ However, we cannot exclude the possibility that the stitches had originally run beside the mounts and that the current condition is a consequence of shrinkage. Three fragments have the mounts still firmly attached (*Pl. 6. 1a-b, Pl. 7. 1 a-b*), while on others, only traces of their one-time presence survive in the form of mostly round perforations of a typical size and placement (*Pl. 8. 1a-b*). The surviving stub of the mounts' attachment spike generally has a circular section with a diameter of 1.8 mm on the average. On the fragments without mounts, the perforations indicating their one-time presence were usually 1.9-2 mm large. Their edges were stained green or greenish-blue by corrosion, resembling the compounds probably containing copper (at least judging from their colour) on the surface of the mounts.

The stitch holes along both edges of the belt were small, regular, round perforations. There were no lentil-shaped perforations among them. They were probably made with a round awl (*Pl. 8. 1b*). The stitching ran 1-1.5 mm from the belt's edges, the stitches were spaced 2.5-3.5 mm apart and they had been made by an experienced hand judging from the fine, even stitching. Although the threads of archaeological leather fragments usually decompose, the

⁵⁴ The alizarin test is suitable for demonstrating the presence of aluminium ions from alum in leather. The test is based on the principle that the aluminium ions react with natrium alizarin sulphonate in the ammonium hydroxide solution, creating a red colouration that retains its colour even under acidic conditions.

⁵⁵ Scanning electron microscopy with X-ray microanalysis (SEM EDS) performed by Attila Lajos Tóth. The elements K, Al and S could be detected in the sample, proving the presence of alum.

⁵⁶ This procedure could also be observed on the leather fragment adhering to the reverse of one of the harness mounts from Grave 11 of the Karos III cemetery (*Pl. 10. 4*) as well as on several early medieval leather finds from Eastern Europe (*Pl. 10. 1-3*).

imprints of the original stitches nonetheless reveal much about the type of stitching. We only found a single imprint on the belt fragments owing to their poor preservation: it lay between two stitch holes, parallel to the edges. This imprint could equally well originate from a running stitch or perhaps from two-needle stitching, although in the latter case, the stitch holes would be elongated rather than round owing to the bidirectional tension. What seems quite certain is that binding stitching was not employed. Due to the physical protection of the leather, scraps of the sewing thread survived in several stitch holes (*Pl. 7. 1a; Pl. 8. 1b*). They resemble tiny rivets or wooden pegs, often with a raised “head”, because following the decay of the uppermost leather layer, its surface lay lower than originally. The threads were often coated with a lubricant (wax, pitch or animal fat) to make the fibres adhere better and to ensure the easier passage of the thread during sewing, to prevent its fraying from friction and to make it more waterproof. The lubricant and the soil remnants adhering to the thread provide a stability to the thread, making it protrude from the leather even after the degradation of the latter’s surface. The examination of one of these “rivets” clearly proved that it was actually a bundle of fibres whose strands were held together by some soft, waxy substance (*Pl. 7. 1c*). After dissolving the lubricant in mineral spirit, the strands became more visible and we found that they had a Z twist, even if this could only be made out very weakly. We separated the fibres in the sample and immersed them in a 1:1 solution of glycerine and water for further examination; however, the fabric of the fibres was degraded to the extent that they immediately disintegrated in the solution, and we were thus unable to identify their material. There were no traces of stitching along the edges of the pendent strap looped around the belt (*Pl. 6. 1a–b*).

Thin leather, probably originating from a garment

Most of the leather fragments assigned to this category had been glued to cardboard and thus only one side could be examined. The traces of an earlier mould growth and the paper fibres adhering to the surface treated with a synthetic consolidant constrained the examination of these remains. The leather was much thinner than that of the belt and had remnants of hair in several spots. The animal species could not be determined, but it was probably a smaller-bodied animal, perhaps sheep or goat.

The samples were all dark brown, probably as a result of impregnation with a synthetic consolidant. One goal of our analyses was to identify possible tanning agents, whether vegetable or mineral, the latter by demonstrating the presence of aluminium ions indicating tawing. A 1% solution of iron(III) salts (e.g. iron-alum iron(III) chloride, etc.) is used for identifying the former under laboratory conditions: these develop dark coloured compounds with vegetable tannins. In the case of archaeological finds, identification is more difficult if there is a higher concentration of iron(III) ions in the soil near the leather finds because in this case, the reaction already occurs in the soil and the change in colour does not develop during the test. Neither can the reddish colouration developing during the aluminium test be noted in the case of darker leather fibres, even under a microscope. However, some of the smaller fragments included scraps that were as thin as the pieces identified as clothing remains and bore traces of a similar stitching, but had not been impregnated, and the presence of aluminium ions could be demonstrated in their case. Thus, while the dark colour of the larger leather fragments and their impregnation with a synthetic consolidant constrained the identification of vegetable or alum tanning agents, their use cannot be excluded.

Several fragments bore stitch remains. Some of these could be noted where the two leathers had been sewn together, others on the edging band of a gathered edge (*Pl. 9. 1-2*). The surviving evidence of manufacturing techniques confirms that the raw material had been very soft, thin leather because the gathering is very dense, with 1 mm folds, and was made with tiny, 1.5-2 mm stitches. The remnants of a leather edging band with lentil-shaped perforations could be noted near the gathered side. Most of the stitches were binding stitches, while the band itself was probably attached with a running stitch.

Compacted fibrous material

Several assemblages included compacted, felt-like fragments of fibrous elements that proved impossible to identify even after a minute microscopic examination. It seems likely that they are made up of vegetal fibres. The original thickness of the fragments could not be determined owing to their fragmentary nature; however, they included 1.5-2 mm thick pieces. Several fragments are covered with a rather degraded dark brown coating on one side, probably originating from leather. After immersing a part of Fragment 33/4a in distilled water, we noted a thin, light, translucent layer under the fibrous material; the alizarin test indicated alum tanning. It is possible that the compacted fibrous fragments came from the lining of a leather garment.

Purse

We could not personally examine the remains of the purse and thus the following observations on its manufacturing technique are based on the photo and drawing made during the excavation, and we are fully aware that the reconstruction proposed here too runs the risk of mistakes. We focused on the purse's decorative design and how it had been made, presenting a reconstruction of its one-time appearance which seems most feasible to us (*Pl. 5. 2*). A design of this type can be created using three techniques. The first of these is incising, when the surface of the leather is incised using a sharp tool along the line of the intended design and the groove created in this manner is enlarged with a thin, blunt implement. The second technique involves pressing a narrow, blunt bone or wooden implement onto the leather to draw the design – in this case, the lines are not as deep and as sharp because the leather surface remains intact. The third is accentuating the line of the design with decorative stitching. In the case of the Sárbogárd purse, incising or decorative stitching seems more likely because the design survived even after burial and the tears in the leather follow its lines. The cohesion of the fibres of a leather artefact bearing a semi-incised design or stitch holes is much weaker in these areas, the fabric is much more prone to damage than in the areas adjacent to the design. Still, it must again be emphasised that this is no more than a cautious assumption. If the drawing accurately reproduces the imprints, the stitching along the edge of the leather is overstitching (*Pl. 5. 3*). The attachment of the purse can be reconstructed from the position of the two stitch holes on the pendent strap. Our reconstruction is in part based on the Bezdéd purse, on which there is a slit in the centre of the purse's top rear fold line and two stitch holes underneath it on the reverse, most likely indicating the place where it was attached to the pendent strap (*Pl. 5. 4-6*).

*The findings of the examination of the leather finds from Sárbogárd**Material*

In her study published in 1962 (“Aspects of leatherworking in the Hungarian manner”), Alice Gáborján notes that “the presence of aluminium indicating the use of alum has been demonstrated on all of the few Conquest period leather remnants submitted to chemical analyses. These leather fragments originated both from footwear and clothing.” [7, p.135]. Unfortunately, she did not specify the findspots and contexts of the analysed leather remains, or the analytical procedures employed in their examination. Neither do we know whether the findings of these analyses have been published.⁵⁷

At the same time, our own analyses have confirmed the use of alum-tanned leathers during the Conquest period. The microchemical tests demonstrated the presence of aluminium ions in the samples taken from the mount-decorated belt, the small fragments probably originating from clothing and the leather adhering to the compacted vegetal fibres. Although the tanning agent of the thin leather fragments quite certainly originating from clothing could not be identified owing to their dark colour and their impregnation with a synthetic consolidant, it is our hope that subsequent analyses will yield conclusive results for these finds too. Whilst we could not personally examine the leather of the Sárbogárd purse, we could demonstrate the presence of aluminium ions on tiny fragments of the Bezdéd purse,⁵⁸ indicating that alum-tanned leathers were used for the manufacture of this artefact type too.

Alice Gáborján has argued that the presence of aluminium merely indicates that the leathers had been tawed, adding that the leathers made in the “Hungarian manner” had also been scudded with a knife and had been impregnated with tallow. In her view, “given that tallow is an organic matter, it decays in the case of archaeological finds and thus its one-time presence cannot be demonstrated with the current techniques.” [7, p.136].

In this respect, there is space for optimism, in part because considerable advances have been made in analytical techniques and in part because it would appear that the animal fat had not completely disintegrated. For example, the bundle of sewing thread became much thinner after soaking in a benzene solution and its colour also changed, suggesting that some fatty lubricant, which had survived the long centuries in the ground, had been dissolved. While we did not note any hairs on the belt fragments, the remains of hairs could be observed on the thinner fragments from the clothing. It must here be noted that some leather fragments from other Conquest period sites were covered with hairs over their entire surface.⁵⁹

Since the microscopic and microchemical analyses did not provide an answer to all our questions, we plan to submit samples to further archaeometric analyses in order to determine

⁵⁷ It is possible that the analyses had been performed by Dr. Lajos Pósa, a leather chemist working in the Leather and Shoe Industry Research Institute, because he is known to have undertaken the identification of vegetable tanning agents in the shoe finds from Dr. Imre Holl's excavations in Buda Castle in 1952 [7, p.111].

⁵⁸ We are grateful to László Révész and the Hungarian National Museum for the opportunity to study this artefact.

⁵⁹ It must here be noted that hairs have been found on vegetable-tanned archaeological leathers too; however, on those finds, the presence of hairs was the result of imperfect scudding with a blunt knife after liming and thus hardly intentional [22, p.221].

whether they contain any fats in addition to alum or whether the presence of vegetable tannins can be demonstrated.

Although the animal species could not be identified owing to the strong degradation of the leather fragments' surface and their impregnation with a synthetic consolidant, we could establish that the belt had been made from a more compact, thicker leather, while the clothing from a thin, softer leather, probably from goat or sheep skin.

Stitching techniques

The belt was made from two layers of leather stitched together: both leather layers were perforated using a blunt round awl leaving round perforations and the thread was then passed through these holes, probably with a blunt needle. The use of an awl was necessary because thick, compact leathers of this type cannot be perforated with a needle. The stitching ran parallel to the edges in a straight line and was either a back stitch or a basting(running) stitch. The use of binding stitching can be excluded on the belt. Stitching along the edge of belts from other sites is uncommon.

The thinner leather fragments have been shown to originate from a garment. This was also suggested by their position because they had adhered to the reverse of the mount-decorated belt. Our examination of the fragments revealed that they had been made from a very soft, thin leather because an unusually dense gathering of 1 mm folds could be identified on one fragment. There is no need for an awl when stitching together thin leathers because they can be easily perforated with a needle. Furriers today use a three-edged needle for sewing together thin leathers and furs because these do not perforate, but rather cut through the leather, making work easier. It seems likely that a slightly sharpened needle was used, although the traces would suggest a double-edged needle because the stitch holes are not round, but lentil-shaped. Binding stitching was employed, a stitch type that has been used by furriers for centuries.⁶⁰ The stitching is very fine and even, with the stitches spaced 1.5–2 mm apart (for a drawing of the stitch type, see *Pl. 5. 3*).

In general, the stitchings surviving on the leather fragments were all made by a very experienced hand. This is hardly surprising in the case of the garment since in a period when every single item of clothing was sewn by hand, each family probably had members who were skilled at sewing, regardless of whether the garments were sewn from textile or leather. The manufacture of belts, however, was a more complicated task. Thick leather, especially if made up of two layers, can only be sewn together if it is perforated with an awl before each stitch, a procedure calling for more advanced skills. The stitches on the Sárbogárd belt are small, their spacing is surprisingly even both from each other and from the belt's edge, suggesting that its maker had made similar pieces oft-times. Since there was no need for too many belts in a single household, and thus there were no opportunities to practice belt making for long weeks or months, it is possible that these items were made as part of a craft industry.

⁶⁰ The names of various stitch types employed in the textile, leather and fur industry change, even in the case of the same stitch type.

Conclusion

The examination and analysis of the leather fragments from Sárbogárd were extremely rewarding because they provided a wealth of new information and they also contributed to the creation of a protocol for the study of leather remains from the Conquest period. Although several questions remain unanswered, it is our hope that our research project can be broadened in this direction too and will include further archaeometric analyses.

The next step is setting our findings in a broader archaeological context and interpretative framework. Our finds can be best compared to the well-preserved leather remains of the ninth–eleventh-century cultures of Eastern Europe whose metalwork shares similarities with the Conquest period material. Of outstanding importance among these is the middle horizon of the so-called ancient Mordvinic cemeteries dating to the ninth–eleventh centuries [9; p.5], whose finds include belts with pendent straps as well as leather purses made in different styles and with diverse structures and fastening mechanisms. Although the assessment of these eastern leather finds is still in a rudimentary stage, the leather structure of the belts indicates that they resemble the Sárbogárd belt regarding the stitching along their edge (*Pl. 10. 1-3*). In Hungary, Grave 11 of the Karos III cemetery yielded the fragment of a comparable multi-layered, buckled and folded belt (*Pl. 10. 4*).

We believe that one of the most unexpected findings of our leather studies is that we now have archaeological evidence for the one-time existence of upper garments made of leather (*Pl. 4. 2; Pl. 9*). The literary sources of early Hungarian history and the early medieval sources on Eastern Europe record the use of leather upper garments among the ancient Hungarians and the neighbouring peoples as well as in the Byzantine Empire. Several Muslim sources recount the marriage customs of the ancient Hungarians:

They have the custom in [the matter of] taking a wife that when they ask for a wife, they take a bride-price in accordance with her wealth, consisting of horses of more or less that wealth. And when they mount to take the bride-price, the girl's father takes the groom's father to his house and whatever he has by way furs of sable (or marten), ermine, grey squirrel, weasel, and underbellies of fox, brocade fabrics and various leather pieces, he brings together to the amount of ten leather garments. [Then] he wraps [these] in a bed roll and ties [it] on the groom's father's horse and he sends it off towards its home.

(Gardizi)

In his account of the Pechenegs, Constantine Porphyrogenitus records that in addition to the well-known and oft-cited silks and other textiles, they also received processed leather in exchange for their services from the Byzantines in the Crimea:

Yet another folk of these Pechenegs ... receive from the Chersonites a pre-arranged remuneration in respect of their service proportionate to their labour and trouble, in the form of pieces of purple cloth [silk], ribbons, gold brocade, pepper, scarlet or "Parthian" leather⁶¹ and other commodities

⁶¹ Scarlet or Parthian leather was probably a leather type made with alum tanning, which was a specialty of Asia Minor from the late Roman Age onward and was still employed in the Byzantine era. It has been

which they require according to a contract which each Chersonite may make or agree to with an individual Pecheneg.

(Constantine Porphyrogenitus: De administrando Imperio)

It would appear that the Pechenegs were not the only people to receive leatherware from the Byzantines – leather articles were coveted diplomatic gifts among other nomadic peoples too. We know from Ibn Fadlan's account that in 992, an Arab embassy presented leather articles to Etrek, the commander of the army of the Oghuz Turks:

He sent him fifty dinars, among which were a number of Musayyabi dinars, three mithqals of musk, pieces of processed [tanned?] leather, and cloth from Merv from which we cut him two tunics, tanned leather boots, one brocade garment, and five silk garments.

(Ibn Fadlan)

References to the leather upper garments worn by the Hungarians can be found in late medieval sources too, written several centuries later, for example in a description of fourteenth-century Hungarian soldiers:

I have no doubt that, as has been noted by others before me, the people of the Hungarians do not wear armour. When preparing for combat or jousts, they don a tight leather garment or a very close-fitting costume, which holds their limbs tightly.

(Description of Máté Csák's Hungarian light cavalry by a Czech chronicler, 1315) [11, p.213]

In sum, the examination of the leather remains preserved in the archaeological record of the Conquest period confirms the information contained in the literary sources on the ancient Hungarians. Our studies indicate that tenth-century leatherworking was practiced on a much higher level than earlier believed. The finds from Sárbogárd provide evidence that the tanners of the tenth century were familiar with tawing and, also, that the various leather articles whose workmanship surpassed the more simple objects made as part of a home craft industry were created by highly skilled leatherworkers. A better and more detailed knowledge of the period's leatherworking calls for the continuation of the study of the period's leather remains as well as the widening of the scope of these studies.

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suggested that the ancient Hungarians had adopted this tanning procedure from the Byzantines – the Hungarian word for tanner (*tímár*) comes from Greek [8, p.237].

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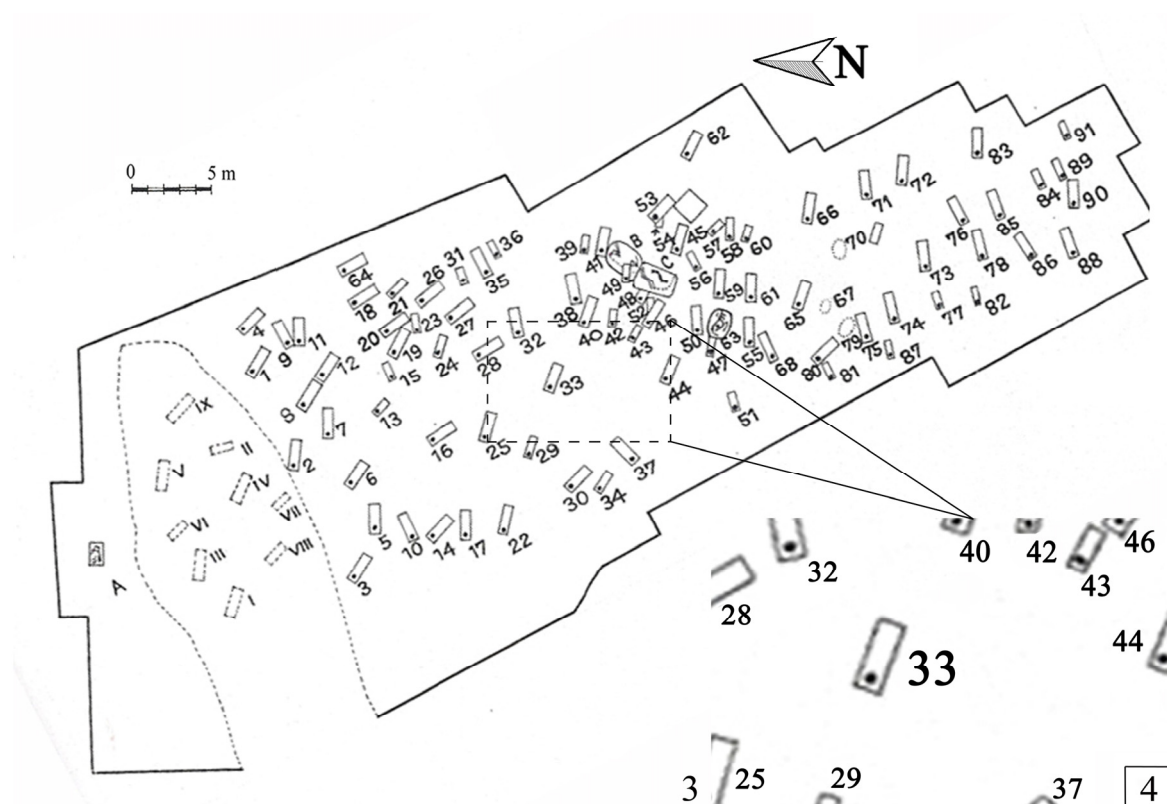
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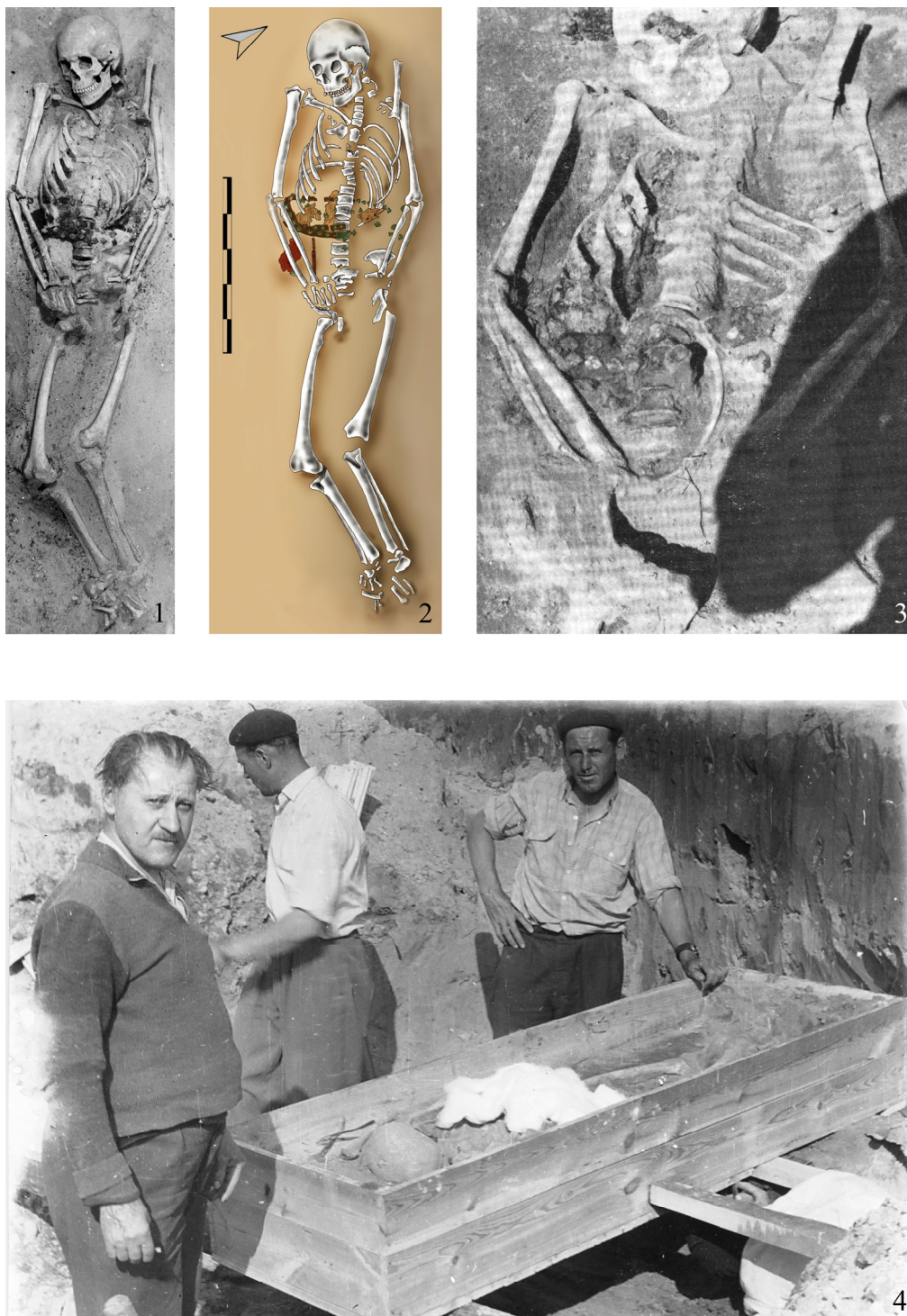
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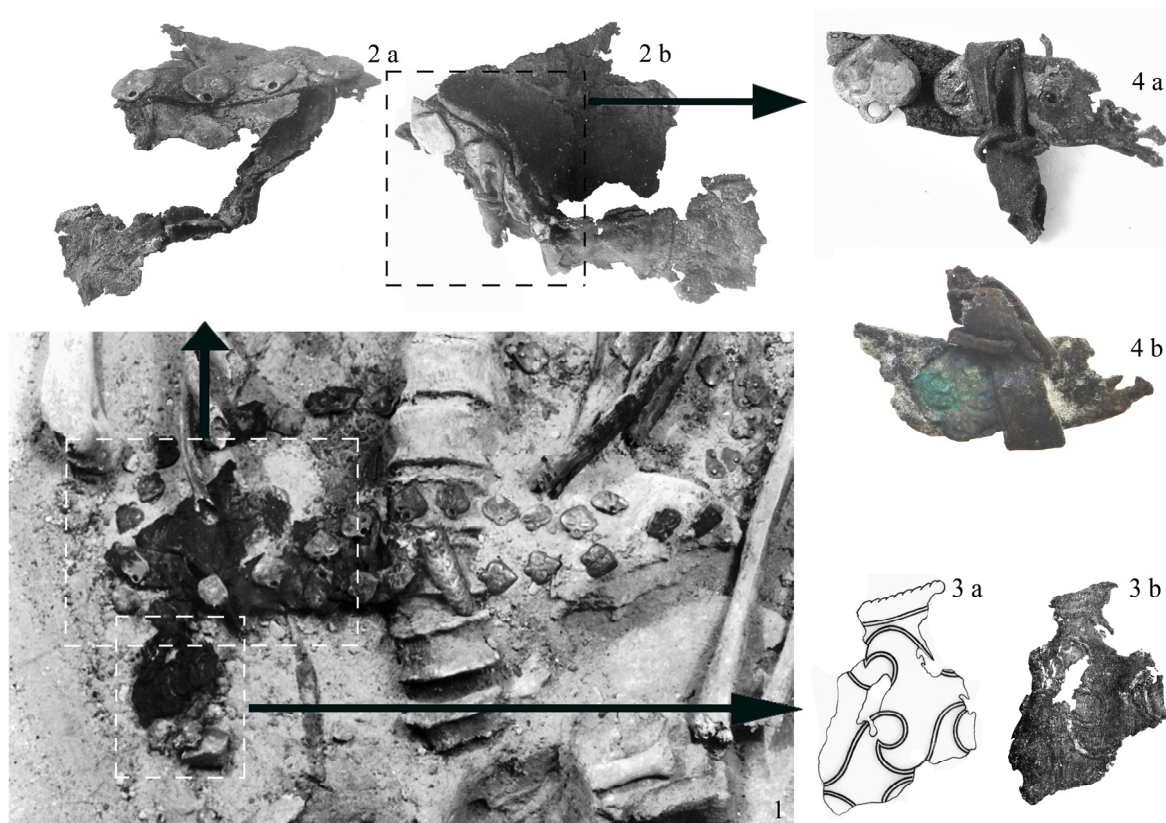
Pl. 1. 1–2. Location of the tenth-century site of Sárbogárd-Tringer-tanya;
3–4: Plan of the cemetery and the location of Grave 33



Pl. 2. 1–3: Sárbogárd-Tringer-tanya, Grave 33;
4: Sárbogárd-Tringer-tanya, in situ lifting of Grave 33 in 1961



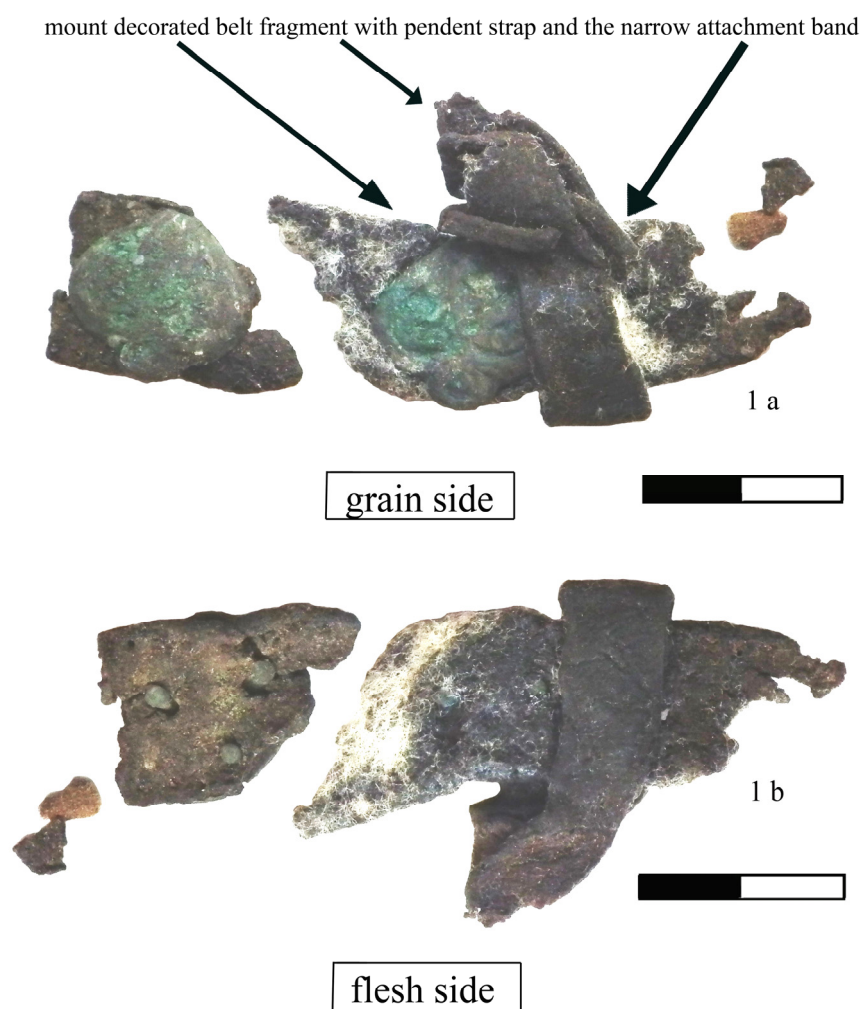
Pl. 3. 1–2: Leather remains in the pelvic area and the position of the belt.
Alán Kralovánszky's excavation photo (1) and the reconstruction based on it (2) (by Edit Ambrus)



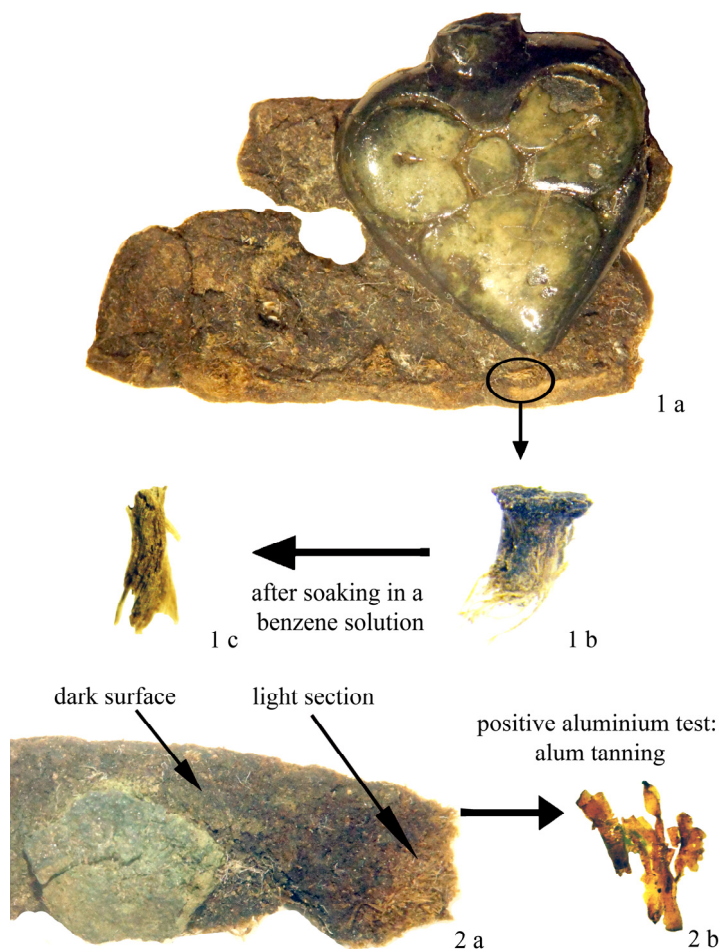
Pl. 4. 1–4: Position of the leather purse, the belt, the pendent suspension strap and the remains of the leather upper garment in the grave, based on Alán Kralovánszky's excavation photos



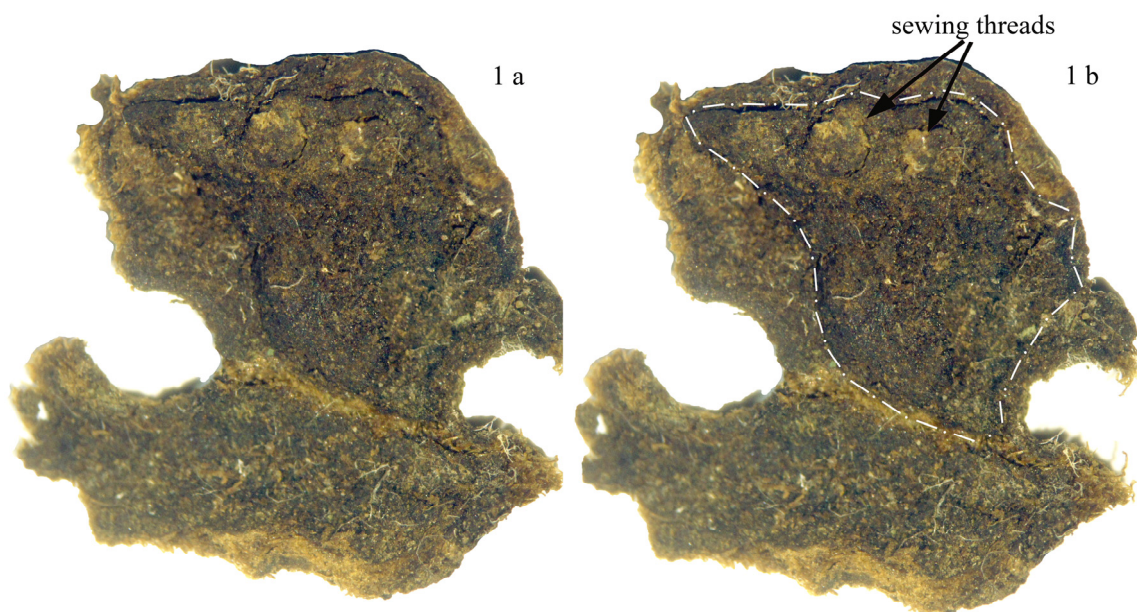
Pl. 5. 1: Reconstruction of the belt and the objects associated with it (by Edit Ambrus);
2–5: Reconstruction of the leather purse and its possible mode of suspension (by Edit Ambrus,
photo by Márta Kissné Bendefy). 6: Reconstruction of how the purse was attached to the pendent
strap, in part based on the evidence of the Bezdéd purse



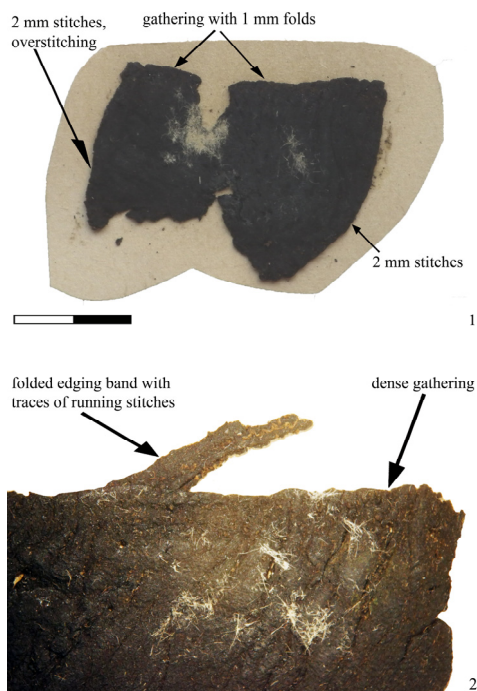
Pl. 6. 1–1a: Detail of the belt and the pendent suspension strap of the purse
(photos by Márta Kissné Bendefy)



Pl. 7. 1: Results of the technological examination of the finish of the leather belt's edge and the greased edging thread; 2: Results of the chemical analysis of how the leather belt was tanned (photos by Márta Kissné Bendefy)



Pl. 8. 1–1a: Detail of the leather upper garment and its stitching (photos by Márta Kissné Bendefy)



Pl. 9. 1–2: Detail of the leather upper garment and its stitching and gathering (photos by Márta Kissné Bende fy)



Pl. 10. Tenth-century leather finds from Eastern Europe. Multi-layered leather belt from Panovo, Grave 2 (1–2) and Kryukovo Kuzhnoye, Grave 491 (3), detail of the multi-layered leather strap of the horse harness from Grave 11 of the Karos III cemetery (4) (photos by Attila Türk)