FUROR NORMANNORUM

A 9–11. századi kétélű kardok kutatása: régészeti, metallurgiai megközelítések

Research on 9-11th Century Double-Edged Swords: Archaeological and Metallurgical Approaches

NKFI Mecenatúra 2021/140807

19–23/09/ 2022.
Szent II. János Pál Pápa Díszterem, 1088 Budapest, Szentkirályi u. 28–30.

September 19 (Monday)

14.00–14.30	Opening speeches
14.30–15.00	Introduction of the PPKE 'Double-edged Swords Research Group'
15.00–15.40	Plenary speech – Neil Price (University of Uppsala): Arms and the (Wo)man: Swords, Gender, and Death in the Viking Age
15.40–16.20	Plenary speech – Gareth Williams (British Museum): Swords for the living and the dead
16.20–17.00	Discussion
17.00–17.30	László Tapolcai (Eötvös Loránd University): The Political and Territorial Changes in East-Central Europe after the Battle of Lechfeld (955–972)
17.30–19.00	Reception at the hall

September 20 (Tuesday)

Archaeometallurgy – Chairman: Béla Török

9.00–9.40	Plenary speech – Alan Williams (The Wallace Collection, London): Swords in Medieval Europe – possible methods of analysis
9.40–10.00	Discussion & coffee break
10.00–10.20	Mathias Mehofer (University of Vienna): Archaeometallurgical analyses of early medieval weaponry from Austria

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10.20–10.40 Francesco Grazzi (Consiglio Nazionale delle Ricerche Istituto di Fisica Applicata & Istituto Nazionale di Fisica Nucleare): The evolution of the structure of Viking swords. A non-invasive analysis of their manufacturing and structure through neutron tomography
10.40–11.00 Boglárka Tóth, Márk Haramza and Béla Török (Janus Pannonius Museum / University of Miskolc): The Sword from Himesháza – origin and technology
11.00–11.20 Árpád Rácz (Austro-Lab): Essential chemical analytical techniques in archaeometry
11.20–11.40 Béla Török, Péter Barkóczy and Boglárka Tóth (University of Miskolc / Pázmány Péter Catholic University): Types of production methods of swords based on metallographic studies
11.40–12.20 Discussion
12.20–13.30 Lunch break

Swords in written sources – Chairman: Beatrix F. Romhányi

13.30–13.50 Szabolcs Polgár (University of Szeged): Swords and weapons as trade goods in Eastern Europe (c. 9th–12th)
13.50–14.10 Csete Katona (University of Debrecen & Pázmány Péter Catholic University): Secret(s) of the Rus'. Production of and demand for Viking Age swords in the 'East'
14.10–14.30 Bence Fehér (Institute of Hungarian Research): The curse of tradition. Existent and obsolete sword types in the descriptions of medieval Muslim authors
14.30–15.00 Discussion

September 21 (Wednesday

Swords in East, Central and Southern Europe – Chairman: Péter Langó

9.00–9.40 Plenary speech: Valeri Yotov (Museum of Varna): Weapons and military equipment in the Balkans in the 11th century (interplay of the Scandinavian and Byzantine examples)
9.40–10.00 Discussion & coffee break
10.00–10.20 Taxiarchis Kolias (University of Athens): The symbolic significance of the sword in Byzantium
10.20–10.40 Béla Török, Boglárka Tóth, Péter Barkóczy, and Péter Langó (University of Miskolc / Eötvös Loránd Research Network / Pázmány Péter Catholic University): The Kunágota sword – manufacturing characteristics and Byzantine connections
10.40–11.00 Jiří Hošek and Jiří Košta (The Czech Academy of Sciences, Institute of Archaeology / National Museum, Czech Republic): Petersen Type Y sword with pattern-welded blade from Rajhradice (Czech Republic) – examination, classification and comparison
11.00–11.20 Milica Radišić (Institute of Archaeology, Belgrade): Double-edged swords and polearms of western origin in the territory of present-day Serbia: an overview and reinterpretation
11.20–12.00 Discussion
12.00–13.00 Lunch break

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Carolingian swords – Chairman: Miklós Takács

13.00–13.20 Maja Petrinec and Tomislav Šeparović (Museum of Croatian Archaeological Monuments, Split): New Insights on early Carolingian swords from Croatian Territories
13.20–13.40 Róbert Müller (Balaton Museum, Keszthely): Karolingisches Schwert aus Murakeresztúr-Kollátszeg (Kom. Zala)
13.40–14.00: Boglárka Maróti, György Káli, Béla Török and Péter Barkóczy (Eötvös Loránd Research Network / University of Miskolc): Complex examination project of the sword from Murakeresztúr-Kollátszeg
14.00–14.20 Péter Prohászka (Slovak Academy of Sciences): Schwerter, Gräber, Münzen – Bemerkungen zu den frühmittelalterlichen Gräbern mit Schwertern und Münzbeigabe aus Mitteleuropa
14.20–15.00 Discussion
15.00–15.30 Coffee break

Swords in Hungary – Chairman: Csete Katona

15.30–15.50 Bertalan Zágorhidi-Czigány (Pázmány Péter Catholic University): Double-edged swords in the Carpathian Basin during the 9th–11th centuries
15.50–16.10 Flórián Harangi and Réka Fülöp (Pázmány Péter Catholic University / Hungarian National Museum): Swords, silks and beads. Some remarks on the commerce of the Carpathian Basin in the 9th–11th centuries
16.10–16.30 Márk Haramza and Béla Török (Janus Pannonius Museum / University of Miskolc): From sabre to sword. The so-called 'Weapon Change' from the aspect of archaeology
16.30–17.00 Discussion

September 22 (Thursday)

9.00–9.20 Beatrix F. Romhányi (Károli Gáspár University): The image of the Carpathian Basin around 1000
9.20–9.40 Andrea Ilés-Muszka (University of Szeged & Hungarian National Museum): New results concerning the contacts between the Carpathian Basin and Northern Europe during the 10–11th century
9.40–10.00 József Szentpéteri and Béla Török (Eötvös Loránd Research Network / University of Miskolc): The Scandinavian and Baltic connections of stray metal finds from Solt-Tételhegy, County Bács-Kiskun, HU (archaeological and archaeometrical data)
10.00–13.00 Guided Tour in the National Museum

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ARMS AND THE (WO)MAN: SWORDS, GENDER, AND DEATH IN THE VIKING AGE

Neil Price

Fig 1.

For well over a century of scholarship on the Viking Age, the presence of swords in burials has been taken as a clear sign of a 'warrior' identity for the deceased. At first, merely the fact of their deposition in the grave was enough, but in the later twentieth century more precise recording brought with it greater attention to the placement and disposition of the blades, and also their association with other weapons and so-called 'grave-goods'. Swords, more so than any other offensive armament, were also taken as markers of masculinity: this followed a conflation (and simplistic definition) of biological sex and gender, and an assumption that such tools of war were 'obviously' the property of men. In the absence of surviving human remains, swords in funerary contexts resulted in the assignment of male sex determinations by default. In many cases where skeletal material was preserved, no osteological analyses were thought necessary for the same reasons.

In the second decade of the present century, archaeologists now tend to work with concepts of 'weapon graves' rather than 'warrior burials', in an attempt to critically interrogate the received interpretive wisdom of earlier decades. Not least, this applies to the gendered construct of warriorhood itself, and the complexities inherent in reading lived identities from the potentially very different

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signals of mortuary behaviour. The sword occupies a central place in these debates.

Between 2017 and 2019, the author was part of a Swedish research team from the universities of Uppsala and Stockholm that published a new genomic sex determination for the spectacular chamber grave Bj.581, from the island town of Birka in Lake Mälaren. With its full panoply of weapons, horses, and a well-preserved skeleton, the burial had appeared in countless publications over the preceding seventy years, achieving a modest fame as a kind of 'ultimate Viking' of the tenth century, universally interpreted as the grave of a high-status male warrior. When osteology suggested female skeletal characteristics, and then aDNA analysis confirmed that the person carried XX chromosomes, the ensuing debate over the 'warrior woman' from Birka consumed the internet for many months, with an impact that is still felt today.

This plenary talk will not rehash the details of the burial and its controversies, but will instead present a new, detailed study of the weapon-set in Bj.581, with a strong focus on the sword in context. Illuminating new facets of the Birka grave, this acts as a starting point for exploring the tangled intersections of martial material culture, gender, and identity as they combine in the varied death rituals of the Viking Age. Other burials of an arguably military nature are also considered in the same associative light, including the dramatic boat graves from Salme on Saaremaa in Estonia, in which 41 men with severe traumatic injuries were accompanied by an even greater quantity of swords. It is clear that the Salme burials involved very specific behaviours relating to the blades, including differential treatment of single- and double-edged weapons, and the deliberate placement of the latter in ways that imply their active agency in the closing rituals and long-term appearance of the graves. Different, though compara-

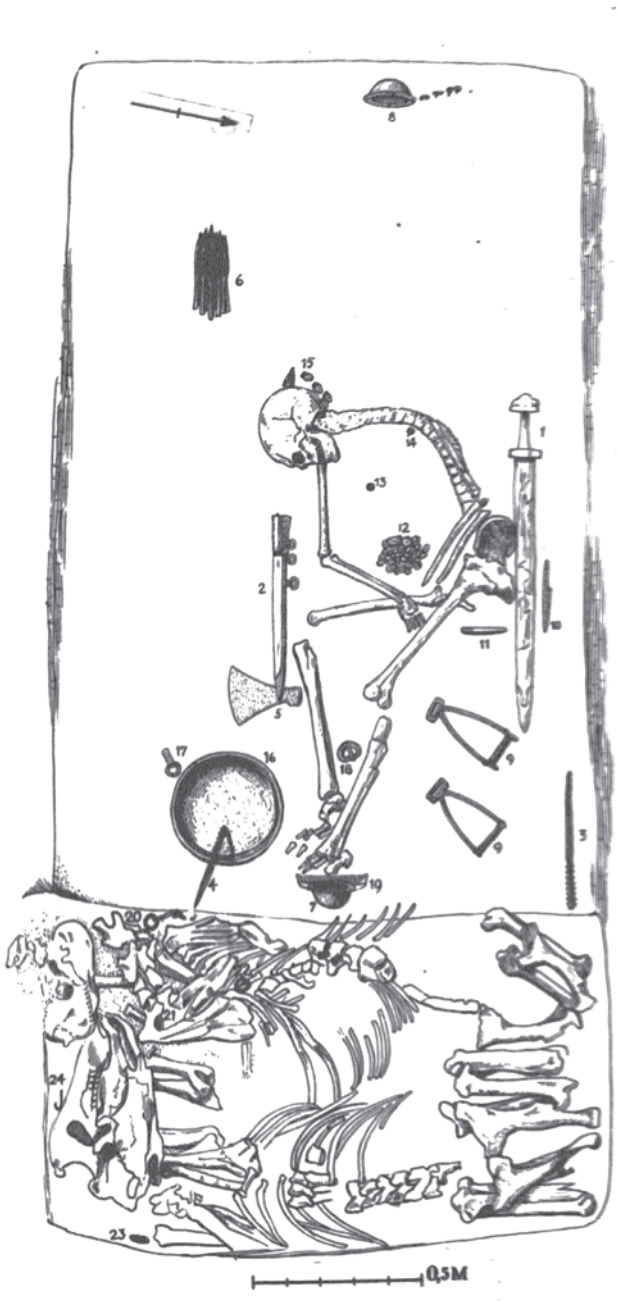

Fig 2.

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Fig 1.

ble, materialities of swords can also be detected in the cemeteries of central Uppland, the region from which the Salme crews seem to have originated on the basis of isotopic analyses.

At the same time as late Iron Age funerary studies were awakening to the full diversity and range of mortuary practice, not least in relation to weapon rituals of this kind, new typologies and comparative surveys of the swords themselves were appearing, including several major catalogues and publications. It is clear that the long-held conviction that swords were reserved for Viking-Age elites needs to be revisited, and it may even be possible to reconstruct a basic 'social hierarchy' of these weapons. Intriguingly, some of these may include blades with names and literal biographies, of the kind found in the Icelandic sagas. Similarly, the use of swords beyond the battlefield or as symbols of status can also be seen, not least in contexts of oath-taking and vows of martial loyalty.

Swords, gender, and death form a complex triad in the archaeology of the Viking Age, a set of relationships that offers new possibilities for early medieval scholars in their explorations of ancient world-views. With the more open, pluralistic and multi-vocal research trends of recent years, perceptions of the sword are moving far beyond stereotype, to embrace its many symbolic roles in the ever-changing mind-set of the North.

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SWORDS FOR THE LIVING AND THE DEAD

Gareth Williams

Swords are found across the Viking world, both in the east and west. These include grave finds, swords which appear to be deliberately sacrificed and single finds without a clear archaeological context to explain their deposition. These include 'Scandinavian' types, but also swords of Frankish or Anglo-Saxon type, and hybrids, e.g. swords apparently combining Frankish blades with Scandinavian hilt fittings, or types in which the hilt fittings appear to represent a fusion of styles. Swords also feature both in contemporary written sources such as skaldic verse and Arabic geographical texts, and in later literary sources such as sagas, which point to symbolic as well as practical functions.

It is often difficult to reconcile conflicting evidence on specific points such as the role of swords in funerary traditions, and the quality (or lack of it) of Viking blades. However, recent work on the Viking world has also seen a conflict between the recognition of local and regional identities and the sense of a shared cultural identity across (and defining) the Viking world. To this may be added the question of how far the Anglo-Saxons and Franks shared cultural traditions regarding swords with their Scandinavian contemporaries as a result of shared Germanic heritage. Against this background it is legitimate to consider Frankish and Anglo-Saxon evidence from non-Viking contexts when interpreting 'Viking' swords, as long as there is a clear understanding that it cannot simply be assumed that symbolism and practice were identical across different cultures.

This paper will explore how differing approaches to swords both within the archaeological and literary evidence may reflect the existence of multiple cultural traditions, and will raise the question of whether placing individual sword finds within the 'wrong' tradition may impact on our wider understanding of swords in the Viking Age. The paper will specifically consider the possibility that some swords may have been made or modified for the grave, in which case consideration of their practical function may be quite misleading for the understanding of the quality and use of swords in combat.

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TERRITORIAL AND POLITICAL CHANGES IN EAST-CENTRAL EUROPE AFTER THE BATTLE OF LECHFELD (955–973)

László Tapolcai

The lecture's timeframe is set between a bloody battle (Lechfeld, 955) and a large-scale Easter feast (Quedlinburg, 973). Both events had a major impact on the development of the German state and on the further history of the three emerging peoples of East-Central Europe – the Bohemians, the Poles and the Hungarians.

The spatial frame is provided by the contemporary territories of the smaller and larger ethnic groups or tribes belonging to these three peoples, which underwent very rapid successive changes during the period. We should keep in mind, however, the existence of the Eastern March, founded in 939 by Otto I, which also played an important role in the period. In my lecture I will briefly review the state of these territories before 955. Prior to the Battle of Lechfeld (Augsburg), most of the territory was inhabited by tribes and ethnic groups who had arrived there during the time of the Hungarian conquest at the turn of the 9th and 10th centuries. Their territories extended beyond the Carpathian Basin to the Moravian Basin, to a significant part of present-day Lesser Poland, and partly to the plain lying north-east and east of the Carpathians (parts of present-day western Ukraine, Romania and Moldova). By the mid-10th century, the earlier alliance of the tribes had broken up, with each area being ruled by the leaders of the occupying groups.

On the present-day Czech territories various smaller and larger Western Slavic groups settled down, and the names of three dynasties have survived from that period in the Bohemian Basin: the Přemyšl, the Slavník and the Vrš. After long-lasting battles, Prince Boleslav I swore an oath of allegiance to King Otto I of Germany in 950.

There are hardly any written records of the contemporary political organisation of the present-day Polish territories, which can therefore only be revealed by the growing and sometimes contradictory results of archaeological research.

After 955, the balance of power in the Central and Eastern European region changed. Control of the Moravian Basin gradually passed to Boleslav I of Bohemia, who soon extended his power to parts of present-day Lesser Poland (e.g. Kraków). The conquest of the territory must have been gradually executed, with Boleslav I occupying the territories of Lesser Poland only in around 962, and therefore changing the status quo in the areas north of the Carpathian Basin. In these areas, the Hungarians coexisted with local Slavic groups (e.g. the Lędzians) during this period, and there is no record of any major conflict between the different groups.

In the later Polish territories, significant social and political changes took place in the middle of the 10th century in the areas between the river Oder and the river Vistula, especially in the territory of present-day Greater Poland. Archaeological

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evidence shows that most of the earlier strongholds were destroyed and that by the middle of the century five strongholds had risen in the area where the centre of power of the later Piast dynasty was established and then expanded, so much so that by the early 960s it had almost simultaneously reached the borderland of the Eastern March (by the Oder) and the areas around Kraków (by the Vistula) occupied by Boleslav I.

The ensuing conflict has long been discussed in German, Polish and Czech historiography. The Saxon Count Gero attacked and twice defeated Mieszko (963), who made an alliance with the Bohemian Boleslav I, married his daughter, and after Gero's death, with the Bohemians' help, defeated Wichmann (967). Later he also defeated the next Saxon Count Hodo (972), after which Otto I dismembered the Eastern March.

The novelty of my lecture lies in depicting a more nuanced picture of the role of the Bohemian Boleslav I in the series of events that has hitherto been described as a German–Polish conflict. The Polish prince Mieszko most certainly did not regard Boleslav I as a potential ally in the beginning, but rather a potential threat in the East while he was fighting against the Saxons in the West. The alliance of Mieszko and Boleslav was therefore not an expression of Slavic brotherhood against the Germans, but rather arose from the interest of the Polish prince to avoid a two-front war.

The shift in political power in East-Central Europe resulted in the acceleration of the Christian mission. Although Christianity was present in the Bohemian territories as early as the 9th century, no independent diocese or ecclesiastical province was established. The first bishopric was not created on Bohemian territories, but in Poznań in 968. During the reign of Géza, the Christian mission also began on the territories of the Árpáds. Boleslav I made continuous efforts until his death (972) to establish an independent Bohemian bishopric in Prague, but it was not until the following year (973) that Otto I established it.

It seemed that the conflicts of East-Central Europe could finally be settled peacefully during the Easter feast during the Quedlinburg Congress in 973. There emerged some seemingly stable centres of power on the territories of earlier smaller or larger tribal settlements, which, despite their external and internal conflicts, soon became Christian principalities and later kingdoms.

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SWORDS IN MEDIEVAL EUROPE – POSSIBLE METHODS OF ANALYSIS

Alan Williams

As well as being a picture gallery, The Wallace Collection holds the largest collection of European armour in London, and one of the best collections of Indo-Persian swords and armour outside the subcontinent. Here, we have set up a small laboratory for the analysis of plate armour and many swords, provided that they were already broken to some extent, metallography (microscopic examination of a cut edge). *Metallography* (although micro-invasive) enables the phases present in steel, and thus the carbon content, slag content, presence of phosphorus, as well as any attempts at hardening, to be determined.

For much of the early Middle Ages in Europe, the only ferrous material available was 'bloomery iron'. This was the product of heating iron ore with charcoal in a small furnace, to produce a heterogeneous lump, parts of which would be of higher carbon content than others. Early smiths would have found that some samples of 'iron' were harder than others, but whether they could be deliberately produced was another matter, and it would be a very long time before the production of steel could be anything other than adventitious.

A very common way of proceeding was to make an artefact of iron, and then convert part of it to steel. This might be done by forge-welding a steel edge, or other crucial part, to an iron body, or by 'case-carburising' the body; that is, heating the iron in contact with carbon for several hours. Adding a steel part to an iron part, however, still does not require the smith to know how to make steel. Its production may be a matter entirely of chance, as long as its presence can be identified.

Many swords show a microstructure of an iron body and steel edges. Swords made of several pieces of steel are rarer, being much more expensive to make.

The edge of a sword recovered from the wreck of King Henry VIII's warship 'Mary Rose' shows a similar method of manufacture to swords made 500 years earlier.

Case-hardening, although less suitable for swords, does entail some knowledge of converting iron to steel. And there is however another route to making steel. Crucible steel involves heating iron with organic material in a covered crucible to form an ingot of cast steel, and this was made in Iran, and Central Asia, from at least the 7th century onwards, and some of which seems to have found its way into Viking swords, by means of the Volga trade route. Wet chemical analysis in the past provided clues to its presence, which metallography has since confirmed, and its presence demonstrated in a

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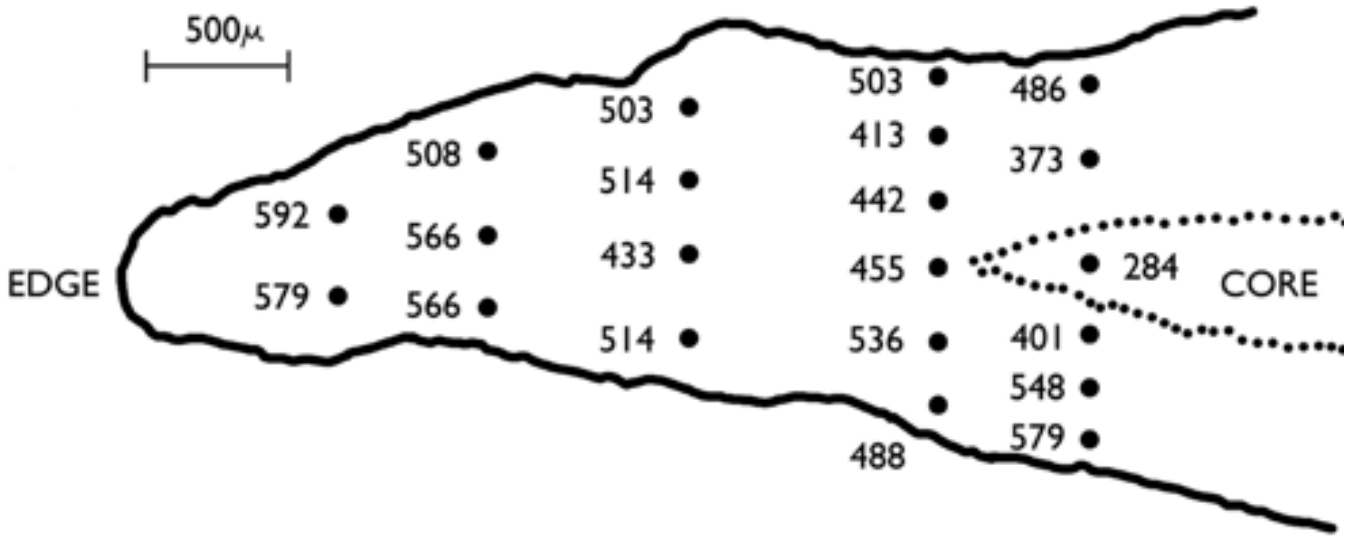

Fig 1.

very specific group of Viking age swords, whose manufacture apparently ceased when the Volga trade route was closed, although medieval chroniclers were aware of the existence of a different type of steel in Asia.

The usefulness of a sword, or indeed any weapon, depends upon a number of factors. As well as the length and weight of the blade, which determines the energy of impact, the sharpness of its edges, which in turn depends upon the hardness of the metal used, determines how much energy can be concentrated in a narrow band or point on the target. Equally important is the fracture toughness of the metal used, that is to say, its resistance to cracking. A blade which is brittle, and snaps upon impact, is worse than useless. On the other hand, one which is ductile, and deforms upon impact, may still remain of some use in combat. The ideal blade should be both hard, resisting plastic deformation, and tough, resisting brittle failure. This combination of properties depends upon the smith being able to control the properties of the steel used, by its successful heat treatment, difficult though this was in the absence of any instrumentation.

Our ultimate aim is to find an analytical technique which is not even micro-invasive, but provides as much information as metallography. So, we have for some years been using neutron diffraction to study swords from the Wallace Collection, at the Rutherford-Appleton Laboratory, Harwell, and the Budapest Neutron Centre.

Many Oriental blades were made from crucible steel, a hypereutectoid cast steel, and a proportion of those were forged in such a way as to retain a distinctive surface pattern said to resemble watered silk (the so-called 'Damascus steel').

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ARCHAEOMETALLURGICAL ANALYSES OF EARLY MEDIEVAL WEAPONRY FROM AUSTRIA

Mathias Mehofer

Within the framework of the presented research project, we were able to examine a selection of early medieval weapons from a metallographic point of view. The selected objects include weapons from well-known early medieval sites of international significance, such as an early-8th-century warrior's grave from Enns, but also specimen from less-well known, but just as important sites, for example weapons from the cemeteries of Auhof near Perg and Gusen, or the sword from Schwödiau. These finds in fact circumscribe a closely limited area, which may be equated with the immediate, eastern border of the Bavarian duchy in the Early Middle Ages.

The archaeological complexes selected for this study comprise the two centuries between the Late Merovingian and the end of the Carolingian period, from 700 to about 900 AD. During this period, significant changes in warfare, the type of equipment and the technology of weapons took place. The typological and chronological position of the selected objects will be summarised briefly. Weapons from Avar cemeteries, such as Zillingtal and Leobersdorf, but also Grabelsdorf, Hohenberg, Wien-Leopoldau, Steinabrunn were also studied. Apart from different research questions concerning the development of weapons, this analysis also aims to find out more about the blacksmith's technology in the Austrian region during the Early and High Middle Ages, because – to date – there are no detailed studies of weapons from this region. Assuming that in producing such 'utensils', the smith used all his technological expertise in order to create a functional weapon, we shall attempt to investigate and describe the technology of producing both offensive and protective weapons.

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THE EVOLUTION OF THE STRUCTURE OF VIKING SWORDS. A NON-INVASIVE ANALYSIS OF THEIR MANUFACTURING AND STRUCTURE THROUGH NEUTRON TOMOGRAPHY

Francesco Grazzi

Historical metallurgy is one of the most interesting fields of archaeometry, especially with regards to the production and the use of steel for arms and armour components. In order to correlate similar samples to a specific period or provenance, it is important to build trustworthy classification parameters that do not simply rely on aesthetic features. Scientific and technological investigations into these kinds of artefacts have usually relied on destructive analytical techniques, such as metallography. However, neutron techniques allow the measurement of bulk properties in a non-invasive way with excellent performances. CNR-IFAC (Firenze, Italy), Niels Bohr Institute (Copenhagen, Denmark), The Wallace Collection (London, UK), and the National Museum of Denmark, as well as the MLZ, the ISIS and the SINQ neutron sources have been carried out using such a non-invasive approach.

During the Early Middle Ages in Europe, the manufacture of 'pattern-welded' swords flourished among several populations. Pattern-welded blades were made by welding together several thin strips of iron, phosphoric iron and steel, that were then folded, twisted and forged in various ways, producing a herring-bone or spiral pattern on the surface of the blade. Since the stiffness of the blades and then the probability of a critical fracture were mainly due to slag inclusions, the pattern welding method was one way of making stiff material with mechanical properties that were better controlled. In addition, this technique produced a highly esteemed decorative effect, which made this kind of blades immediately evident.

This type of sword disappeared by the end of the 10th century, as it was discovered that the same results could be obtained through simpler processes. The novel procedure consisted of piling few pieces of iron and steel into a bar and forging them together, without twisting or other elaboration. Such a process produces a strongly differentiated distribution of the steel related phases (ferrite, cementite and martensite) in the different parts of the blade. The composite structure of sword blades from the Viking Age (793–1066 AD) was often obtained with pattern welding technique and represents one of the greatest examples of early metalworking methods.

We analysed three blades from the National Museum of Denmark from 9th, 10th and 11th centuries retrieved from graveyards in Jutland, by using neutron tomography and neutron diffraction. All the blades showed, on the surface, the presence of a pattern welding structure.

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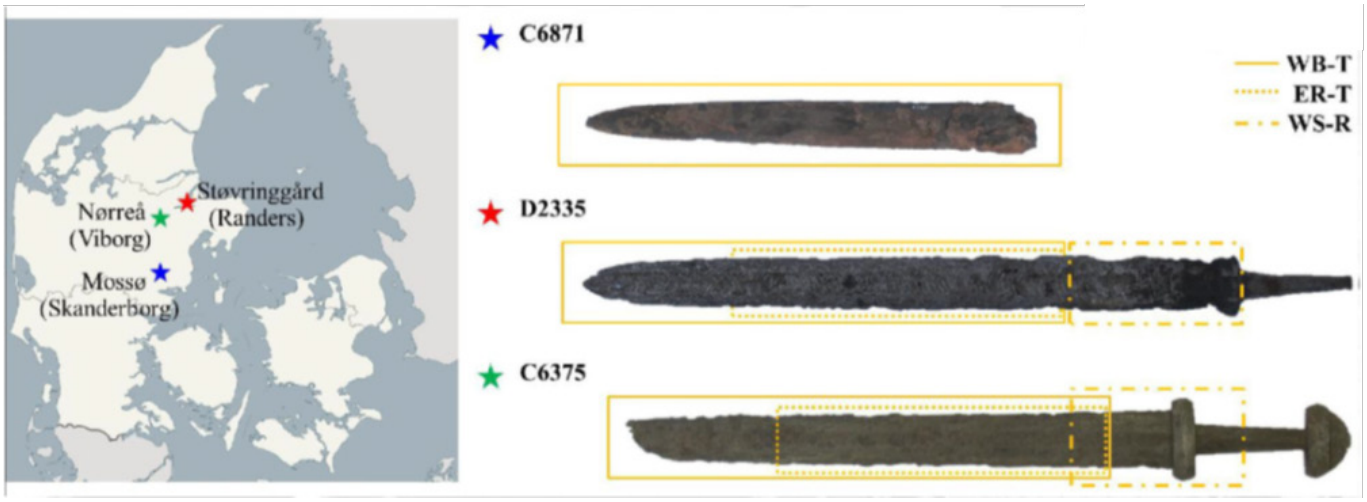

Fig. 1. Left: map of Jutland showing the retrieval areas of the three analysed Viking blades. Right: Pictures of the three blades with highlighted the different areas analysed with neutron techniques

Alas, passivation thermal treatment was applied for conservative reasons on all the three analysed blades so that some features, especially those related to the microstructural and compositional point of view in steel, were lost or heavily altered by the treatment.

The analysis allowed us, however, to obtain information concerning morphological features and spatial mapping of the metal phase relative concentration and details of the main mineralized areas on a full 3D volume reconstruction. The latter were all localized within the pattern welding structure, testifying its scarce resistance to corrosion. The pattern welding morphology of the three blades was completely different from one another together with the combination with the steel stripes on the edges.

The structure of the blades confirmed the structural differences possibly correlated to their provenance and production period. These results allowed us to evaluate the claims in the early chronicles about the superiority of Nordic swords.

We were also able to observe the microstructural features of the welding areas and of iron and steel components. We have found evidence of large single crystal grains in the areas around pattern welding which is quite informative about temperature and time parameters used in forge welding treatments.

We will present our results and possible interpretation of the observed microstructural features. Neutron methods confirmed themselves as an excellent analytical technique for steel artefacts characterization.

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THE SWORD FROM HIMESHÁZA – ORIGIN AND TECHNOLOGY

MÁRK HARAMZA – BOGLÁRKA TÓTH – BÉLA TÖRÖK

In the spring of 2021, a double-edged straight sword, with a special pommel was brough to the Janus Pannonius Museum in Pécs. Although the find was found in Himesháza (South-West Hungary), the exact location of the find place and its archaeological context are unknown. Due to the uncertain provenance of the artefact, a more in-depth examination of the object was necessary.

The well-preserved weapon was certainly buried in the ground. After it was found, its blade and fittings were significantly modified by amateur restoration attempts: the uneven edges of the blade, as well as the guard were grounded, the fuller was filled with an unknown paste, and the entire object was covered with metal lacquer. All of this set limits to the examination of the object and raised doubts about its originality.

After restoration, the shaping of the upper hilt became more visible. The pommel and the upper guard were riveted together, and the ends of the upper guard were curved on the sides of the pommel. This technological solution is closest to the Petersen G-type swords, but at the same time, it cannot be clearly classified into this type. Based on its formal features and metric data, it can be classified as Geibig's 4th blade type, and the closest known analogy is a stray find in the vicinity of Budapest, thus the weapon can be dated between the end of the 10th century and the beginning of the 11th.

In order to inspect the originality of the weapon, and to map its technological features, archaeometallurgical examinations (OM, SEM-EDS) were also carried out at the University of Miskolc, Faculty of Materials Science and Engineering. The basic microstructure of the blade and the pommel is ferrite and pearlite. The EDS examination also provided an answer to the question about the originality of the sword.

Fig. 1. The sword from Himesháza

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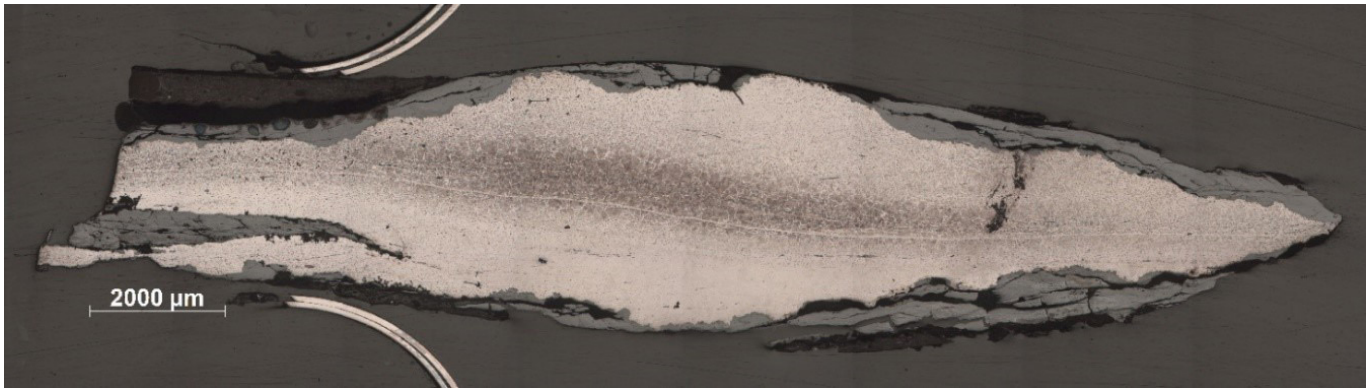

Fig. 2. Specimen of the blade

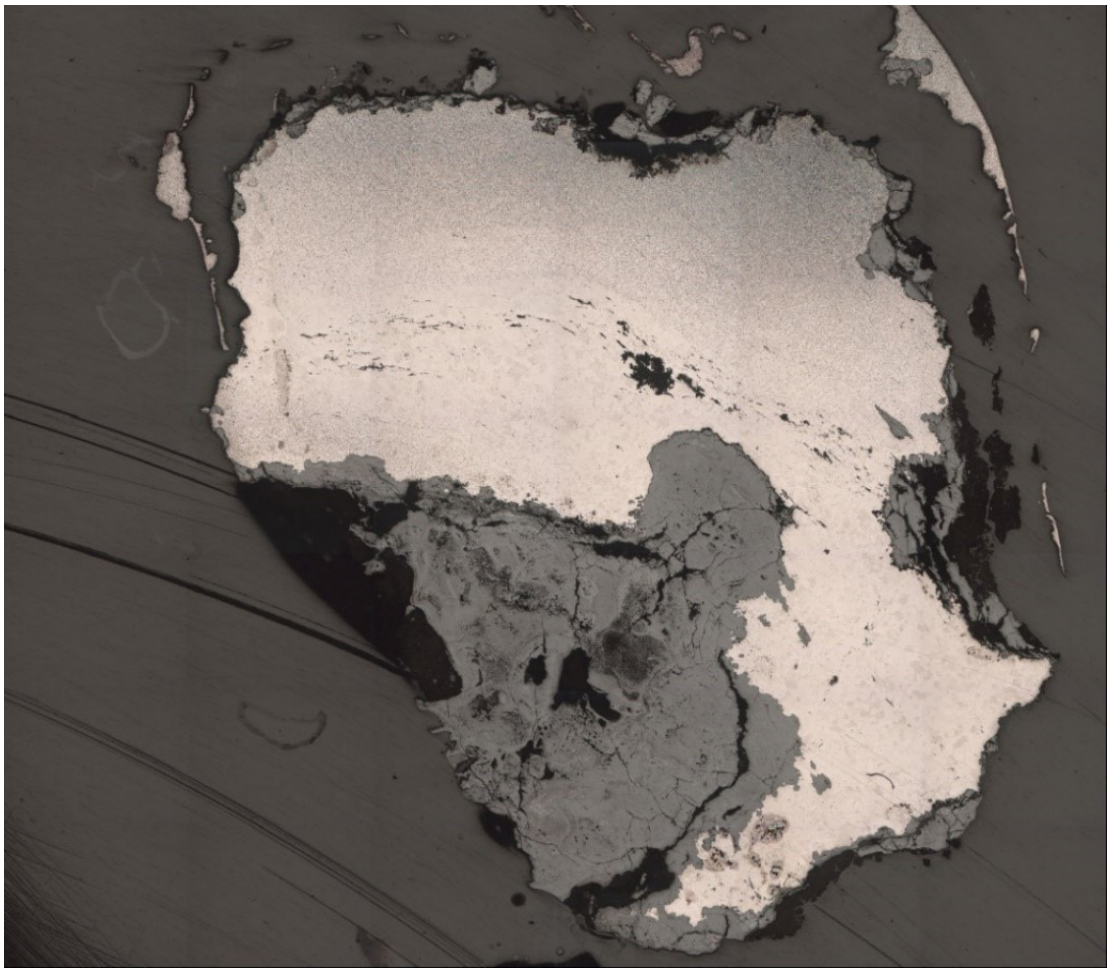

Fig. 3. Specimen of the pommel

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ESSENTIAL CHEMICAL ANALYTICAL TECHNIQUES IN ARCHAEOMETRY

Árpád Rácz

Archeological findings are of great importance to our discovery in history and how different peoples' cultures developed through time. Modern day science provides a vast range of possibilities for gaining more insight into sacred archaeological objects. Due to the value of such findings, the most widespread techniques among these studies include non-destructive X-ray analytical techniques. They can provide information about the elemental composition of the surface and crystal structure through phase identification and complete 3D image.

The technology of different ages and geographical areas implemented different solutions with different materials in many aspects of life. Depending on the technology used at the time, manufacturers fabricated their products in a different fashion. A good example can be observed by inspecting the development of the blacksmith craftsmanship or the use of dyes for ceramics through time. As different eras went by, people used materials of different compositions to forge swords or to make dyes.

X-ray Fluorescence Spectroscopy (XRF) gives chance to study the ratios of the elements that make up the archaeological items without causing any damage in the sample. By knowing the elemental composition used at a specific time of a region, one can conclude the origin of the handcrafted pieces after executing XRF analysis.

Energy Dispersive X-ray Fluorescence Spectroscopy (EDXRF) is a non-destructive measuring method, probably used the most frequently in archaeometry to gain information about what the objects are made of. This technique employs an X-ray with 'continuous' wavelength source that is directed onto the sample, where the X-rays will interact with the electrons of the individual atoms. As a result, characteristic X-rays will be produced by the atoms that make up the sample, which is then detected. The created characteristic X-rays will have a well-defined energy which depends only on the atoms they derive from. A cardinal limitation of XRF is the fact of getting lower signal from the elements with lower periodic numbers, which results in low detection of characteristic X-rays of light elements.

EDXRF instruments come both in portable handheld and benchtop editions. The handheld version has lower excitation energy but it is able to do measurements on site and analyze a wider range of samples. The benchtop machines can produce a higher X-ray output for the measurements but has limitations when it comes to inserting samples and transporting the instrument.

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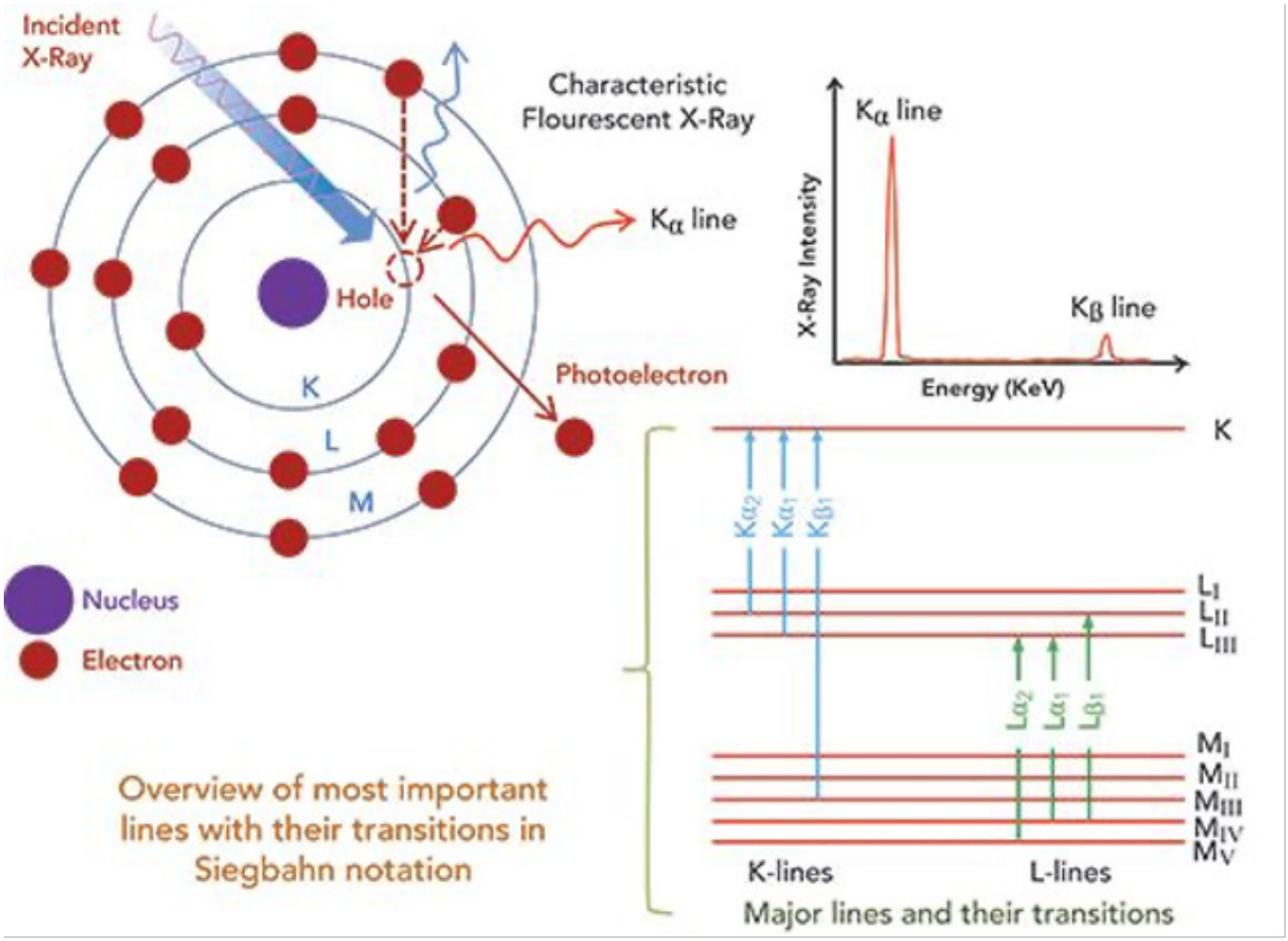

Fig. 1.

A special XRF technique that is getting more attention among archaeologists is the so-called micro-XRF. It uses the same phenomena with the difference of exciting only a small area of the sample. While this gives information of a specific area of the object, it can be used in mapping mode which can give the elemental distribution of elements throughout the whole surface of archaeological relics. Micro-XRF examinations take place in a closed chamber where the measurement can be carried out under vacuum or helium atmosphere which greatly improves the detection of X-rays coming from the lighter elements.

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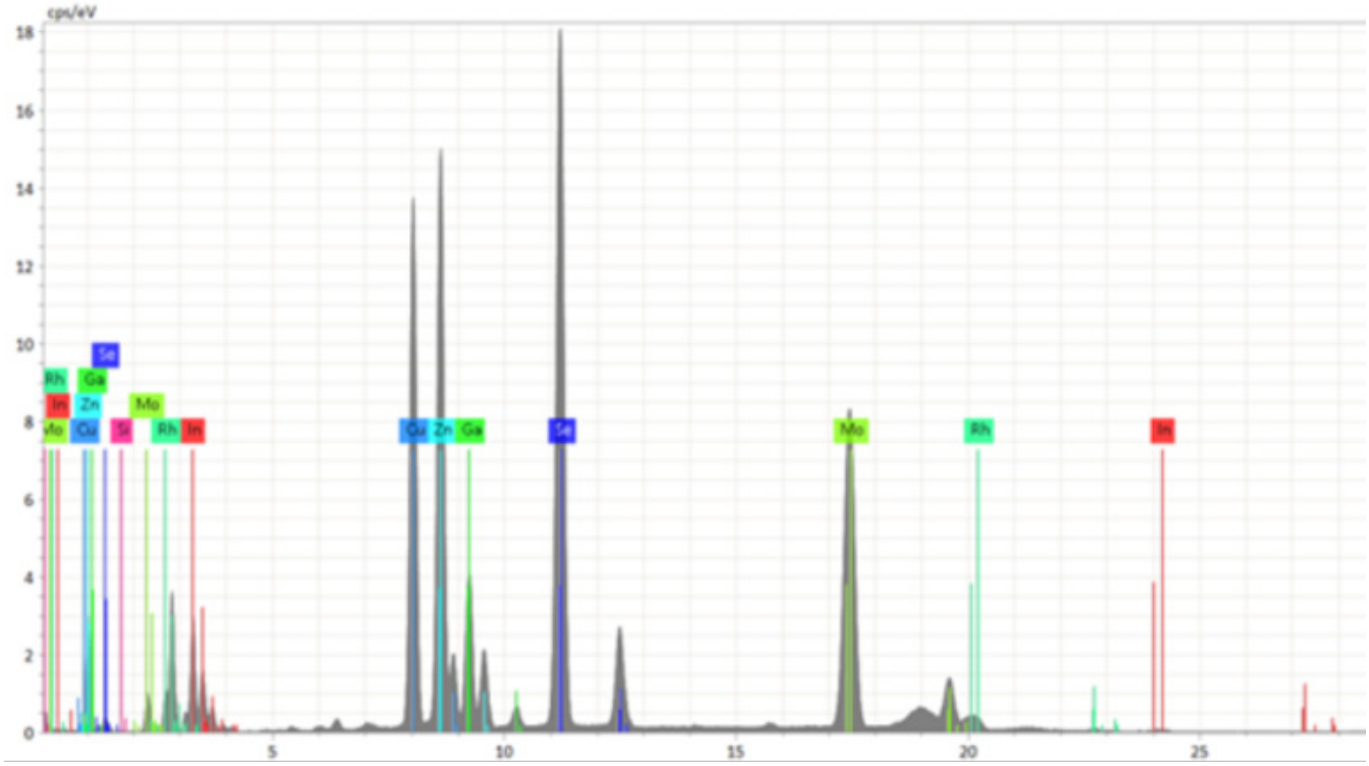

Fig. 2.

Sometimes knowing the atoms present in the sample is not sufficient. Specific elements can take different chemical crystal structures, which in these cases are vital to be separated. X-ray Diffraction (XRD) is a technique that uses a source of "monochromatic" X-ray radiation to shine onto the sample at different angles while it detects the scattered X-rays with constructive interference. This gives insight into the atomic planes and crystal structure of the sample measured.

Just like at XRF, it is also possible to execute micro-XRD by delivering a focused X-ray beam on a very tiny spot of the sample, making it available to focus on the crystalline structure of a specific area on the sample.

X-rays can also be utilized to create complete 3D images of such archaeological findings, called micro-CT or X-ray Microscopy (XRM). The main difference between classical Optical Microscopy and X-ray Microscopy is the wavelength of light used to create the image of the object. Using higher energy X-rays can fully penetrate the sample, granting access to detecting photons coming from inside of the items of interest. As a result, it is possible to construct complete 3D images of these relics, being able to see the inner morphology.

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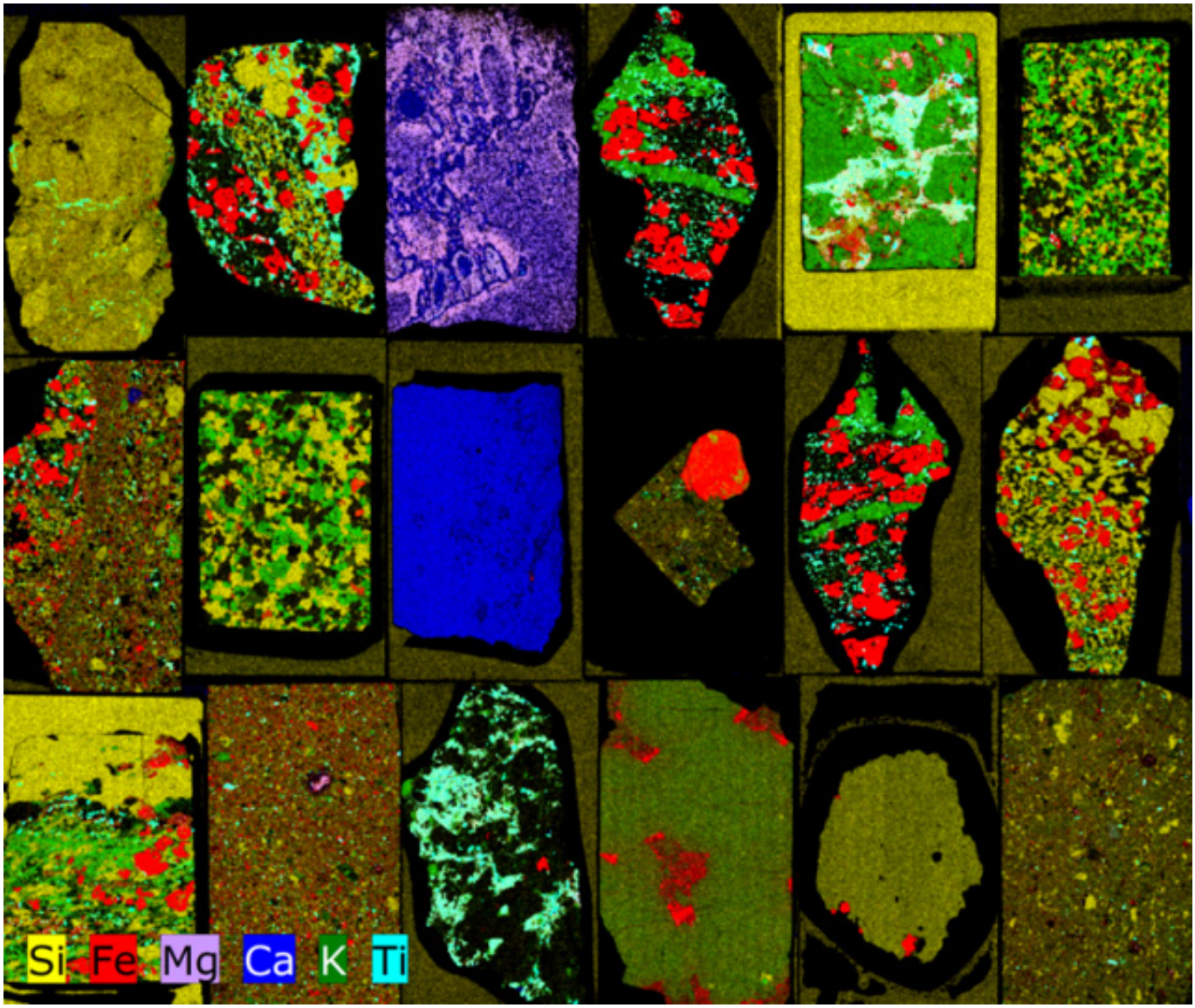

Fig. 3.

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TYPES OF PRODUCTION METHODS OF SWORDS BASED ON METALLOGRAPHIC STUDIES

Béla Török – Péter Barkóczy – Boglárka Tóth

The examination of medieval double-edged swords from the 10th-century Carpathian Basin always has been a significant research area. Despite the popularity of this topic, an interdisciplinary work on this research field is still missing. In 2020, an extensive research project has started in collaboration with associates of the Pázmány Péter Catholic University and the Archaeometallurgical Research Group of the University of Miskolc (ARGUM). In the last two years 20 double edged swords were examined by using archaeometrical-archaeometallurgical methods. Seven from the examined swords are currently preserved in the Jósa András Museum of Nyíregyháza, five in the Szent István Király Museum of Székesfehérvár, four in the Móra Ferenc Museum of Szeged and one in the Hungarian National Museum, the Laczkó Dezső Museum of Veszprém, the Rippl-Rónai Museum of Kaposvár and the Janus Pannonius Museum of Pécs.

The samples, which were cut from the swords, were embedded in epoxy-resin. After the process of grinding and etching, the microstructure of the samples was examined with a Zeiss AxioImager optical microscope (max. 1000X magnification) equipped with a computer-controlled stage featuring mosaic imaging for the examination of the whole surface, and a Zeiss EVO MA10 scanning electron microscope equipped with EDAX energy dispersive spectroscopy (SEM-EDS) to perform elemental analysis. The investigations were completed with Vickers-microhardness test (Intron Wolpert microhardness tester) and energy dispersive X-ray fluorescens spectrometry (ED-XRF – Oxford Instrument X-MET8000). The primary aims of the research are the investigation of the microstructure of the swords' blades, and the determination and comparison of the manufacturing technologies.

Two of the examined artefacts were unsuitable for metallographic investigations but in the case of the other samples, very interesting and various microstructures and manufacturing technologies can be distinguished. The most frequent microstructures, which were found in every sword, are the ferrite and pearlite. However, martensitic-bainitic structure was recognised only in two cases. Based on the examinations, we can state that the most commonly used manufacturing technology is the so-called 'bulk forging'. This means that half of the examined sword were made by hot forging. Similarly, layered structure was often discovered as well, which is the result of folding technology. This kind of manufacturing method was found in six cases, but on the other hand, traces of any kind of heat treatment was detected only in three swords. The term 'heat treatment' is used in terms of microstructure rather than in terms of manufacturing technology.

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Apart from the frequently used manufacturing technology, some special cases were observed as well. One of the most unique methods was observed only in one case (Székesfehérvár – Rádiótelep II. (Bikasziget) grave 36., Inv. No: 5988; Szent István Király Museum of Székesfehérvár) is the cementation *(Fig. 1).*

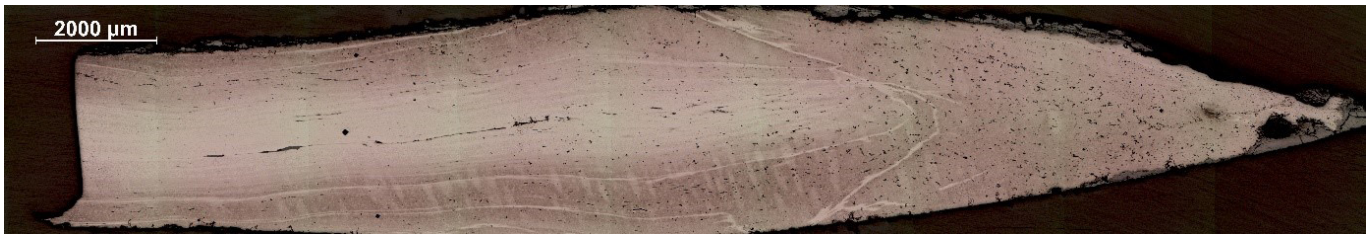

Fig. 1. The mosaic image of the sample from sword of Székesfehérvár with cementation

In certain instances, the above-mentioned manufacturing methods were used together. Very interesting example of such a technology is the sword from Kiskundorozsma (Kiskundorozsma, Vöröshomok-dűlő; Móra Ferenc Museum of Szeged), where folding, welding and some kind of heat treatment (presumably 'slack-quenching') were also observed (*Fig. 2).* Therefore, it can be assumed, that the smith strived to achieve a quality work by using this 'technological hoarding'. Nevertheless, such swords were also found being made by using only one method, for instance, the sword unearthed at Újfehértó-Micskepuszta, East-Hungary (currently preserved in the Jósa András Museum of Nyíregyháza; Inv.No.: 66.47.1.). This sword was made without using any special technology but hot forging, thus, this sword is probably a result of mass production *(Fig. 3).*

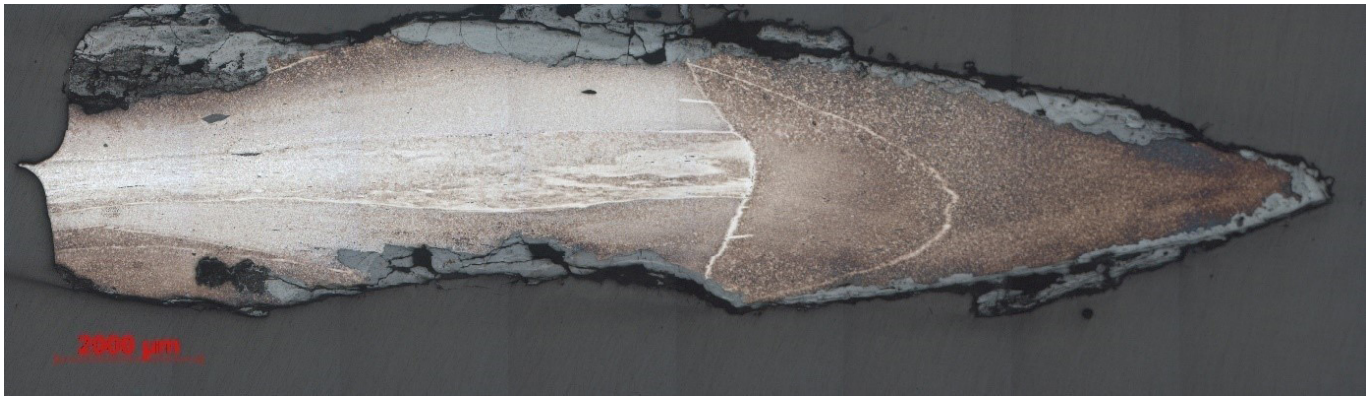

Fig. 2. The mosaic image of the sword from Kiskundorozsma

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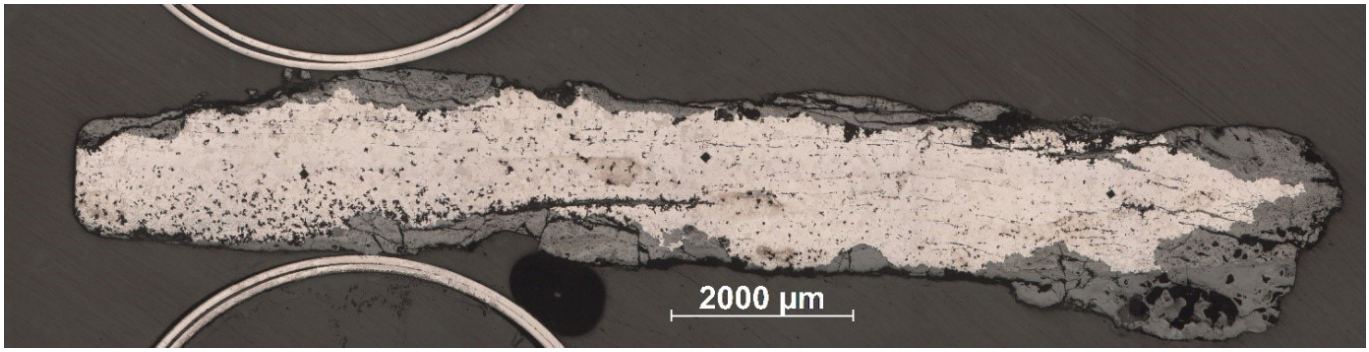

Fig. 3. The mosaic image of the sword from Újfehértó-Micskepuszta

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SWORDS AS TRADE GOODS, OBJECTS OF TAXATION AND GIFTS IN EASTERN EUROPE (9TH–12TH C.) IN THE WRITTEN SOURCES

Szabolcs Polgár

From the end of the 8th century a new period began in the trade contacts of Eastern Europe. It was a period of booming trade. In the 9th and 10th centuries, Eastern Europe took part more considerably in world trade than in the earlier centuries. The Khazars played a key role in the international trade since they controlled the main routes. One of them was the North–South route system, the Fur Road, which led from the Eastern European forest zone to Byzantium and the Caliphate (through the Volga–Kama and the Dnieper routes). The other route was the north western part of the Silk Roads. There were many export wares, the most important being furs. The medieval sources, however, also mention swords and other weapons among the export wares. The aim of the paper is to analyse the reports on the weapon trade.

We can divide the sources into two categories: 1) Muslim sources, and 2) the Russian Primary Chronicle. The Muslim sources preserved valuable pieces of information on the trade including the export of weapons. The earliest reports on the trade of swords are in the work of Ibn Khurdadbeh (ca. middle of the 9th century). According to the author, the Rahdanite (Jewish) merchants exported swords from the countries of Western Europe to the East (Asia). One of the trade routes of the Rahdanites led via Khazaria. The same author reported on the Rus'ian merchants who exported swords from the lands of the Saqlabs to the sea of the Byzantine Empire. Al-Muqaddasi (last quarter of the 10th century) wrote that from Volga Bulgaria swords were exported to Khwarazm. The anonymous author of the Hudud al-Alam, a geography from the end of the 10th century also mentioned the export of swords from the centres of the Rus'. The reports of Muslim authors on the eastern export of western (Frankish) swords are demonstrated by archaeological finds from the forest and the forest steppe belt of Eastern Europe, including the main trade routes, the Dnieper and the Volga basins. The western type swords were widely used first of all in the territory of the Rus'. Other Muslim authors (including Ibn Rusta and Ibn Fadlan) usually respected the swords of the Rus'ians and these weapons were indeed valuable in the Muslim world.

Later, in the 12th century, swords were exported from Muslim countries into the northern zone of Eastern Europe. A traveller from Granada, Abu Hamid reported on the peoples of the forest zone (north of Volga Bulgaria) and he wrote that the natives obtained sword blades from Muslim merchants.

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There are a few mentions on the swords of the Rus'ians in the Russian Primary Chronicle (ca. 1113/1116 AD). There is a story on the sword tribute of the Kievan Polianians, who paid tribute to the Khazars. Although there is a hypothesis that in the 9th century the Khazars obtained weapons from the trade centre of the Rus'ians (and other Scandinavians) in Kiev, another solution is perhaps more probable. The swords given to the Khazars predict the victory of the Rus' over them in the future. We can compare this story with another passage of the chronicle. A Rus'ian commander changes weapons with his enemy, a Pecheneg leader, during which the Rus'ian gives the Pecheneg a sword. The scene is loaded with symbolism; to give a sword to the enemy signals a prediction. At the end of the story the Pechenegs were defeated by the Rus' (like earlier the Khazars). This motif is borrowed from northern (Scandinavian) folklore and the chronicle proves that it was known among the Rus' too.

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SECRET(S) OF THE RUS'. PRODUCTION OF AND DEMAND FOR VIKING AGE SWORDS IN THE 'EAST'

Csete Katona

Double-edged swords in the Eastern part of the Viking world (encompassing today's European Russia, Belarus and the Ukraine down to the spheres of the Islamic world) are sporadically mentioned in contemporary Muslim written accounts in connection with the Scandinavian Rus', a hybrid ethnic group mostly dominated by a Northern elite during the course of the Viking Age. The sources, including geographical literature and scientific treatises, cover a timespan from the middle of the ninth century up to the middle of the eleventh. Aside from highlighting the importance of swords in Rus' society and warfare, Muslim authors report on the excellence of these weapons, the high demand for them in the trade market as well as their production centres and manufacturing techniques.

Immense scholarship exists on the historical traditions and composition of the geographical works to be discussed; ibn Khurradādhbih, the Jayhānī and Balkhī traditions, ibn Faḍlān and the *Ḥudūd al-'Ālam,* whilst revealing texts of Islamic sword manufacture, most famously that of al-Kindī and al-Bīrūnī also received ample attention. Their information on Rus' and Frankish swords, however, was only viewed in isolation regarding specific issues, such as the location of the mysterious Rus' town of Arṭā, the trade of weapons in Eastern Europe or the classification of Islamic sword types. Alternatively, they were combined in more general surveys on Germanic swords, such as those of Zeki Validi Togan or Hilda Ellis Davidson.

The present talk seeks to take a methodologically different approach. First of all, the sources' information, after being cleansed of textual borrowing and other fallacies, shall be presented in a chronological order. Combined together, striking features concerning the demand for and production of Rus' swords unfolds from these brief remarks. Who buys, sells and produces double-edged swords in the East actually seem to show a logical development. The Rus' were likely first importers of Frankish swords in the East, then perhaps buyers of Islamic swords (?), later copiers of Frankish swords, and finally excellent sword producers. If my hypothesis is correct, the establishment (or booming) of specialized workshops in and around Kyiv can actually be dated surprisingly accurately between 978–982 CE.

Secondly, and perhaps more curiously, these tendencies shall be contrasted with evidence from the Western Viking world. Quite in strike contrast with what inferred from the Eastern sources, Scandinavian groups pop up as buyers and seekers, and definitely not as sellers, of swords during the 9tth century as made clear by Frankish capitularies and related sources. Although Scandinavians probably started to produce their own 'Frankish' swords shortly thereafter, Western

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sources, including later Icelandic sagas, are less impressed of their quality: many of the swords seem to be rather stiff or soft. The reverse is being told about the swords of the Rus' during the tenth century: they seem to be excellent products.

Thus, a conclusion prompts itself that some developments in sword production must have occurred within the Eastern parts of the Viking diaspora, but not earlier than the mid-tenth century, possibly even later. Secrets of these techniques must have been classified, perhaps even by deterring foreign intruders with a threat of killing if set foot on the hidden sword producing centre of the arṭānīya. A question for further studies is: how to correlate this information with the archaeological record, and in a wider geographical arena involving the Western spheres of the Viking world?

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THE CURSE OF THE TRADITION. EXISTENT AND OBSOLETE SWORD TYPES IN THE DESCRIPTIONS OF MEDIEVAL MUSLIM AUTHORS

Bence Fehér

Muslim literature of the 9th–10th centuries preserved a few roughly outlined sword typologies, but they describe the individual sword types only briefly, not to mention that these descriptions are sometimes largely at variance with one another. A common feature of these typologies is the trend, to create a canon. According to these, the swords have a certain hierarchy of inner values. In this hierarchy, the so-called 'ancient' types precede the so-called 'recent' types. The authors themselves mention that the denomination 'ancient' do not refer to the real chronology of the swords, but it is simply a synonym for 'excellent', which, however, is a simplistic presentation of the real situation.

According to the medieval descriptions, there are evidently some 'ancient' sword types which were not produced by damascening. Consequently, they were really products of an earlier, or perhaps we can say, 'ancient' technology, and the literary quotations and prominent historical examples which were said to have been of these types, undeniably go back to early times. From the 9th century, a (defective) list of these swords' sale value was preserved by Kindi. According to Kindi's typology, prices of the 'ancient' swords were irrationally high, many times surpassing those of 'recent' swords. However, being not made from damascene steel, they must have been of inferior quality, compared to the most prominent oriental wares.

There is a reasonable explanation, which counts with two 'psychologic' factors, which could work against economic reality. On one hand, 'ancient' swords were overestimated, as traditions were so strong that these types were raised on the top of the canonized hierarchy despite being technically inferior. On the other hand, the rarity of these swords added much to their sale value. Clearly, this indicates that such 'ancient' types hardly existed at all in the 9th century, at least in the real sword market, although even later, the 10th century authors are most eloquent on the topic of the qualities of these ones.

A typical example is the type called *qala'ī,* the longest known early medieval double-edged Arabic sword. Fundamentally false information about their origin and special qualities were circulated in the 10th century, although earlier it was well known that this type had much in common with the early European swords (mostly Byzantine, but the Muslim writers mentioned the Rus-Viking and Slavic blades separately; it is another interesting feature that they never mentioned, as far as I know, the Frank and Avar weapon types). Originally, this name referred most probably to the technology, showing in itself that the type was earlier than the damascene steel swords; but then, the authors tried various etymological hypoth-

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eses, including one, according which the name would have referred to its Malayan origins. In all probability, in the 10th century the *qala'ī* swords were totally eliminated from the actual use and market, receding before the moderner types, which were of better quality. The conclusion we must draw is not a hopeful one: we may use the 10th century Muslim sword descriptions only cautiously, because seemingly they speak about their era, but in fact they are mostly relevant on the earlier, 'ancient' periods.

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WEAPONS AND MILITARY EQUIPMENT IN THE BALKANS IN THE 11TH CENTURY (INTERPLAY OF SCANDINAVIAN AND BYZANTINE EXAMPLES)

VALERI YOTOV

Determining the origin of Scandinavian and Byzantine weapons and equipment depends on the analysis of written sources but also on archaeological finds. The first attempts in this direction were made by the Hungarian Géza Fehér, who in the first half of the 20th century connected his life and professional destiny with Bulgarian archaeology. In the second half of the 20th century, this topic was sporadically examined by Romanian and Bulgarian scholars too. In recent decades, the examples of weapons and military equipment in the 10th–11th century from the Balkans have increased and reached several dozen.

According to the author, the interplay of Scandinavian and Byzantine examples of weapons and military equipment can be traced mainly for the 11th century *(Fig. 1)*. In the first half of the 11th century, numerous Scandinavian mercenaries served in Byzantium. They are arrived in the empire on the so-called road from the 'Varangians to the Greeks' through the rivers of today's Russia and Ukraine. They served as guards of the emperor as well as in field armies and were named 'Varangians' in contemporary written sources. Through another way, after the Battle of Hastings on 14 October 1066 and the Norman conquest of England, great number of emigrants arrived in the Empire. Among them, Normans, Angles and Danes are mentioned in the written records.

Fig. 1. Varangians and Normans way to Byzantine Empire: by the so-called `Varangian way to the Greeks`; across the Mediterranean

The spread of Scandinavian and Byzantine examples of weapons *(Fig. 2)* and military equipment on the Balkans were located in several areas, including fortresses, battlefields, alongside escape routes from battles and naturally at random, even

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Fig. 2. Some Weapons from Bulgarian and Romanian sites: battle axe; spear head; sword pommels; swords (part is probably from the battlefield south of Drastar in 1087)

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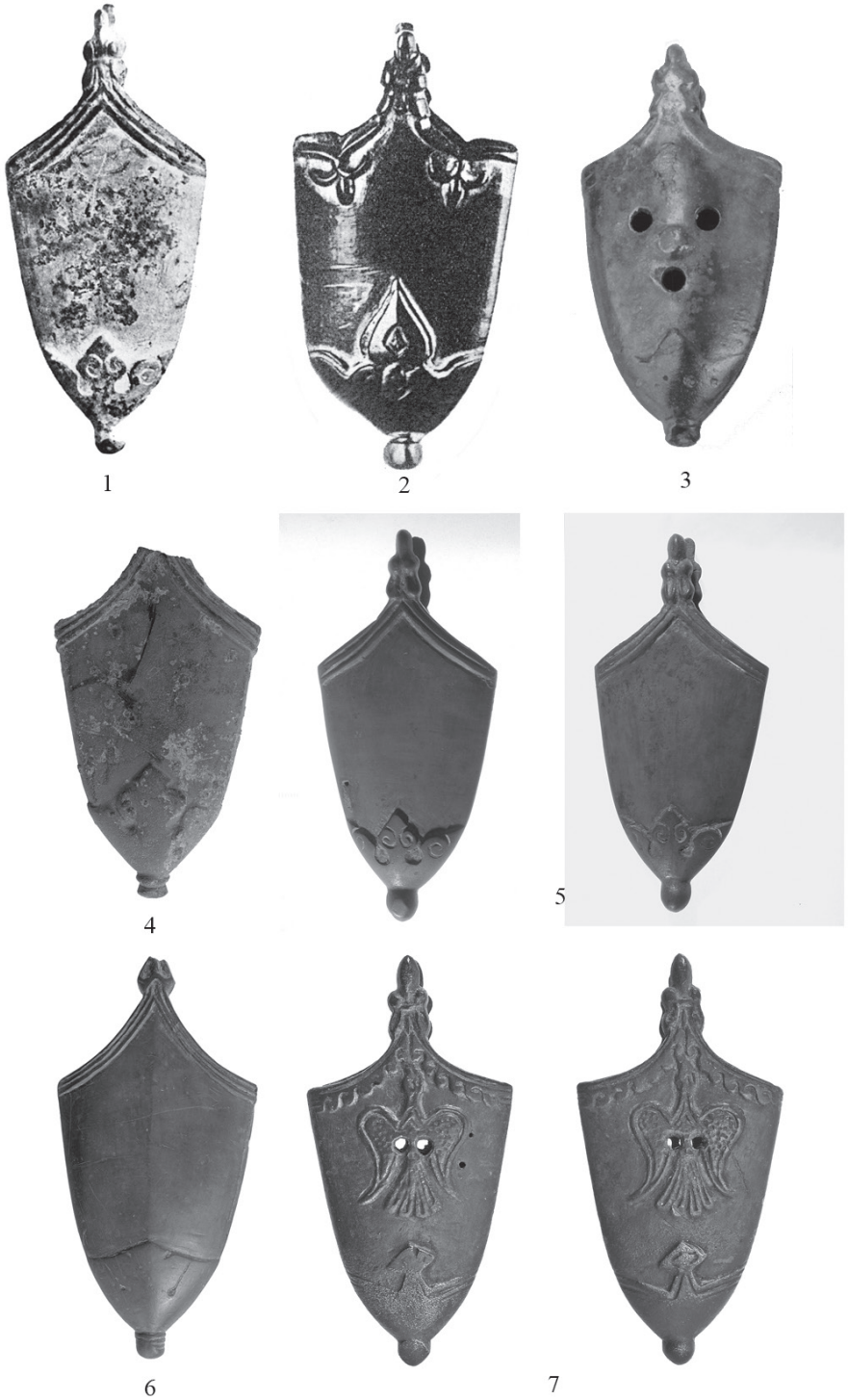

Fig. 3. Some "East Palmete" type scabbard chapes from Bulgaria (part is probably from the battlefield south of Drastar in 1087) – - identified in the literature as local, Byzantine production

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Fig. 4. Stirrups (A) of heavy cavalry (probably from the battlefield south of Drastar in 1087) and parallel (B) from England

obscure places. They fall into the following categories: swords and details of them (pommels, quillions, scabbard-chapes), spearheads, battle hammers, stirrups and some others.

At the present stage of my research, the mutual influences between Scandinavian and Byzantine weapons and military equipment are traced in the so-called 'East Palmete' type of scabbard-chapes belonging to swords *(Fig. 3)* and in specific stirrups used by heavy cavalry units *(Fig. 4).* Other efficient Scandinavian weapons such as battle axes and spears were adopted in Byzantium and are repeatedly mentioned in written sources and are also shown in art. As proposed, the joint service of local military units and Scandinavians in the Byzantine army has led to this interplay and exchange of experience.

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THE SYMBOLIC SIGNIFICANCE OF THE SWORD IN BYZANTIUM

Taxiarchis Kolias

The study of the Byzantine sword has experienced growth in recent years, as existing pieces of the weapon have been recognized as Byzantine. One aspect that has not been discussed enough, is that of the position of the sword in Byzantine society and, especially, of its use as a symbol of power and authority.

References in texts about the presence of the sword in the emperor's entourage are few; there are, however, some depictions that allow us to formulate some ascertainments. According to the traditional Roman model, the sword initially did not belong to the symbols of imperial power. It was, however, gradually included among them. The *spatharioi* were the only ones supposed to carry swords into the imperial court, but from some point onwards the emperor himself appears with a sword. It is interesting to consider the way he is depicted holding or carrying the sword. Through the way the ruler deals with it, the sword symbolized his attitude and his intentions.

The increasing appearance of the sword in coins, miniatures, frescoes etc. should be related to the development of society's interest in the heroic and the warlike, and to the ideological trends from the 10th century onwards. Of particular importance is the representation of the emperor on coins of the 11th century, wearing a martial garb and a sword hanging from the belt. Moreover, emperor Isaakios I Komnenos minted a coin in which he is imprinted with a drawn sword. This weapon has now acquired the symbolic meaning of power and indicates the strength and determination of the ruler. A similar development is to be observed in depictions of military saints during the same period.

The increase of the sword's ideological importance and its emergence as a symbol of power should not be attributed to an influence from Western Europe. The Byzantines already before coming into close contact with Western armies (the crusaders) had deployed a particular interest in warfare. Influence from the West should be dated not earlier than the dominion of the crusading Latin armies over territories of the Empire.

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THE 'KUNÁGOTA SWORD' – MANUFACTURING CHARACTERISTICS AND BYZANTINE CONNECTIONS

Béla Török – Boglárka Tóth – Péter Barkóczy – Péter Langó

Among early medieval double-edged swords discovered in the Carpathian Basin, there are only a few of probable Byzantine origin. One of the most unique pieces of this small but significant corpus of weapons was unearthed at Kunágota, South-East Hungary and is currently preserved in the Móra Ferenc Museum of Szeged. The sword, which has a special sword-guard made of bronze, has been examined by the experts of the Archaeometallurgical Research Group of the University of Miskolc with optical microscopy, SEM-EDS, ED-XRF, and microhardness tests. The primary aim was to study the characteristics of the microstructure of the blade and guard. Another important objective of the investigations was to explore the traces of processing in order to characterize the sword's manufacturing technology.

Through metallographical examination, it was possible to reconstruct the manufacturing process of the 'Kunágota sword'. Three samples were taken from the sword altogether for metallographic examination; two from the sword-guard and one from the blade *(Fig. 1)*.

Fig. 1. The places of sampling

As a result, it can be established that the basic material of the sword-guard is composed of heterogeneous copper-alloy with high lead content *(Fig. 2)*. Theoretically, this bronze sheet could have been casted in two different parts and connected by tin soldering, or perhaps the guard was casted in one piece into a two-part mould (which is technically more justified), while a third part formed its inner core. The examination also revealed traces of a minor contemporary damage on the guard which was repaired with material replacement.

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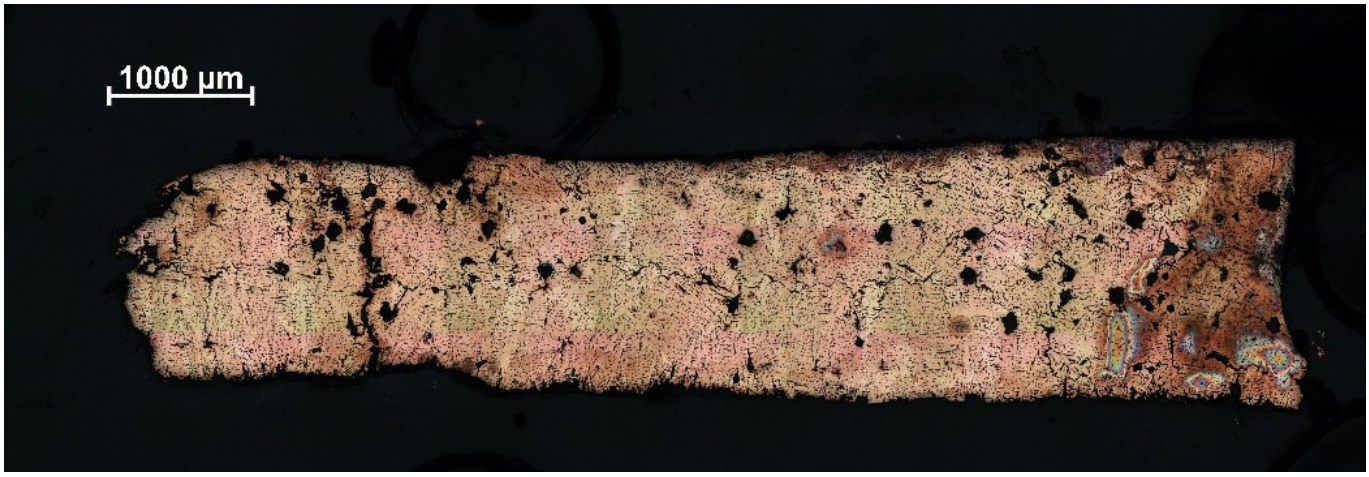

Fig. 2. OM-image of the microstructure of the sword-guard

Regarding the blade, it can be safely stated that it does not have a layered structure and was produced from a single piece of basic material. The entirely corroded edge can be seen in the mosaic image of the sample, where only iron oxide can be found making the edge unsuitable as sample for metallographic examination. Besides the corroded edge, the microstructure of the wooden scabbard is also visible (Fig. 3). However, the microstructure of the blade showed traces of some kind of hardening (indicated by its bainitic-martensitic structure) which can be recognised only at the edge of the sword.

According to our preliminary results, it can be stated that the 'Kunágota sword' is unique in its morphological features and has unusual microstructure. Among the so far examined artefacts, bainitic-martensitic structure, apart from the sword from Kunágota, was observed only in one case of a sabre-hilted sword from Kiskundorozsma.

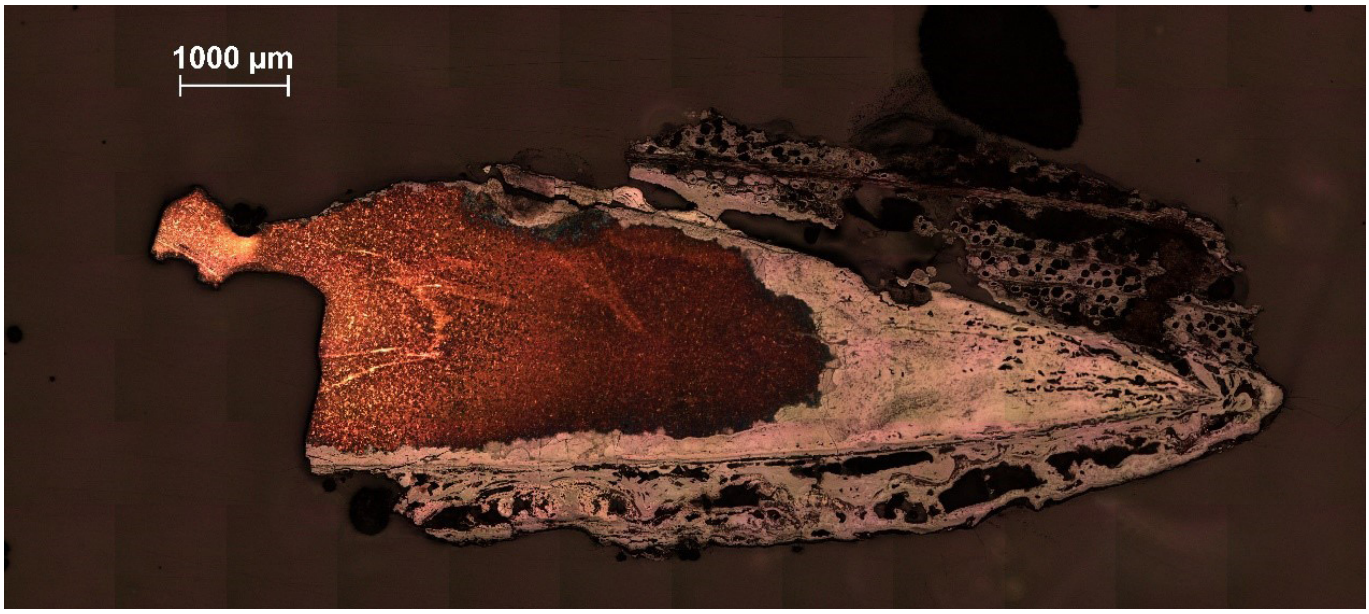

Fig. 3. Mosaic image of the sample of the blade

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PETERSEN TYPE Y SWORD WITH PATTERN-WELDED BLADE FROM RAJHRADI-CE (CZECH REPUBLIC) – EXAMINATION, CLASSIFICATION AND COMPARISON

Jiří Hošek – Jiří Košta

The sword in question was discovered at Rajhradice in 1952 during archaeological excavation directed by J. Král. It was found in grave No. 71 located in the SE part of a large burial ground. Remains of the deceased, orientated W–E, were deposited in a wooden coffin, and the grave goods included the sword with strap fittings, iron forgings with leather belts and textile, spurs and a knife. Based on the archaeological context the sword is dated from the late 9th to early 10th centuries.

The sword is complete though partially damaged by corrosion, its total length is 875 mm today (see *Fig. 1: a, b*). Its pommel is a single-part bulky variant of Petersen Type Y *(Fig. 1. b–c).* The 122 mm long crossguard is straight and in side view has the shape of a long bar, the ends of which are rounded in horizontal view (hence the hilt is the 13-I (13-21(12)-6-11) type in Geib-ig's typology). Nowadays, the double-edged blade seems to be robust and relatively short (735 mm), tapering only slightly to the short and blunt point. The X-ray image shows that the blade was originally roughly 40–80 mm longer: the fuller runs out from the end of the blade, but it narrows before the present point. The fuller is broad (approx. 25 mm), shallow and originally revealed three-row pattern-welding, which is today detectable only in places, and one cannot see it by naked eye. Using X-radiography, the original pattern was described as ZSZ variant, but recently conducted X-ray tomography revealed ZSZ pattern on one side and SZS pattern on the other side of the blade (see *Fig. 1. d*). No signs or inscription were found below the hilt, but the blade is very damaged in this part (the pattern-welded surface panels corroded off). The point of balance is nowadays situated 175 mm from the crossguard, but considering the corrosion dam-age of the blade, the distance had to be originally greater.

For purposes of the metallographic examination, a sample from one edge of the blade was cut out at a distance of 454 mm from the crossguard. The obtained results show (together with X-radiography) that the blade has steel cutting edges welded onto a middle portion consisting of steel core (with uneven and generally lower carbon content compared to the edge) and pattern-welded surface panels (comprised of three rods on each side) (see *Fig. 1. e–f*). The blade was quenched selectively in cutting edges, the hardness of which reaches 501±48 HV (the metallo-graphic structure consists of tempered martensite and pearlite).

The use of steel in both the core and cutting edges makes the sword a very serviceable weapon. Blades of the other three Petersen Type Y swords held in Czech collections and examined metallographically, were provided with a core of iron and, therefore, they cannot compete with the Rajhradice specimen in terms of achievable strength and stiffness.

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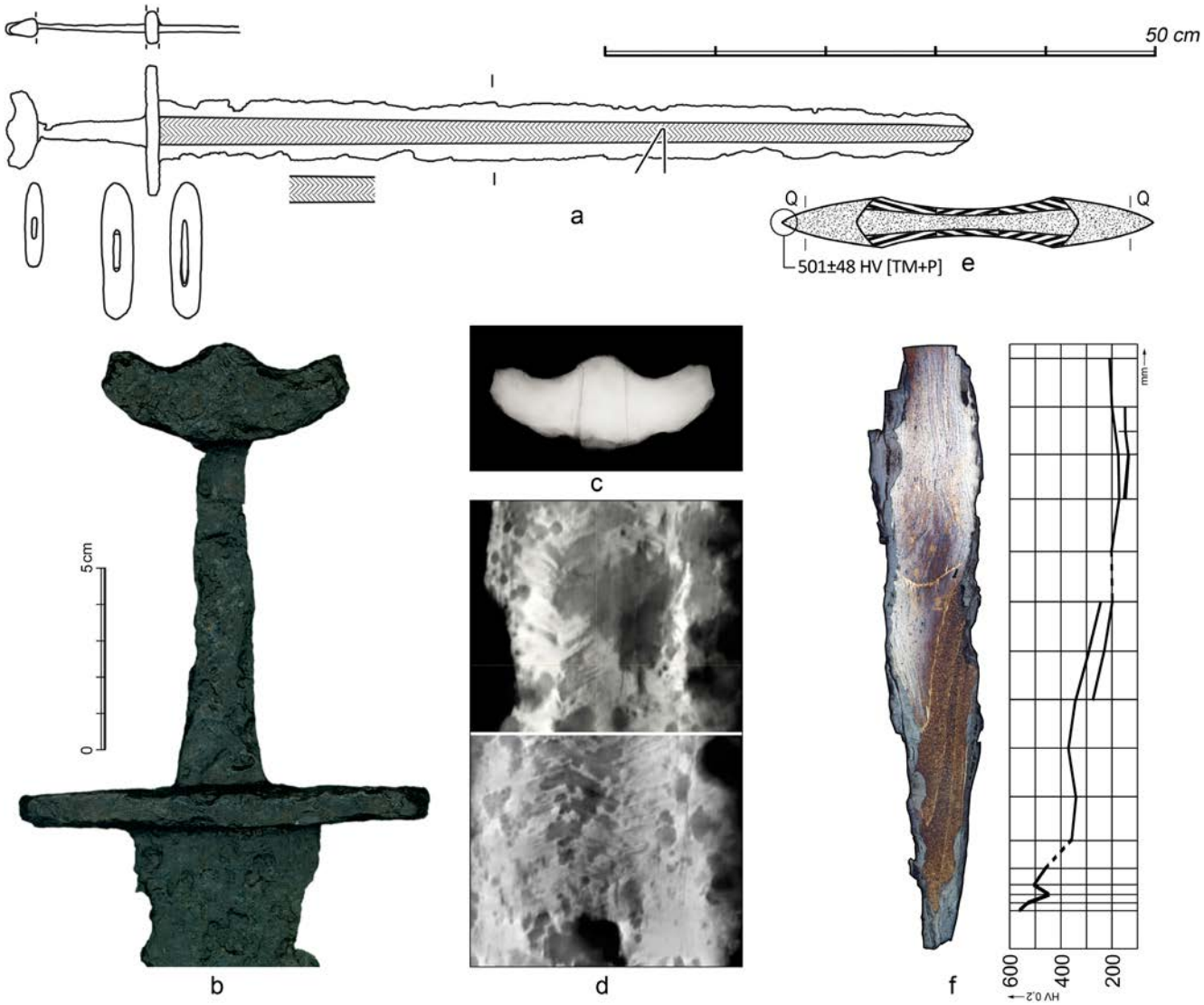

Fig. 1. Sword from Rajhradice; a – schematic drawing of the sword with a marked position where the sample for metallography was taken; b – hilt of the sword; c – X-ray image of the pommel; d – X-ray CT frontal sections of the blade just below the surface; in both cases as seen from outside of the object (thus corresponding to what was originally seen on the blade with naked eye); f – macro-photo of the metallographic sample (after etching with Nital) and hardness-distribution chart

Sword with the simplest blade (consisting of iron core and welded-on edges of steel) comes from Vranovice. More complex was a construction of the blade of sword from Opolany-Kanín (Grave 54); the middle por-tion of the blade consists of surface pattern-welded panels with an iron core in between. Rods of iron are attached to the central part and, finally, other welded-on rods of steel are forming the cutting edges. Difficult to interpret is the blade of sword from Libice nad Cidlinou (Grave 227A). The middle portion comprises an iron core and pattern-welded surface panels. Quite a large rod of iron was welded onto the middle part; however, closest to the genuine cutting edge, traces of quenched steel were also detected. This is a good indication that an effort was made to provide the real cutting edge with steel. Considering that

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the blade is heavily corroded, one can think of the same construction as in the case of the sword from Opolany-Kanín. But we cannot prove it. Some of the Type Y swords excavated abroad were also examined metallographically. Blades of two Type Y pattern-welded sword from Thunau-Obere Holzwiese, Austria, were provided with welded-on edges of steel and iron core, to which the surface pattern-welded pan-els were attached. Hence, these swords correspond to a certain extent to those from Libice nad Cidlinou and Opolany-Kanín. Sword from Gnëzdovo (Barrow No. 88) was not pattern-welded but provided with an iron-inlaid inscription and opposing mark. The core was welded from three strips of steel, the lateral ones having higher carbon content, and the welded-on cutting edges are hypereutectoid steel. Finally, Type Y sword from Rakvere, Estonia, whose blade bears the Ulfberht inscription, was also examined. The obtained results indicate a blade made of a single piece of steel.

The above examples cannot tell us about the main trends in manufacture of blades used for Type Y swords. But they show that at least several constructions were applied and that the blades can vary in terms of achievable mechanical characteristics. At the same time, none of the construc-tions mentioned was used exclusively for Type Y swords.

But let us turn our attention to archaeological issues. So far, eleven Type Y swords were docu-mented from Czech territory. In Moravia, they are relatively rare regarding the overall number of early medieval swords discovered (only four specimens), but in Bohemia represent the most common and, together with Petersen Type X, the only repeatedly encountered standard type of early medieval hilt, documented by seven specimens. The set of Type Y swords registered from Czech territory includes two basic types of upper hilts. The two-part upper hilts, eight in total, predominate. The sword from Rajhradice is equipped by the less frequent single-part pommel. Worthy of mentioning is the extraordinary find of a Type Y sword from Žalov. Its blade is also provided with three-row pattern-welding (ZSZ), and bears a dedication inscription '(ABO) FE-CIT' and a composite geometric mark consisting of a grid and crossbars.

Extremely interesting is the typical character of blades of Bohemian and Moravian Type Y swords, which make them fundamentally different from Petersen Type X swords. Blades domi-nating Type Y swords are those provided with pattern-welding and/or marks and inscriptions. Also, the overall shape of blades of Type Y swords indicates their archaic character compared to most blades of contemporary or older Type X or Type N swords. At least in some cases, the blades used on Type Y swords show such many archaic features that it seems likely that they are not new products but older refurbished weapons.

The find contexts of the Moravian specimens show that the relationship of Type Y swords to the period of the existence of the Moymirid principality was rather marginal. When assessing Type Y swords in connection with the Great Moravian environment, it is necessary to consider that weapons of this type are absent in graves in the centres of Moymirid Moravia, such as Mikulčice, Staré Město-Uherského Hradiště and Břeclav-Pohansko. At the same time, a total of 28 swords (of other types) were found in graves at these fortified settlements and their agglom-erations, which is a sufficient sample. It is possible that Type Y swords were not deposited in graves until the disintegration of Moymirid Moravia at the beginning of the 10th century, which could explain their absence in graves from central sites. The most significant contribution to the question of the advent of Type Y swords is the recent discovery of two pattern-welded speci-mens in Grave 129 and 130 at Thunau-Obere Holzwiese, Austria. Based on both the analysis of the graves and a radiocarbon analysis of the skeletal remains, the swords can be dated to the last third of the 9th century at the latest. Currently, these find contexts are demonstrably the oldest among those with Type Y swords. With regard to the dating of these graves, it should be taken into

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account that the low incidence of Type Y swords in Great Moravian find contexts may not reflect only chronological factors. Type Y swords did not reach Moravian territory (they were not distributed there) or – perhaps more likely, given the overall picture of contacts with the East Frankish realm – these weapons were not accepted by the Great Moravian elites. The swords of Petersen Type X are characteristic of the later stage of Great Moravian culture, often equipped with progressively, albeit with respect to previous ideas, rather atypically constructed long blades and/or provided with displaced fullers. Other finds of Type Y swords in the eastern part of Central, Eastern and Northern Europe are closely associated with the 10th century in both the continental and Nordic environments and their use probably did not significantly extend into the 11th century. The latest find of a Type Y sword dated by a coin is known, again, from the Finn-ish burial ground at Luistari – the burial in grave 15 took place sometime after 991. Indirect evidence of the decline of Type Y swords still before the end of the 10th century is their absence among grave finds in Poland.

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DOUBLE-EDGED SWORDS AND POLEARMS OF WESTERN ORIGIN IN THE TERRITORY OF PRESENT-DAY SERBIA: AN OVERVIEW AND REINTERPRETATION

Milica Radisic

Findings of weapons of western – Late Carolingian origin are not a common occurrence in the territory of today's Serbia. Around twenty examples are known, with approximately half of them being double-edged swords, and the rest axes and spearheads. The weapons are primarily concentrated in Vojvodina and the Serbian part of the Danube valley; these territories represent the furthest south-eastern periphery of the appearance of Carolingian weapons in Central Europe. Items we will discuss here have mostly been already published in catalogues, review papers, or individually in professional articles, but they have not been gathered in one place before. Several of the swords have been analysed by Z. Vinski and L. Kovács in the 1980's and 1990s, and in the meantime, I. Fodor, D. Mrkobrad and M. Aleksić focused their attentions on a number of other specimens of swords and battle axes. Most recently, A. Sajdl wrote about winged spearheads.

The goal of this paper is to provide a complete overview of all the weapons, with their typological and production characteristics, for a wider scientific public and possibly discuss new details where necessary (in accordance with capabilities i.e., current availability of the material). Considering the fact that those were accidental or insufficiently documented findings from graves, there are no conditions for contextual analysis and a closer interpretation of the socio-symbolic role of the weapons. On the other hand, available specimens represent evidence of political events and broader interregional contacts in the period between the 9th and the 11th century. In this sense, pieces with an earlier dating, otherwise few in number, can be interpreted in the context of the expansion of influence of the Carolingian Empire, and indirectly, the Principality of Great Moravia as well, while pieces from the second half of the 10th and the 11th century are thus linked to the expansion of the Hungarian state towards the Balkans.

Along with the standard types of swords well-known throughout Europe, such as types W, X, Y, and Z from Sombor, Novi Bečej, Zrenjanin, Kovin, Vršac, and Banatski Brestovac *(Fig. 1. 1–3),* a special type of double-edged sword has also been documented in Serbia – one without a pommel, with a short rhomboid crossguard. Such are the swords from Horgoš and Batajnica in Vojvodina (Fig. 1. 4), and from Kladovo in Eastern Serbia. Resembling them are two swords from the Jegeniš gravel pit in the Croatian Drava region and one from Ernei in the central part of Romania. Hence, this represents a group of unusual swords from more or less peripheral parts of the Carpathian Basin, which could indicate a special (local?) circle of workshops for production of such weaponry. It is important to note that the aforementioned swords have not yet been considered as an exceptional group of weapons. Another specificity related to this group of findings is the fact that

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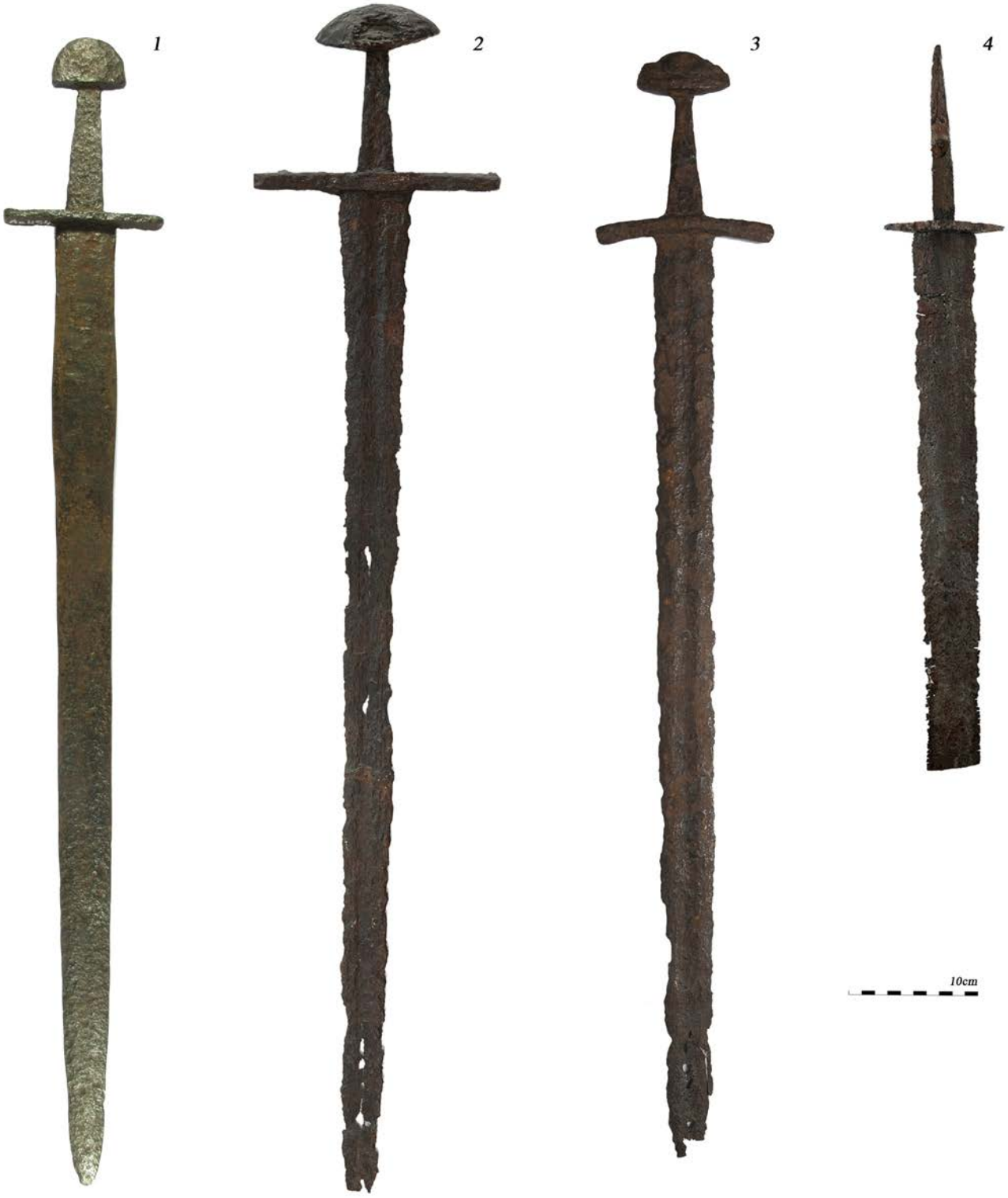

Fig. 1. Swords from Vršac (1), Zrenjanin (2), Kovin (3), Batajnica (4)

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the swords from Horgoš and Batajnica had a bent blade at the time of discovery (the latter was straightened in conservation). Based on the current state of research, it seems that bent weapons represent an extremely rare occurrence in East-Central Europe; to the best of the author's knowledge, there are only two examples from Slovakia which date back to the end of the 10th and the beginning of the 11th century.

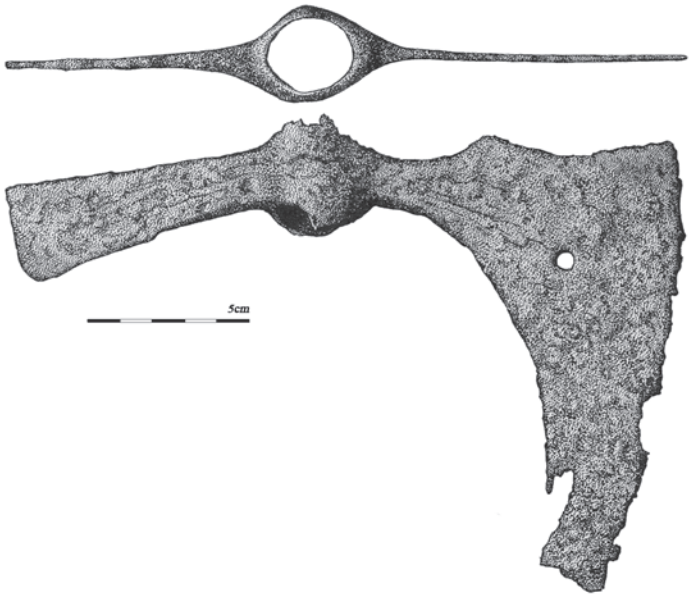

Fig. 2. Axe from Doroslovo

The presence of double-edged Late Carolingian swords in the Carpathian Basin has been interpreted not only through the operations of mercenaries in the army of the Hungarian rulers, but also in terms of a change in the tactics of warfare of the Hungarians themselves. In the context of the mercenary army in the southern parts of the Hungarian state, of significance is the finding of a battle axe of a Kievan-Russian origin, from a partially documented horseman's grave in Doroslovo, Bačka *(Fig. 2).* Some are of the opinion that foreign weapons could have been used by the local army, as well, especially since a slightly higher concentration of swords was observed in the region of Banat, which, according to historical sources, was the location of Ajtony's independent principality, resisting the Hungarian conquest until the first decades of the 11th century. This is all the more probable as the practice of using Western weaponry existed among the Slavic elite of the Great Moravian and Pannonian principalities even before the Hungarian migrations.

Standing out among the findings of spears are the specimens of winged spearheads from Šuljam in Syrmia, and Bačevci in Western Serbia, from the banks of the river Drina. The latter spear holds remains of a wooden pole in its socket, which makes it possible to determine its more precise chronology through a future radiocarbon dating. This makes for a highly favourable circumstance considering the fact that the chronology of the spears is not quite clearly defined, so the datings range across a wide span of two centuries.

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NEW INSIGHTS ON EARLY CAROLINGIAN SWORDS FROM CROATIAN TERRITORIES

Maja Petrinec – Tomislav Šeparović

So far, 10 out of the 18 early 'Carolingian' swords, discovered in the area of the Croatian Principality established in the early 9th century, are recorded and kept in the Museum of Croatian Archaeological Monuments in Split. Some of them have been known for a long time and have been the subject of numerous discussions in Croatian and European professional and scientific literature, most often in connection with the so-called Biskupija-Crkvina horizon. This particularly refers to the three swords from the site of Crkvina in Biskupija that were discovered in graves together with Byzantine gold solidi of Constantine V and Leo IV, as well as to the swords from the sites of Gornji Koljani, Orlić and Morpolača. The presentation will focus on the latest revision excavations carried out at Crkvina in Biskupija, but also in Gornji Koljani and Orlić, which shed more light on the circumstances of the discovery of these swords. We will also point out some new finds of swords and Byzantine coins that complement the current knowledge about this interesting and complex issue.

ORLIĆ (site ZADRUGA) near Knin

Over the last decade, revision excavations have been carried out in the village of Orlić near Knin, at the site of Zadruga. Two early Carolingian swords originate from the site and were purchased for the Museum of Croatian Archaeological Monuments at the beginning of the 20th century. These are the oldest examples of this type of weapon in Croatia so far, which can be dated to the second half of the 8th century. Although we know that they were grave finds, the circumstances of their discovery as well as the wider context of the site itself have remained unknown. Latest excavations revealed an early medieval graveyard underneath mounds and the remains of what is most likely an early medieval settlement. The graveyard and settlement had developed on the remains and in the surroundings of a Roman villa from the 4th century. These are finds that have not yet been registered in Croatian territory within the framework of systematically conducted archaeological excavations.

Fig. 1. Early Carolingian sword from Orlić purchased at the beginning of the 20th century (photo: Z. Alajbeg)

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For this reasons, but also due to the fact that it is located near the significant medieval centre in Biskupija, the finds from Orlić indicate important changes which occurred more extensively at the very end of the 8th and in the first decades of the 9th century. This is precisely the period known as the Biskupija-Crkvina horizon in European archaeological literature.

BISKUPIJA (site Crkvina, Basilica of St. Mary) near Knin

The well-known graves which were discovered in the surroundings of the Basilica of St. Mary in Biskupija at the end of the 19th century have been a subject of interest and research not only in Croatian, but also European archaeological literature for more than a century. As the circumstances of their discovery during the amateur archaeological excavations remain vague and unclear, but also because of the lack of documentation, we have a great many different and often conflicting interpretations regarding the interrelationship between the graves and architecture, but also discrepancies in their age determination.

In 1974, Ulrika Giesler published a significant paper on this subject, in which she, based on the graves in Biskupija that were well-dated by coins, identified an entire horizon with a related archaeological inventory, marking it as the horizon of Biskupija-Crkvina. The horizon was defined by grave finds from Croatia containing Carolingian weapons and equestrian equipment and Byzantine gold coins of Constantine V Copronymus and Leo IV, which the author considered relevant and of value in their dating. Although the conclusions she has reached at the end of the last century have been criticized, relativized and often completely contested from various aspects, the latest finds in the territory of Croatia confirm their correctness.

Fig. 2. Remains of an early medieval settlement in the surroundings of a Roman villa (photograph: R. Maršić)

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Fig. 3. View of site Crkvina (St. Mary) in Biskupija (photo: Z. Alajbeg)

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The reconstruction of the original situation on the site was possible through the latest archaeological excavations (carried out between 2012 and 2019) as well as some previously unknown archival data. Based upon this, it can be concluded that all the graves with Carolingian weapons and equestrian equipment predate the construction of the Basilica in Crkvina, while one grave in a sarcophagus dates to the time of the construction of the church itself. Revision excavations that were carried out in the period from 2012 to 2019 at Crkvina revealed the remains of a damaged grave, which was situated in the immediate vicinity of one of the earlier burials with Carolingian spurs, the remains of which were also identified and precisely documented. Both graves were discovered in the area of the extension of the Basilica of St. Mary, i.e. under its walls, thus making it evident that they predate the structure. The same can be assumed for the known graves south of the church.

GORNJI KOLJANI (the sites Crkvina, Vukovića most) and DONJI KOLJANI (Slankovac) near Vrlika

Early Carolingian swords originate from three different sites in the area of the villages of Gornji and Donji Koljani, which today are completely or partially submerged by the reservoir of lake Peruča. Site Crkvina in Gornji Koljani was also explored by amateurs at the end of the 19th century, when it was mostly devastated. The latest archaeological excavations, along with several photos from the archives of the Museum of Croatian Archaeological Monuments, allow for a new interpretation and rectification of incorrect information which has been repeated in the literature for more than a 100 years.

The find from the site of Vukovića (also part of a smaller graveyard with row graves) as well as the most recent find of a sword from Slankovac complement the knowledge about the importance of the Vrlika area at the time of the formation of the Croatian Principality.

Graves of the Biskupija-Crkvina horizon and finds of gold solidi of Constantine V

The latest finds from Vaćani near Bribir and Bojna near Glina confirm the validity of the dating of graves with Carolingian finds and gold Byzantine *solidi* to the period of the last decade of the 8th century and the first two decades of the 9th century. By establishing a connection between the graves from Biskupija and some other graves with finds of weapons and equestrian equipment to the rich female burial from Trilj, which also contained coins of Constantine V and Leo IV, we can conclude that the majority of female graves with finds of gold and silver jewellery can be attributed to the Biskupija-Crkvina horizon. In addition, all finds of late Avar and post-Avar items from the area of present-day Dalmatia also belong to the Biskupija-Crkvina horizon.

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Fig. 4. View of site Crkvina in Gornji Koljani (photo: A. Jurčević)

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EIN KAROLINGISCHES SCHWERT AUS MURAKERESZTÚR-KOLLÁTSZEG (UNGARN, KOM. ZALA)

Róbert Müller

In 2020 kam in einer Schottergrube des Grundbettes des Flusses Mur in Murakeresztúr-Kollátszeg das Fragment eines ursprünglich vollkommenen Schwertes ans Tageslicht. Es handelt sich um einen Typ K nach Petersen. Die untere Hälfte der Klinge fehlt, aber der Griff blieb unversehrt. Die Parierstange ist relativ kurz, die Knaufkrone besteht aus fünf Lappen, die mit Furchen abgeteilt wurden. In den zwei inneren Furchen blieb der Perldraht aus Messing erhalten *(Abb. 1)*. Die Klinge wurde beiderseitig mit einem tauschierten griechischen Sohlenkreuz verziert. Die Füllung fehlt. Es konnte sich um Silber oder ebenfalls um Messing handeln.

Der Typ K ist eine charakteristische karolingische Waffe des 9. Jahrhunderts, der in ganz Europa von Irland durch Skandinavien bis Dalmatien verbreitet war *(Abb. 2)*. In Ungarn ist aber dies das erste Exemplar. Der Besitzer des Schwertes war aller Wahrscheinlichkeit nach Mitglied der militärischen Begleitung von Pribina, der sein Sitz in Mosaburg (heute Zalavár-Vársziget) hatte, und seine Grafschaft reichte bis zur Drau. Die Mur änderte öfters ihr Flussbett in den vergangenen Jahrhunderten. Der Besitzer kam um oder er verlor seine Waffe als er die Fähre durch die Mur überqueren versuchte.

Abb. 2. Der Knauf des Schwertes von Murakeresztúr-Kollátszeg

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Abb. 1. Die Verbreitung des Schwert-Typs K. Roter Kreis: Fundort des Schwertes von Murakeresztúr-Kollátszeg

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COMPLEX EXAMINATION PROJECT OF THE SWORD FROM MURAKERESZTÚR-KOLLÁTSZEG

Boglárka Maróti – György Káli – Béla Török – Péter Barkóczy

The Carolingian sword in this study was dredged out from the gravel in Murakeresztúr-Kollátszeg by a work machine in December 2020. The length sword is 578 mm, including the handle and the damaged blade. The sword is considered a rare, unique find in Hungary.

The first experiments using Delta Premium and Oxford Instruments Met8000 handheld ED-XRF spectrometers took place in the Hungarian National Museum, after the cleaning of the object by a professional metal restorer. The surface composition results already implied that the blade and the pommel is made of iron with manganese and nickel content, while the inlays of the pommel are made of brass.

Considering the uniqueness of the artefact and the archaeometallurgical questions – What is the raw material of the blade? How was it produced? What was its function? – a complex examination protocol was proposed *(Fig. 1)* to answer all the questions with the least amount of invasive sampling on the object.

The neutron-based measurements took place in the Budapest Neutron Centre (BNC). Prompt gamma activation analysis (PGAA) was used to determine the alloy composition non-destructively. PGAA is based on the radiative neutron capture reaction, and since the neutrons and the emitted gamma photons are highly penetrating, this technique provides the bulk alloy composition of the whole irradiated volume. Besides iron, the blade contains 620 ppm cobalt, 400 ppm manganese and 700 ppm nickel.

Time-of-flight Neutron Diffraction (TOF-ND) is capable to provide information on the crystalline structure of the artefact to identify the phases, as a complementary non-destructive technique to PGAA. The edge of the blade contains ferrite, martensite and cementite phases. The estimated amount of carbon is 0.9%.

The metallography measurements were performed by the Archaeometallurgical Research Group of University of Miskolc (ARGUM). The damaged end of the sword was selected for sampling to perform the metallography experiments. The prepared sample was examined by optical and scanning electron microscopy equipped with energy dispersive spectrometry (OM and SEM-EDS). This part was analysed with TOF-ND earlier, thus, the results from the non-destructive bulk structural characterization and the spatially much finer and detailed phase and texture analysis on the thin section can be compared on a more well-founded basis. The preliminary information provided by the TOF-ND spectra can be modified (e.g. the volume and composition of martensitic fraction), clarified or completed by microscopic metallography.

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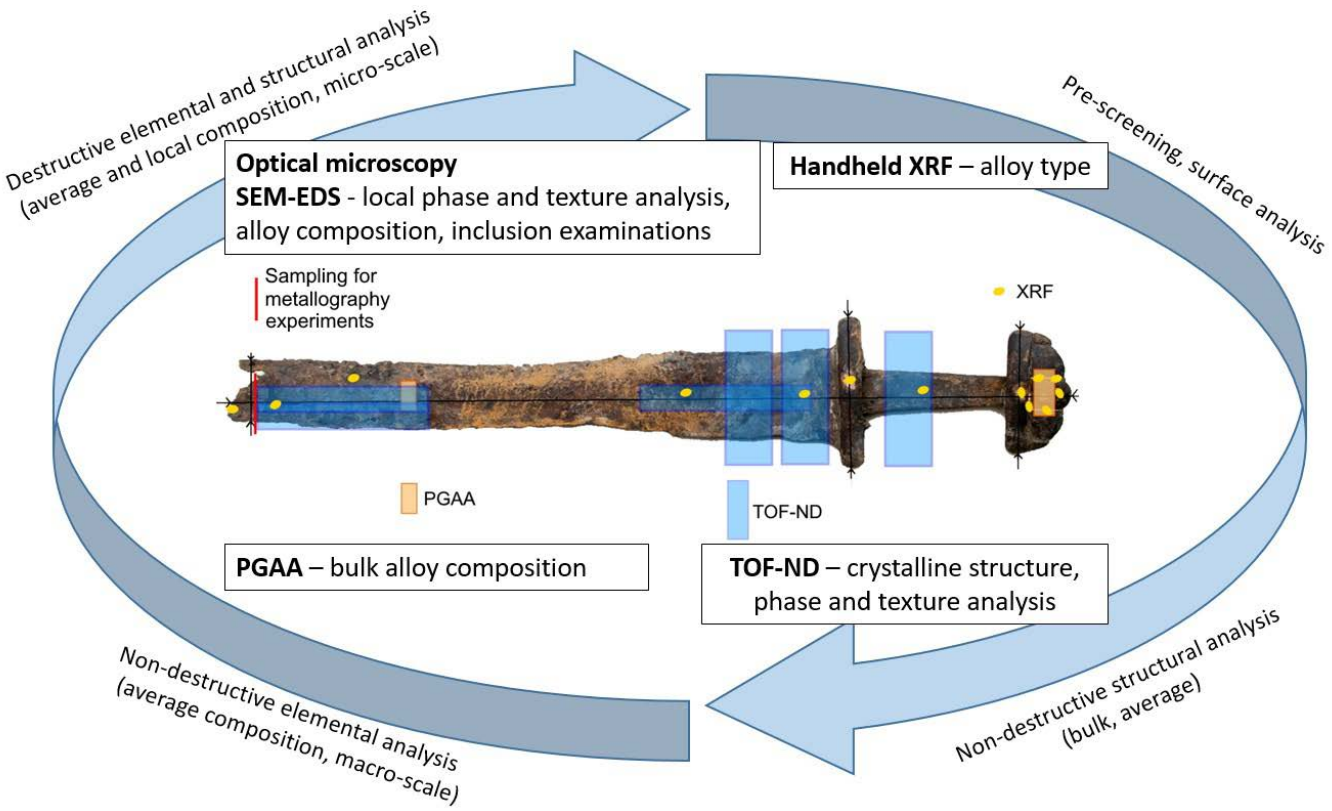

Fig. 1. Non-destructive and destructive techniques used in the complex characterization of the Carolingian sword.

The optical microscopy and SEM analysis revealed that the middle of the blade was folded and shows layered structure. The edge of the blade was formed from the same material – this was confirmed by inclusion studies carried out with SEM-EDS – though these underwent different metalworking process. The metallography results confirmed the presence of very fine needle-like martensite, located only at the very edge of the blade. The carbon content varied between 0.8–1%, in good agreement with the TOF-ND result. The inner part is ferrite-pearlite and a slight Widmanstätten character could also be observed. Ferrite is present in small amounts; the cementite content of the middle part is lower than the edge.

The examination series was complemented with Vickers hardness measurement to have more information on the mechanical properties of the blade.

In this presentation the advantages and limits of the used methodology is detailed, discussing also those questions that can be answered properly only by using techniques that require sampling.

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SCHWERTER UND MÜNZEN – FRÜHMITTELALTERLICHE GRÄBER IM KARPATENBECKEN MIT SCHWERT- UND MÜNZBEIGABE

PÉTER PROHÁSZKA

Frühmittelalterlichen Gräbern mit Münz- und Schwertbeigabe erscheint in Europa nur sporadisch und zeigt eine unterschiedliche Intensität. Neben den Bestattungen von Birka konnten zahlreiche Münzen beobachtet werden, bei denen es sich ausnahmslos um arabische Dirhems handelt. Am Adriatischen Meer, in Biskupija, wurden Bestattungen mit byzantinischen Solidi des Kaisers Konstantins V. (751–775) freigelegt, die im Vergleich zu den anderen Beigaben eine Diskussion bei der Datierung der Gräber auslösten. Zu diesen gesellt sich eine vor einigen Jahren entdeckte Bestattung eines Kriegers mit gleicher Münze aus Zalavár. Nach der ungarischen Landnahme kommen die Münzen als Beigabe oder Schmuck in den Gräbern etwas häufiger vor. Aus dieser Zeit kennen wir aus dem Karpatenbecken allerdings nur einen Grabbefund, in dem die Beigabe von Schwert und Münze zusammen vorkommen. Es handelt sich dabei um das Grab von Kunágota *(Abb. 1),* in dem sich neben einem byzantinischen Schwert gelochte Silbermünzen von Romanos I. (920–944) befanden. Aus der Sicht der ungarischen Archäologie ist das 2002 freigelegte Grab von Kiev, Alexander Nevsky Kirche, Velyka Zhytomyrska Strasse 2 *(Abb. 2),* besonders interessant: Im Kammergrab lagen neben dem Skelett ein Schwert, ein Eimer, eine beschlägverzierte Ledertasche, darin vier byzantinische Kupfermünzen von Basileus I. (867–886), Leo VI. und Alexander (886–912) und Konstantin VII. (913–959). Über dem Grab kam ein Köcher mit Pfeilspitzen zum Vorschein. Das Grab zeigt enge Kontakte mit dem landnahmezeitlichen Funden aus dem Karpatenbecken. Die beigelegten Münzen haben aber bisher keine Parallelen im Münzverkehr dieser Zeit. Im Vortrag werden die Gräber aus Mitteleuropa mit Schwert- und Münzbeigaben vorgestellt und evaluiert.

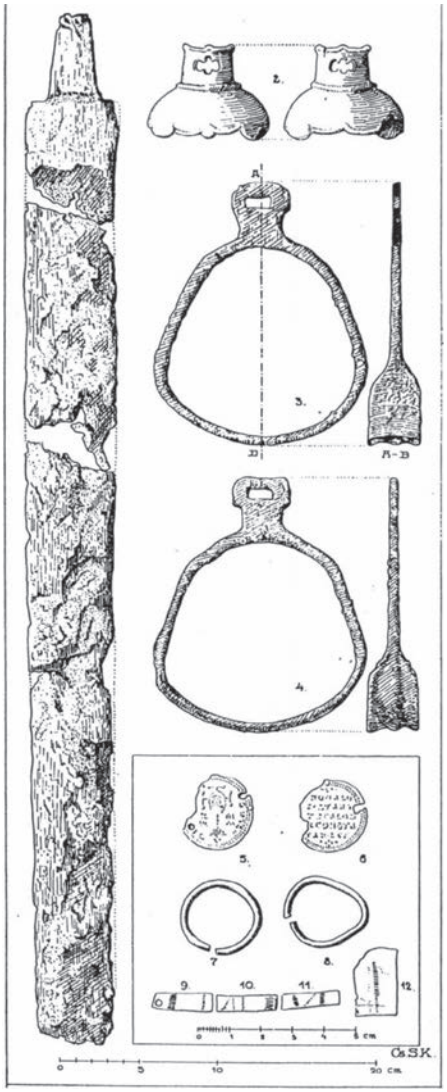

Abb. 1. Die Beigaben des Grabes von Kunágota (Kom. Csongrád/H)

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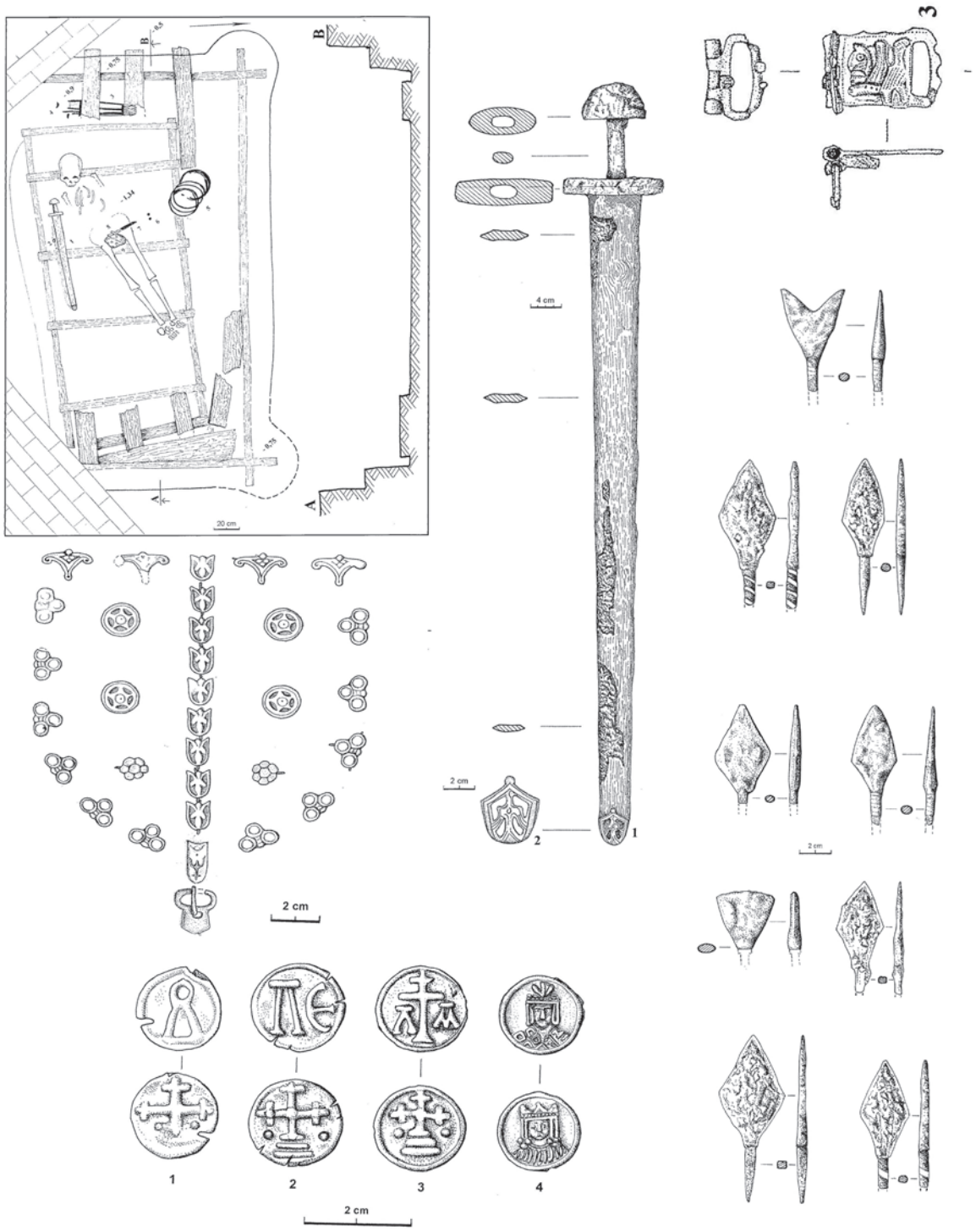

Abb. 2. Das Grab von Kiev, Velyka Zhytomyrsja Strasse 2 und seine Beigaben

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SWORDS AND SPECIAL STRAIGHT BLADE WEAPONS IN THE CARPATHIAN BASIN DURING THE 10TH–11TH CENTURIES

Bertalan Zágorhidi-Czigány

During the 20th century important archaeological studies were published in Hungary regarding the 10th–11th-century double-edged swords of the Carpathian Basin. However, it is necessary to continue this great work alongside the methods and research possibilities of the 21th century. Since 2020, our PPCU research group (in co-operation with several partner institutions) specifically focuses on the topic.

Besides the modern documentation of the previously well-known finds (planned to be published in an encompassing catalogue), we are turning attention for some hitherto not or not-satisfactorily discussed aspects of the corpus. Apart from the 'classic' double-edged swords which have primarily Western European, or in some cases Scandinavian or Rus' origin, several swords of markedly different designs are also known from the territory. Such examples include single-edged swords of wider European and Southern manufacture, as well as later modified hybrid types.

After a concise summary of the main characteristics and chronological attributes of burials including sword deposits, the present talk turns to an intriguing and rarely discussed weapon type; the so-called 'saber-hilted sword'. Our hypothesis, presented in earlier conferences, seems to be supported by new investigations, according to which 'saber-hilted swords' should be classified as an independent weapon type rather sub-types of either swords or sabres, or a hybrid of the two. They existed within a wider chronological and geographical framework, and were created by the modification of straight, double-edged swords of European origin. Interestingly, parallels are to be found not only in the Eurasian territories, but at least in one case from the Baltic region too.

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SWORDS, SILKS AND BEADS. SOME REMARKS ON THE COMMERCE OF THE CARPATHIAN BASIN IN THE 9TH–11TH CENTURIES

Flórián Harangi – Réka Fülöp

In the 7th–8th centuries, the Avar Khaganate was one of the most potent political formations in Central Europe. In the 8th century, Avars united the entire Carpathian basin under their rule. At the end of the 8th century, a foreign and domestic political crisis overturned their rule. Firstly, the military campaign of Charlemagne weakened the Avar empire in 791 AD. According to the written sources – such as the *Annales regni Francorum* – a civil war also broke out within the Avar Khaganate, resulting in some Avars turning against their leaders in 795 AD.

As a consequence of the war, Erich, the duke of Friaul, was able to rob the so-called *hring*, the political capital of the Avar Khaganate, where the treasury was kept. In 796 AD, Pippin, the son of Charlemagne, captured and destroyed the *hring*, the khagan's seat. After the fall of the Avar Khaganate, the previous trade relations were broken. The peoples of the Carpathian Basin were looking for new ways. The Transdanubian region became part of the Carolingian Oriens. This region maintained strong relations with the western and northern territories, like Great Moravia. These strong connections are reflected in the elite graves and their weaponry. The double-edged Carolingian swords are most often found as stray finds. In addition to the elements of the Carolingian weaponry, a Byzantine sword is also known from Garabonc-Ófalu, a heritage of southern long-distance connections. A significant number of elite finds are known, but some types of luxurious products, like silk samite fragments, which are well known from Great Moravia and the Western European treasuries, are absent from the archaeological heritage of the 9th-century Carpathian Basin.

A similar phenomenon is emerging for imported beads. The finest imported beads of the 9th century were produced of plant ash glass. This type of glass and its items were produced under Islamic rule in the glassmaking workshops of the Middle East. They were used to make mosaic and metal foil beads, the appearance of which in graves was a sign of certain social status, since they were uneasy to obtain. However, they spread quickly and over a large area. This is an outstanding example of how quickly the trade reacted to changes and demands of the era. These types of imported beads, however, are extremely rare in the Carpathian Basin. For these too, it is most probable that they were obtained through Carolingian mediation, rather than through their own trade connections. In the Late Avar period, local production takes over the major role, with only raw materials coming to them, which they shape and prepare themselves. By contrast, the proportion of imported beads from the Carolingian, Moravian, and Sopronkőhida-Pitten-Pottenbrunn culture areas is much higher, where we can assume real trade connections. A significant aspect from a commercial point of view is that both the raw ma-

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terial and the imports of beads were supplied to these areas through Byzantine mediation.

Against the Transdanubian region, we have very little information on the central and eastern parts of the 9th-century Carpathian Basin, both from an archaeological and historical point of view. Carolingian rule in the Carpathian Basin lasted until the Hungarian Conquest. The Early Hungarians conquered the Carpathian Basin at the turn of the 9th–10th century. The graves of the Hungarians conquerors form a distinct archaeological horizon. These graves contain some sabres, arrowheads, axes, and other weapons with eastern connections. The connection network of this weapon is extensive, from the territory of modern-day Ukraine to the Caucasus and Iran. In addition to weapons, silk samite remains are often found in these graves *(Fig. 1).* The historical and archaeological sources — data of the Jayhānī tradition and the finds of the Subbotsy-horizon — show that the early Hungarians had already become involved in commerce in the 9th century. The high number of weapons and other luxurious goods in these graves suggest that we can appreciate the early Hungarians as a 'commercial-military consortia'. They already participated in European wars at the end of the 9th century as mercenaries.

Fig. 1. 10th century silk samite fragment from Derecske-Nagymező-dűlő

After the Conquest of the Great Plain, the early Hungarians often led plundering raids over Europe. According to the written sources, they had many opportunities to get hold of such goods during their military campaigns in Western and Southwestern Europe in the first half of the 10th century. These sources suggest that the most valuable booties for these military campaigns were slaves, silk clothes and silver items. We have a detailed description from abbot Leo Marscianus about goods requested as tribute, but he (surprisingly) does not mention the looting of weapons. Nevertheless, the Hungarians certainly had the opportunity to loot swords.

At the end of the 10th century, when these plundering raids finished, a new type of army emerged. These warriors had some western connections in their weaponry; besides the bow and arrows, they often used double-edged swords, which were also placed in their graves. These graves often contain objects that could have come from the Kievan Rus'. So, we cannot be sure whether these swords came from the east or the west.

After the 10th century, the direction of the bead trade changes completely, and the workshops of the Kievan Rus' become the main glass and bead suppliers to the Carpathian Basin instead of Byzantium. The emergence of a new type of beads with eyes and eye lashes in the 10th century, or the appearance of the cylindrical bead with lattice pattern typ-

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Fig. 2. 10th century string of bead from Székesfehérvár-Demkóhegy

ical of the 11th century, are one of the proofs of the close connection with glass workshops in the Kiev region. However, not only is there a trade flow of imported beads, but also a flow of techniques for glass production, with the appearance of wood ash glasses in the Carpathian Basin, which is probably already produced in workshops around Kiev (Fig. 2). There are also similar types in Scandinavian areas, but the similarity in bead material between the two regions is probably the result of trade. It seems that the commercial connections with the Kievan Rus' played an important role in the acquisition of weapons and other luxurious trade goods.

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FROM SABRE TO SWORD. THE SO-CALLED 'WEAPON CHANGE' FROM THE ASPECT OF ARCHAEOMETALLURGY

Márk Haramza – Béla Török

There are several questions surrounding the issue of the appearance of double-edged straight swords in the archaeological material of the conquering Hungarians. However, studies on the subject often date this type of weapon in the second half of the 10th century, and relate it to changes in the political or military organisation of the period. Several factors could cause this shift from 'sabre to swords' in Hungarian weaponry such as the general development of heavy cavalry in the period, the appearance of foreign (Bavarian, Scandinavian or Kievian) troops as allies or mercenaries in Hungary, or the failures of the Hungarian incursions in the middle of the 10th century (Lechfeld, 955 AD). The question, however, has been generalized in research and it is hard to sustain that lightly curved bladed sabres were neglected and replaced by double-edged straight swords.

Thus, the issue affects both the appearance of weapons foreign to the conquering Hungarian material culture, the change in the proportion of troops in the Hungarian army (light and heavy cavalry), as well as the political tensions and changes surrounding the organization of the Christian state.

It seems fruitful therefore to compare the two weapon types, along their mapped technological characteristics. Based on the results of archaeometallurgical research carried out so far, assumptions can be made concerning the use of specific material and certain elements of the manufacturing process of sabres and double-edged swords.

Although the number of investigated specimen is still low, certain trends can certainly be identified regarding the technology of the two types of weapons. The aim of this study is to present new possibilities of interpreting the results of the archaeometallurgical examinations in the light of archaeological and military historical issues.

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THE IMAGE OF THE CARPATHIAN BASIN AROUND 1000

Beatrix F. Romhányi

The analysis of archaeological objects has been the foundation of archaeological research since its emergence in the 19th century. The interpretation of written sources has been of similar importance in historical research. However, the results of the two disciplines, and the narratives emerging out of them were sometimes difficult to harmonize. Narratives are either diverging or subordinated to each other. In recent years, however, the increasingly easy accessibility of digital technologies and the possibility of spatial analysis of large data sets have opened up new dimensions for research. The present paper deals with the spatial aspects of the Hungarian Conquest and the formation of the medieval Kingdom of Hungary, based on the complex evaluation of the spatial distribution of selected types of objects from the 10th and 11th centuries (with special focus on swords and other objects linked to the military elite), of the network of early churches and monasteries, and specific data from written sources as the earliest monastic estates or the so-called 'tribal' place names *(Fig. 1–2).*

From a methodological aspect, the investigation aimed at identifying different indicators that are not or but loosely related to each other (grave goods, settlement findings, charter evidence etc.). The presumption was that the overlapping of different layers can visualise not only the settlement density, but to some extent the settlement hierarchy, as well as the hotspots of political control and of economic activity.

The visualisation of the dataset led to several findings. First, there is significant difference between the spatial distribution of objects linked to the Hungarian Conquest, and that of the basic elements of the 11th-century church organisation. While about 80 per cent of the objects were found outside Transdanubia, the majority of 11th-century rural churches, churchyards, and monasteries (mainly under royal patronage) were in Transdanubia. Furthermore, the monastic estates donated before 1060 AD, as well as five out of eight early episcopal centres were also concentrated in the very same region. Second, the spatial distribution of graves and grave goods linked to the Hungarian Conquest seem to follow the main roads leading westwards from the Great Hungarian Plain and from the Balkan region. Third, neither the distribution pattern of the objects linked to the Hungarian Conquest, nor that of the weapons linked to the military strata overlapped with the distribution of the place names originating from the names of the Hungarian tribes as preserved in the Byzantine *De Administrando Imperio* of Contanstantine VII.

Based on the above statements, it seems to be reasonable to set up a modified model of the kingdom's formation. The main questions are:

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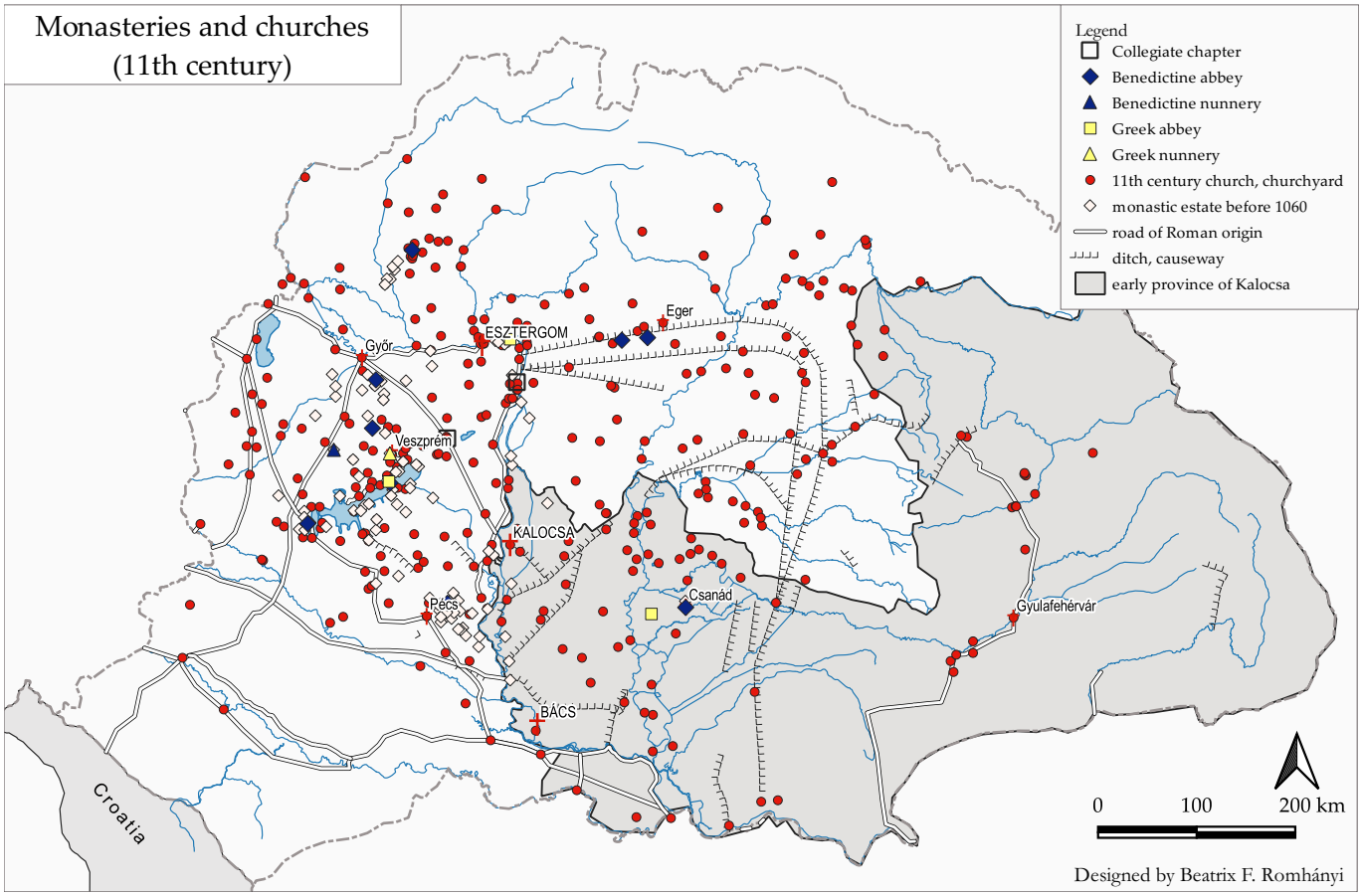

Fig. 1.

1. What did the social landscape of the Carpathian Basin look like in the period of the Hungarian Conquest?

2. How can we interpret the discrepancy in the spatial distribution of the objects linked to the conquering Hungarians and of the place names of tribal origin?

3. What was the character of political/military control in the 10th and 11th century, and how did it (possibly) change after the Kingdom of Hungary was founded in early 11th century?

The results can lead us one step further to understand the making of political control and the formation of the Christian kingdom, as well as to model relative population density and outline economic activity in the Carpathian Basin around 1000 AD.

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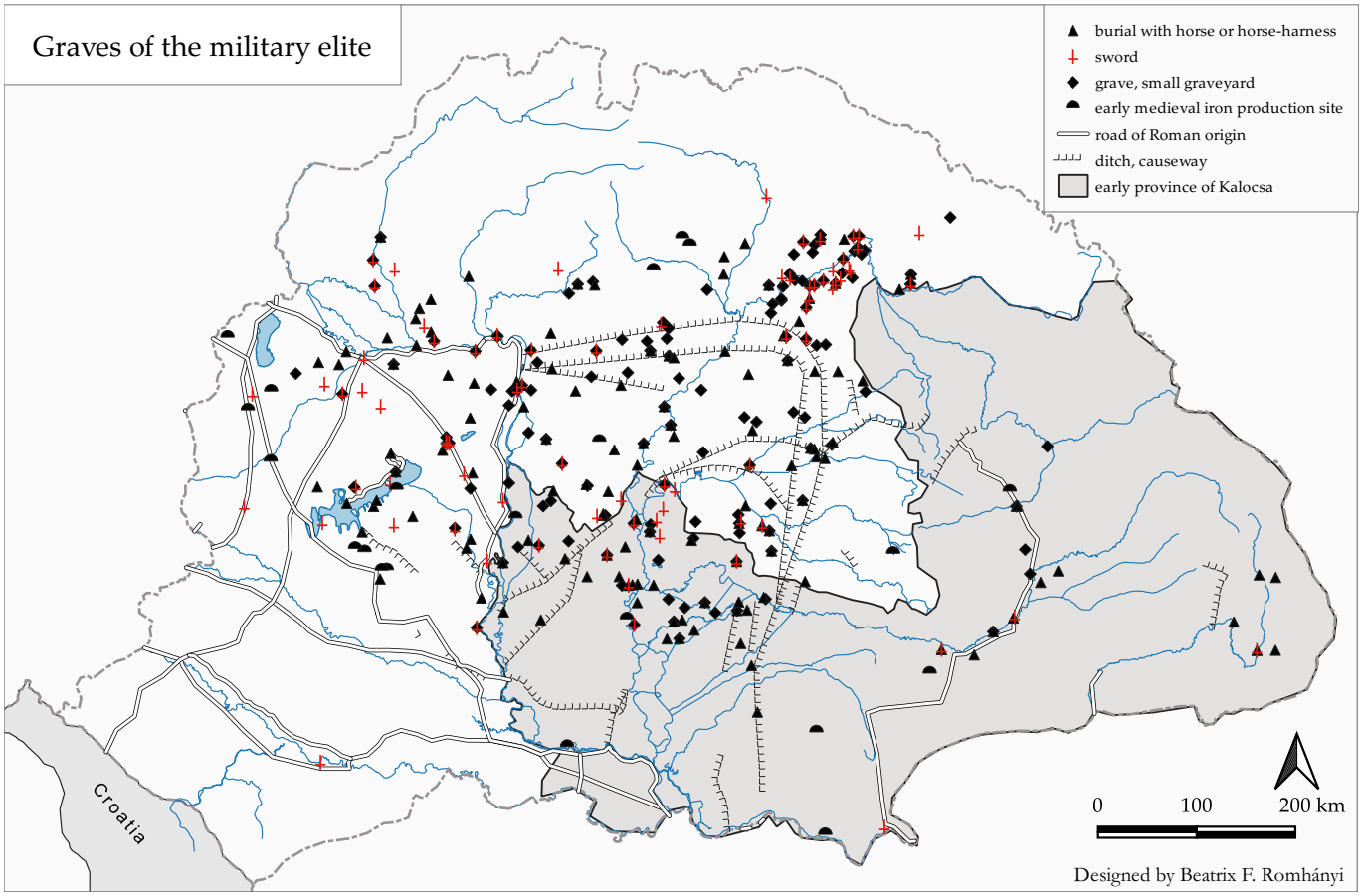

Fig. 2.

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NEW RESULTS CONCERNING CONTACTS BETWEEN THE CARPATHIAN BASIN AND NORTHERN-EUROPE DURING THE 10TH–11TH CENTURY

Andrea Ilés-Muszka

The possible relationship between the Carpathian Basin and Northern Europe was in the centre of Hungarian research in the past decade; firstly, due to the number of objects of Northern origin found in the Carpathian Basin, and secondly because of the material found in Birka, a Viking trading town dated to the 8th–10th centuries, where numerous 'oriental' finds, exhibiting parallels with the material of the Carpathian Basin were unearthed. Such artefacts include sabretaches (both mount ornamented and plate sabretaches), belt sets, headgear tips, nomadic attire fittings and everyday objects. Due to recent systematic excavations in the area of the fortifications, the number analogues of Eastern objects has increased, and more steppe-derived finds have been identified in the area of Birka's garrison, launching a new wave of exploration of oriental objects found in Scandinavia.

In the garrison, among oriental mounts and belt sets, Eurasian archery equipment has been identified as well (arrow heads, traces of a composite bow, archer's thumb ring and closed quivers). The Carpathian Basin was again listed as a direct source regarding a few finds, therefore it is tempting to re-evaluate the results and the possible origin and function of the aforementioned items.

Many of the oriental finds from Birka, are widespread items that were preferred by the elite of the time and can be found in a huge area between the Carpathian Basin, Scandinavia and Eurasia. Certain details and objects suggest a deeper connection, other than trade, between the areas of interest. For instance, weaponry, burial rites, the attire of the deceased, 'ethno-specific' objects that are differ from the area's material culture and custom, as well as everyday objects might not be considered as commercial goods. In addition, methodologically, it is important to analyse the micro- and macroregions of the sites to be able to decipher a possible pattern or the lack of it. Therefore, I have started to investigate firstly the area of Birka, then the microregion surrounding Lake Mälaren as well as the macroregion of Sweden and finally Scandinavia. So far, I have examined 58 archaeological sites, from which 736 objects of steppe origin were discovered. I have started to evaluate first the objects, then the burial rite and customs where possible. It was necessary to classify the sites and objects, taking into account the motifs and decoration on the items, the way they were placed in the grave, their possible functions and the funeral customs of the deceased.

As a classification, I have created the following 2 main groups with 3 + (3) – 4 sub-groups. The first group is the *objects with oriental origin* with sub-group of 3 (+3); 1.: secondarily used as a fibula and pendant, 2.: used according to original

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function a.: with underlying symbolism b.: only adopted a way of wearing it 3.: Objects of eastern origin, mixed with objects of northern ornamentation a.: with underlying symbolism. The second group is the *orinetal style objects* with 4 sub-groups; 1.: copying oriental ornamentation, in oriental fashion 2.: copying oriental ornamentation, in a northern fashion 3.: decorated with northern ornaments, in an oriental fashion 4.: decorated with Nordic ornaments. Each group is presented by archaeological sites, such as Adelsö, where a belt set was found in a cremation grave and can be listed in group 1.2., or Långön and Rösta with a mounted purse in original function. Sollentuna-Skälby represents Group 1. 3. where out of 42 graves, three of them contained eastern origin belt sets mixed with northern ornamented objects. Most of the second main group's sites are represented in Gotland, however the island has sites from Group 1 too. Eastern origin objects can also be found in small towns as well like Mälby, where an oriental belt mount, ring and arrowheads (showing parallels with Birka's material) were found.

As a result, it can be noted that oriental objects and burial rites (that differ from the usual) cannot only be found in a small area of Sweden (where Birka is located) but also in the macroregion throughout Sweden, as well as in Denmark and Norway. An example is Dollerup where a purse mount, parallel to the Bodrogszerdahely and Micskepuszta finds was detected. Some of the aforementioned objects' closest parallels can only be found in the Carpathian Basin. If we examine the items of Northern origin found in the Carpathian Basin, such as the armrings from Zsennye and from an unknown site, or the Budapest spear which is thought to be made in Gotland, the horse bit from Koronco or the neckring from Galgóc, we must assume that the two regions had serious contacts and possiblly exchanged mercenaries during the 10th and 11th centuries.

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THE SCANDINAVIAN AND BALTIC CONNECTIONS OF STRAY METAL FINDS FROM SOLT-TÉTELHEGY, COUNTY BÁCS-KISKUN, HU (ARCHAEOLOGICAL AND ARCHAEOMETRICAL DATA)

József Szentpéteri – Béla Török

The lavishly furnished burial of a high-ranking woman of the Hungarian Conquest period came to light on Tételhegy Hill overlooking the floodplain of the Danube near Solt in 1907, which acted as the springboard of the research project begun in 2005, whose goal was the interdisciplinary investigation of the multi-period site with the aim of determining whether it had function as a major power centre. We conducted systematic metal detecting surveys on the site as part of the project. Here, we describe and discuss some of the stray finds *(Fig. 1)* brought to light during the survey whose form, ornamentation and craftsmanship differ markedly from the local metalwork dating from the mid-10th to the end of the 11th century.

Using archaeological and archaeometric methods (ED-XRF and SEM-EDS), we sought an answer to the question of whether these finds indeed reflect connections between the Scandinavian and Baltic peoples and the ancient Magyars settling in the Carpathian Basin. The examined belt fittings, ornamental plates and belt-ends were all made by casting. It seems likely that the two large strap-end fragments and the left ornamental disc of the brooch were worked after casting. The chemical analysis and the examination of the micro-structure indicated a wide variance in their chemical composition. The finds could be grouped based on the zinc, tin and iron content (the latter an impurity) of these copper-alloy costume accessories. The classification based on the lead content was uncertain.

The ornamental discs of northern origin were part of two different penannular brooches. Although their imagery differs from the classical Scandinavian interlace patterns, the lion depiction points towards the Eastern European region, while the figure of the warrior (the costume accessories and the weapon types) correspond to the usual grave goods of the period's Viking warriors *(Fig. 2)*. Although we did not find any direct analogies to the large strap-end fragments, certain elements such as the form of the edge, the design imitating interlace patterns and the perforation in the centre are encountered in Scandinavia and the Baltics. The shield-shaped belt mount is paralleled by a similar piece from the Danube Bend, while a piece comparing well with the small strap-end terminating in a triple leaf was recovered from the Conquest-period burial of a man interred with his bow uncovered in Transdanubia. Both represent widespread types in the Baltics. Composite head and pectoral ornaments adorned with bead-rows and spiral motifs separated by openwork beading were widely popular in the Eastern European region, but are rare finds in Hungary, whose exact counterparts were discovered at Solt-Tételhegy.

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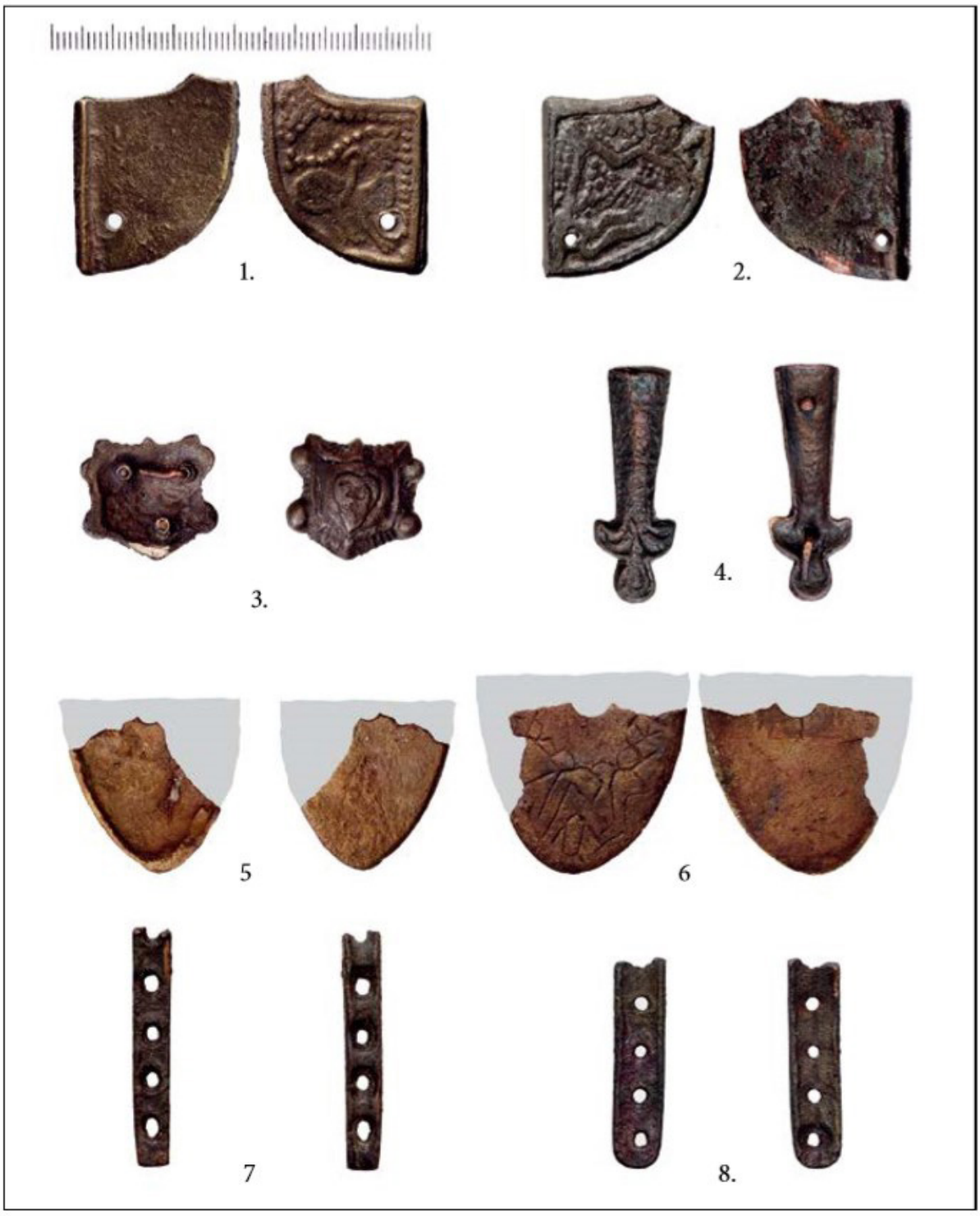

Fig. 1.

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Fig. 2.

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10TH-CENTURY SWORDS FROM THE CARPATHIAN BASIN AND THE BALKANS

Bertalan Zágorhidi Czigány – Péter Langó – Flórián Harangi

The study of 10th-century double-edged swords has a long tradition both in international and Hungarian research. However, despite the huge number of specimen discovered in the Carpathian Basin – around 140 in number –, the topic has not received ample attention since the 20th century. Previous studies focused on the well-known Western European and Scandinavian parallels and connections of these finds. Slight attention was also devoted to swords of possible Eastern (mostly Rus') origin, and the so-called 'sabre hilted swords', which are regarded as independent hybrid weapon types originating in the eastern territories.

One direction of possible networks through which these weapons might have reached the Carpathian Basin, was, however, left out of the discussion so far. It seems clear that a number of weapons arrived from the South. An outstanding example for this is a Byzantine sword found in Kunágota, which, together with related artefacts, assigns a possible (commercial?) route through the Balkans. The increasing number of Bulgarian finds, including double-edged swords and sword chapes, called attention to the possibility such a 'bypass' through which weapons could reach Hungary. The turbulent history of the region in the second half of the 10th century is well-known, and appearing Rus' and Byzantine armies might well be considered as possible sources of such weapons in the territory. In addition, written sources testify that Scandinavian warrior groups (Rus' and Varangians) served in the Byzantine bodyguard alongside Magyar warriors. The fluctuation of retainers in the East also affected Hungary, where foreign units, among them Rus', also served in the period.

Thus, the authors make a claim that regardless of the Western European or Scandinavian localization of workshops where blades were manufactured, weapons might have been transported to the Carpathian Basin through various routes. Therefore, we should not exclude the possibility that weapons found in Hungary came through a southern network in which people of multiple ethnic and social groups operated. Such a functioning network between the Carpathians and the Balkans is a hitherto unexplored option in this regard, and should be the subject of detailed examination in the future.

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THE HUSZT HOARD OF THE HUNGARIAN NATIONAL MUSEUM

Sulayman Al Halabi

This research covers a topic related to Islamic coins, namely the Huszt Hoard of the Hungarian National Museum. The hoard was discovered in 1904 in Máramaros county, in the north-eastern part of historic Hungary.

The Huszt hoard is remarkable primarily because it was found at the south-westernmost point of the distribution of 9th–10th-century Muslim silver coins in Eastern Europe, and to this day no other such hoard has found in the Carpathian Basin. The dirhams of the hoard date to the 10th century AD (the period after the Hungarian conquest of the Carpathian Basin), and were minted by the Samanid dynasty in Central Asia. The hoard was studied by László Kovács (Hungarian), and Aleksey Vladimirovich Fomin (Russian) in 1987, and later by Gert Rispling (Swedish) in 1993.

The present study will discuss new results of the Huszt hoard. The dirhams were analyzed by archaeometrical examination, such as X-Ray Fluorescence (XRF) technique in the Laboratory for Heritage Science MTA Atomki (Debrecen, Hungary). The X-ray fluorescence (XRF) analysis for coins allowed us to study the dirhams from all points of view. We were able to obtain new information about the provenance of the metal and the ore source, the production technology, the geographical distribution of dirhams mints, and the difference between original and imitation dirhams.

During the research the aim was to study and describe each individual coin and determine the mint of the struck, the name of the Emir and the Abbasid Caliph, the date, weight, and diameter of the coins as well as to decipher their inscriptions.

The research aims to highlight the importance of Islamic silver coins in the Hungary during the 9th-10th centuries, and to shed lights on the commercial relations between the Islamic World, Scandinavia, and Eastern Europe in the period. Finally, the hoard's dirhams will be presented with 3D measurements via using a VHX digital microscope and are planned to be published in a modern catalogue.

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FISH AND BLADE: NEW DATA REGARDING THE USE OF FISH SKIN IN EARLY MEDIEVAL CARPATHIAN BASIN

András Gulyás – Attila Türk – Balázs Jancsik – Márk Haramza – Szilvia Döbröntey-Dávid

In the territory of modern-day Hungary, the Jászság region (found within Jász-Nagykun-Szolnok county) seemed to be 'poor' in the aspect of archaeological surveys, excavations, and material. This situation is caused by the fact that in the Jász Museum there was no working archaeological department, and that the region belonged to the official museum of the county, the Damjanich János Museum in the city of Szolnok. The aforementioned museum was mainly responsible for the archaeological works in the whole county, but owing to this fact, they could not focus on the Jászság region. This situation changed in 2016, when the archaeological department was established in the Jász Museum. This department was responsible for the archaeological works in this region.

One of the most forward-looking steps was the organization of the local archaeological community group. Now almost every week, a significant number of people equipped with metal detectors do archaeological field surveys in the Jászság. Then, they give the stray finds with GPS coordinates to the museum; and in excavations and other field works of the museum, numerous volunteers are helping the specialists. Owing to their work, the number of known archaeological sites in the Jászság significantly grew approximately by 50% since 2016. Unfortunately, the Jász Museum is too small to excavate all of these sites, nevertheless it built up a very wide network with universities and research centres. The archaeological site presented here is excavated through the joint mission of the Jász Museum, the Early Hungarians Research Team of the Research Centre for Humanities, and the Pázmány Péter Catholic University.

In 2021, we excavated the cemetery at Jászjákóhalma, Béke TSZ II in the third season. It is dated to the Hungarian Conquest Period, in the second half of the 10th century, and maybe the first third of the 11th century too. In three seasons we excavated 18 graves, out of which 15 are dated to the Hungarian Conquest Period. We will now present the 17th grave. In this grave *(Fig. 1)* there a young man *(iuvenis?)* was lying on his back, arms and legs stretched out. The orientation of the grave and the skeleton was W–E. The grave was disturbed in the Modern Age by agricultural works: the region of the pelvis was not in the grave, and the region of the ankles was also disturbed. There were no traces of medieval or Early Modern Age disturbances, but it is not ruled out. Grave goods *(Fig. 2):* on the left side of the head and torso fragments of a saber was lying (unfortunately the weapon was dislocated by the excavator and because of this, it broke into pieces). The grip was closer to the head. On the left side of the ankle region a fragmentary stirrup was found (the other stirrup was

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Fig. 1. Photo of grave 17, Jászjákóhalma, Béke TSZ II.

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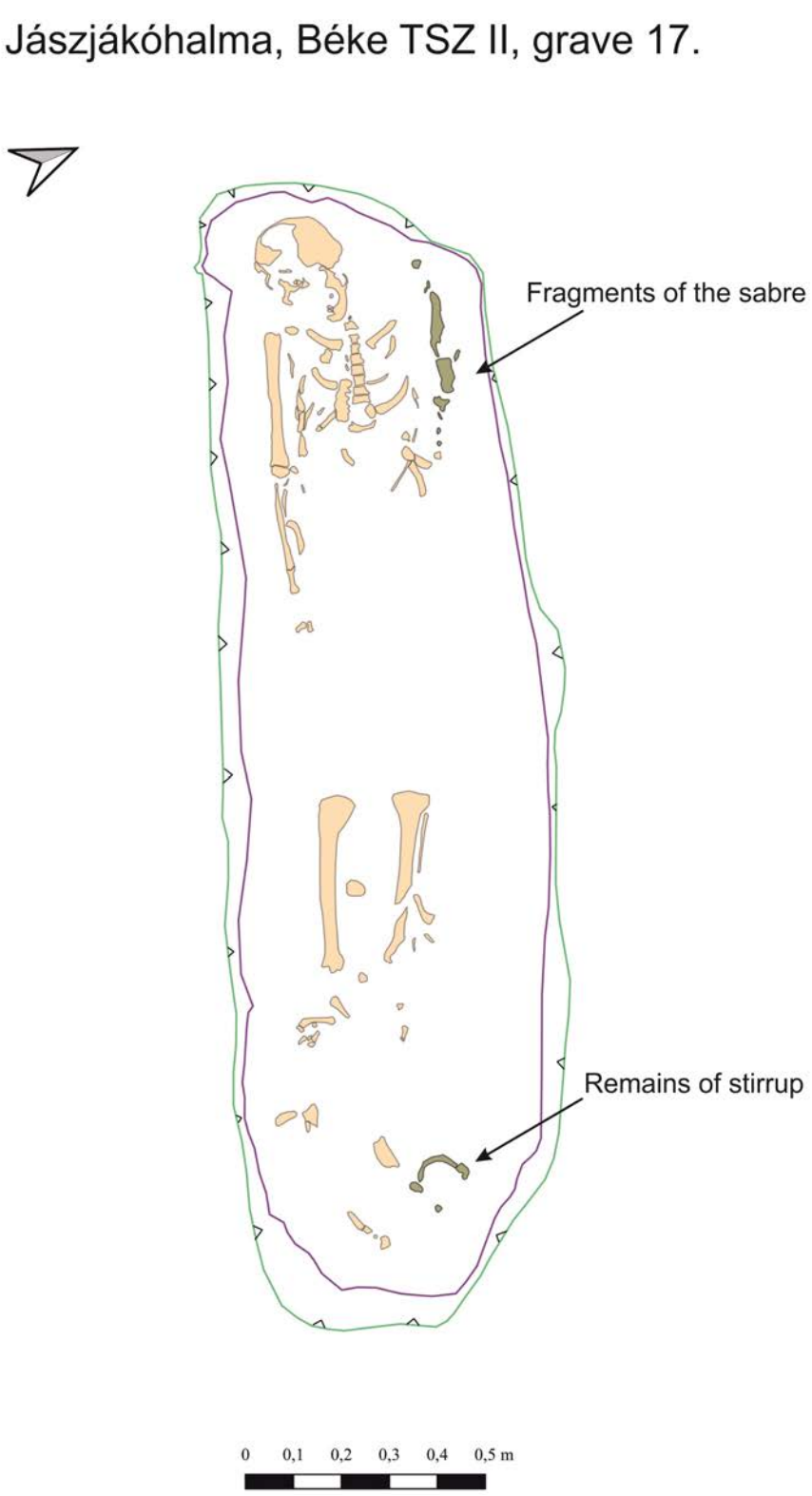

Fig. 2. Drawing of grave 17, Jászjákóhalma, Béke TSZ II.

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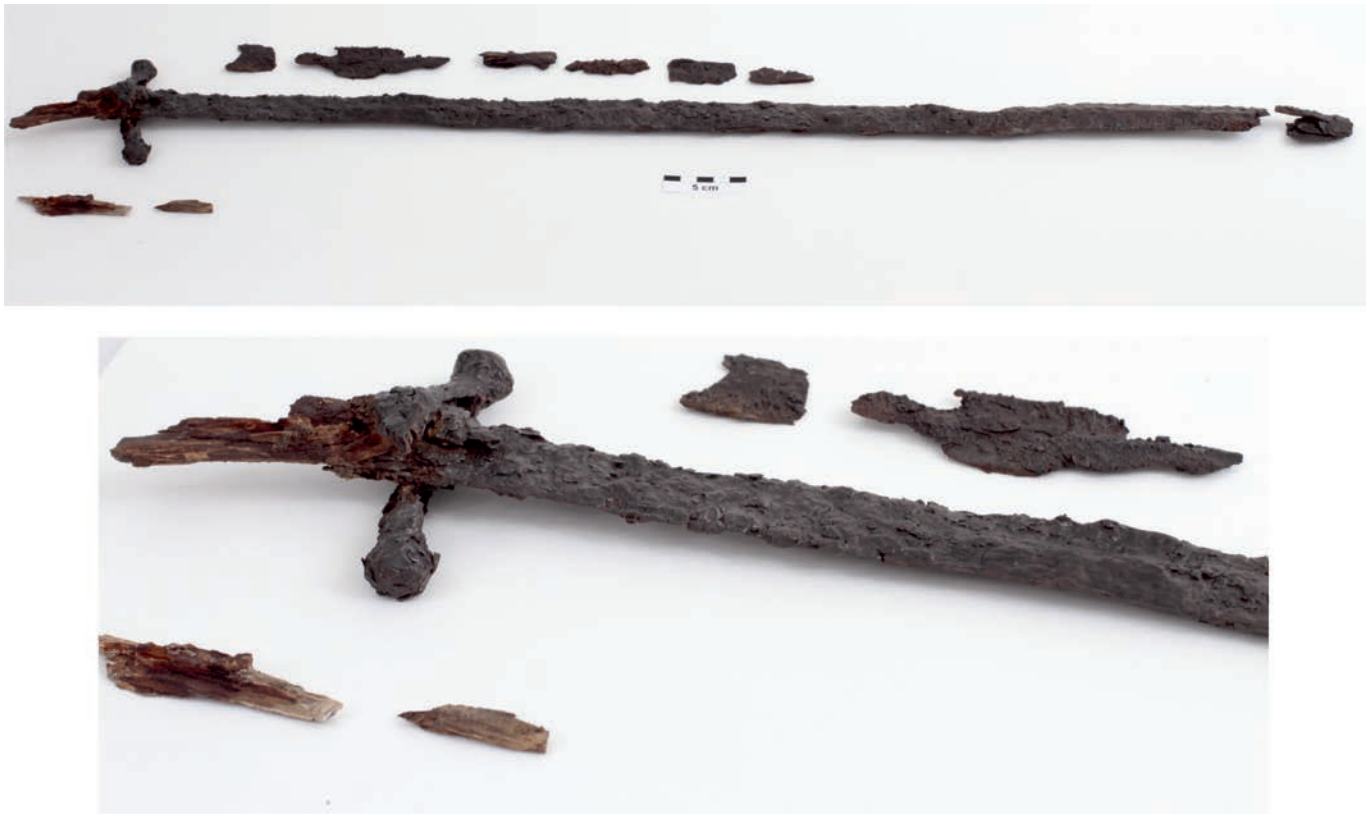

Fig. 3. The saber after the conservation process

not in the grave). Between the right ankle and the eastern side of the pit there was a hoof of a little horse (maybe a foal?). Therefore, the 17th grave is maybe a grave with a partial horse burial.

The saber was in need of a serious restoration *(Fig. 3)*. During the restoration process it was found out that on the grip of the saber there are remains of fish skin *(Fig. 4–5)*. There is not an infallible, 100% identification of the species of that skin. According to Nina Bogutskaya (Laboratory of Ichthyology, Naturhistorisches Museum, Wien), the species is a Russian sturgeon *(Acipenser gueldenstaedtii),* also known as a diamond sturgeon or Danube sturgeon. It can be found in the Black Sea, the Sea of Azov, in the Caspian Sea, and in the rivers which flow into the aforementioned bodies of water. This species was fished in the Carpathian Basin too. Another expert, László Kocsis assumes that the remains belonged to some type of ray *(Batoidea)* or shark *(Selachimorpha),* maybe from the Indian Ocean, Persian Gulf or the Red Sea. The first task our research team will do is to make a 100% identification of the species, because it is the key to the following analyses and conclusions about the grave and the saber.

We also do not know anything about the tanning of the leather. Chrome-tanning is unfortunately ruled out due to the fact that it was invented much later. In the Middle Ages, various methods were available for tanning skins (oil, smoke, vegetable and mineral too). If the fish skin is from the Carpathian Basin then we can make some presumptions. In the Hungarian Conquest Period samples, only traces of aluminium were revealed. This shows that maybe they used potash alum for tanning. On the other hand, the vegetable tanning requires months or in case of thick skins up to a year. It is

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Fig. 4. Macrophotography of the skin remains

unlikely that the ancient Hungarians who lived a nomadic or semi-nomadic lifestyle, used this method for tanning leather. Of course, only after specific research and examinations can we say this accurately.

We can find analogies for sword grips with fish skin in the early medieval Carpathian Basin and in Eastern Europe too. The best-known example is from Vienna, the so-called Vienna saber, or Charlemagne's sword from the Kunsthistorisches Museum, on which there is ray skin. There are a lot of other examples from the Carpathian Basin (Karos-Eperjesszög II/11, Vízkelet (Čierny Brod, Slovakia), Gnadendorf (Austria), Nemesnádudvar) but as far as we know, only the Gnadendorf skin remains were thoroughly examined. In Gnadendorf, we do not have a certain identification as it can be either gulper shark *(Centrophorus Granulosus)* or some kind of guitarfish *(Rhinobatidae)*. In Eastern Europe we can also find good examples of saber grips with fish skin (Podorvannaya balka, Verhniy Saltov, Karakaba). Wherever we found a description about the species those were ray skins. We have to say that these analogies are more prestigious than the Jászjákóhalma saber, the masters used gold and silver for most of them.

The conclusion strongly depends on the exact identification of the species, but we can say that in both situations the saber from the 17th grave of Jászjákóhalma, Béke TSZ II. is a very interesting find. If the remains are some kinds of shark, or ray skin, then there is a strong chance which indicates a direct or indirect trade connection between the Carpathian

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Fig. 5. Macrophotography of the skin remains

Basin and the Indian Ocean, Persian Gulf, and/or Red Sea (or between this places, and one of the previous living areas of the early Hungarians). The 17th grave of Jászjákóhalma, however, seems to be poor. Even though not every Hungarians were buried with a horse or a weapon, the value of the grave goods does not refer to a man with high prestige. But if the fish skin is ray or shark, then it indicates that the lower classes of society could also afford this import commodity, not just the higher classes. If the skin turns out belonging to a Russian sturgeon, then that is also an interesting situation. As they could get this type of fish from the local rivers (in Eastern Europe or in the Carpathian Basin as well), it can indicate the fact that the early Hungarians fished regularly. Currently we have no archaeological evidence on fishery of the early Hungarians (except some bones which can be identified as parts of a fishing web). On the other hand, we cannot exclude that this type of fish skin was also accessible by trade.

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