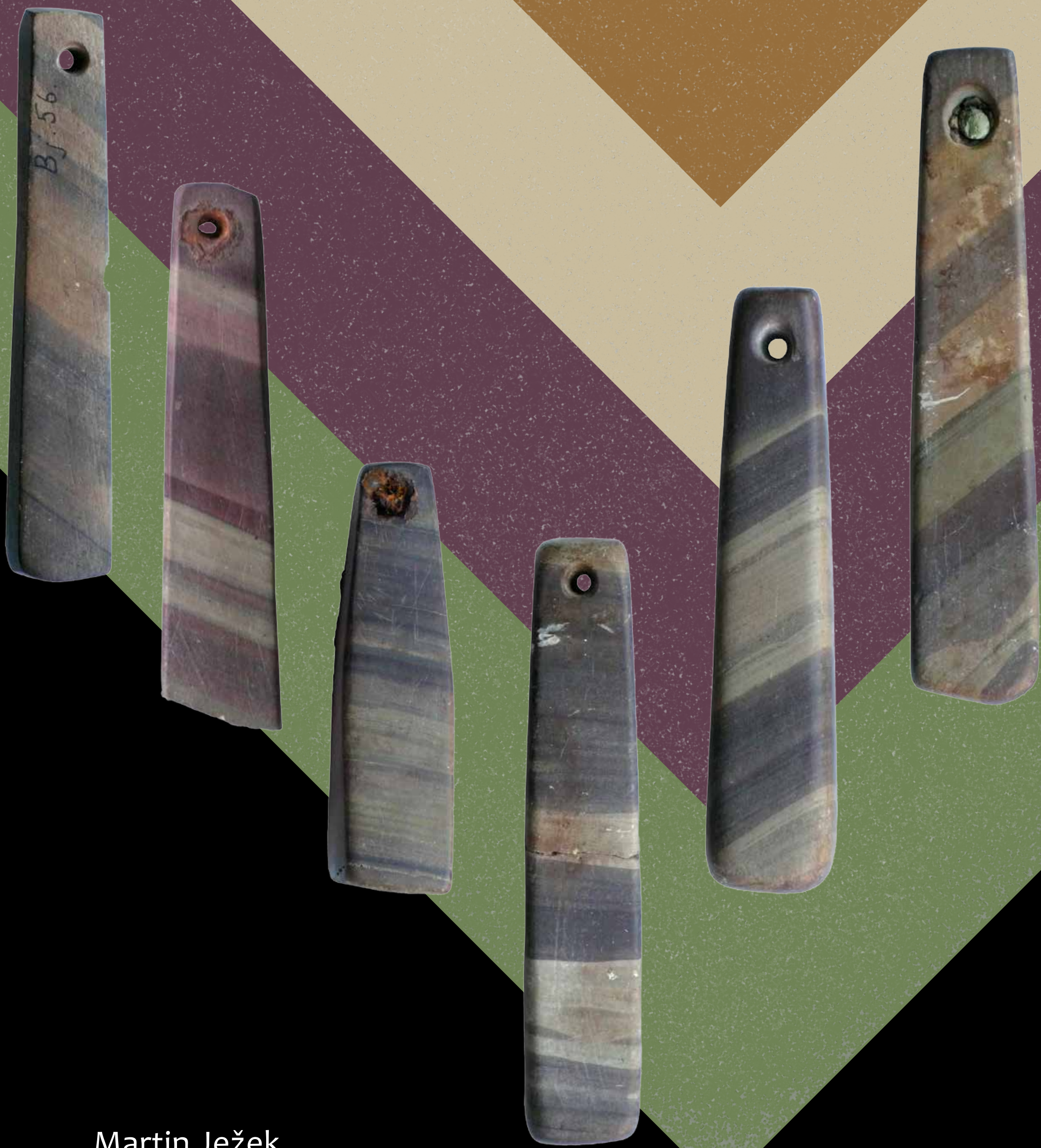

Martin Ježek

ARCHAEOLOGY OF TOUCHSTONES

AN INTRODUCTION BASED ON FINDS FROM BIRKA, SWEDEN

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Sidestone Press

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Acknowledgements

Viking Age Birka, one of the cornerstones of European archaeology, is remarkable not only for the character of its settlement and cemeteries and the scope of the excavations, but also for the outstanding documentation of the numerous burials created under the direction of Hjalmar Stolpe in the late nineteenth century, the exemplary assessment conducted by Holger Arbman and the subsequent systematisation of the finds under the direction of Greta Arwidsson. However, the fact that Birka has produced – probably on a worldwide scale – the largest assemblage of the artefacts that form the subject of this study is the result of circumstances dating back much earlier. Despite having provided the largest sample of touchstones from one site to be analysed using electron microscopy, this investigation has managed to include only a fraction (less than half of one percent) of the candidates belonging to this type of artefact from Birka. This study is based on (a selection of) finds from the Birka graves (51 specimens, i.e. 29 % of local burial finds), with the thousands of similar artefacts from the 'Black Earth' (i.e. the settlement layers) being beyond our possibilities. Nevertheless, the reason that these particular touchstones form the basis of this study is neither the exceptional character of Birka nor the extremely high number of artefacts from the site. Even though this is ideal from a theoretical perspective, the reality is far more prosaic – and also eloquent. Simply put, it is because Birka is located in Sweden:

1. Requests for access to archaeological finds for the purpose of their analysis often founder because of the unwillingness of museums, which either reject or simply fail to respond to them (for an incomplete – still much longer, fortunately – list of institutions with opposite manners, see Ježek 2013b, 728). The request sent to the Swedish History Museum in Stockholm was resolved in minutes, thanks to Charlotte Hedenstierna-Jonson, who I thank also for her generous assistance and volumes of advice.

2. The Swedish History Museum is one of the institutions that entrusted objects in their collections for laboratory processing with confidence in the importance of such research. This book would not have been possible without their generous approach. However, even with the utmost help from everyone involved, it is necessary to secure safe transport for the

archaeological finds to the laboratory. This was accomplished thanks to the kind assistance of Mari-Louise Franzén and Kent Andersson. Moreover, it is difficult to organize from Prague all the necessary procedures in Stockholm. But thanks to the help provided by colleagues at the Swedish History Museum, unexpected and often trying problems were solved, not to mention their kind and expert comments and suggestions; thanks for their dedicated help go to Nina Persson, Lotta Fernstål and Thomas Eriksson.

3. Early medieval touchstones are widely distributed in Scandinavia (or in the early medieval bullion-economy zone: see below); however, Sweden is the only country in this part of Europe with an institution that has a contract with the Czech Academy of Sciences permitting short research stays. Without the assistance of the Royal Swedish Academy of Letters, History and Antiquities, this work could not have been undertaken.

4. It is not a matter of course to find a laboratory near the museum that is equipped with a scanning electron microscope (SEM) of the required parameters and, particularly, to be able to obtain permission for its use for several weeks. Prof. Stefan Gunnarsson and Gary Wife of the University of Uppsala were remarkably accommodating, as were Prof. Kerstin Lidén and Malgorzata Wojnar-Johansson of the Stockholm University.

5. The work would have been incomplete without the as yet unpublished results concerning the modern anthropological determination of human remains from Birka burials by Anna Kjellström. I am grateful for Anna's willingness to assist, as also for the great and willingly shared knowledge of Thomas Eriksson.

I thank Luboš Jiráň, Director of the Institute of Archaeology, the Czech Academy of Sciences, Prague, for the patience he has shown for this work during its hopeless years. Subsequently, it evolved thanks to the support of the Czech Academy of Sciences (No. M300021203) and, finally, of the Czech Science Foundation (No. 16-22207S). Unfortunately, not even the financial ability to cover the research costs, including museum staff-time, the safe transport of specimens to a laboratory, etc., has proved sufficient for some museums – in which, incidentally, the unattractive stones, regarded as 'whetstones', have lain for many years with little attention paid to them (see below).

This work could not have been undertaken without the kind assistance of colleagues from numerous institutions, and this book would not have been possible without the help of Simona Bubeníková, Jana Čižmářová, Jarmila Valentová, Ralf Bleile, Christoph Blesl, Petr Drda, Detlef Jantzen, Florian Knopp, Peter C. Ramsl, Roland Risy and Holger Wendling, who made available the artefacts from the territories of Austria, Germany and the Czech Republic, Prof. Marzena Szmyt and colleagues from the Poznań Archaeological Museum, who enabled the analysis of selected early medieval finds from Greater Poland, as well as Prof. Andrzej Wyrwa, Paweł Sankiewicz and Anna Wrzesińska in the case of the collection of the Museum of the First Piasts on Lednica Lake. I thank Andrei Ju. Alekseev, Aleksandra Kattsova and Prof. Mikhail B. Piotrovsky for their generous assistance with the specimens from the State Hermitage Museum, and Ladislav Olexa and Matej Ruttkay for making available Bronze Age artefacts from Nižná Myšľa. I am grateful to the National Museum of Iceland and the Institute of Archaeology in Reykjavík, as well as to Prof. Gavin Lucas. Thanks for the true detective work that corrected the mistake in my article on artefacts from Hedeby go to Volker Hilberg and Inga Sommerfeld.

I am grateful to Zuzana Korbelová, Vlasta Böhmová, Šárka Jonášová (Institute of Geology, Czech Academy of Sciences, Prague), Ksenia Chugunova (State Hermitage Museum, St. Petersburg), Birgir Jóhannesson (Innovation Center Iceland, Reykjavík), Mathias Mehofer (VIAS, Vienna) and Marc Theodor (Universität Hamburg) for conducting the chemical microanalyses of the specimens mentioned below, and to Jan Mařík for his 'portable XRF assistance'.

Great thanks for assistance with geochemical matters go to Jan Zavřel and Milan Holub – for language and editorial assistance to Prof. James Graham-Campbell – and for scientific and lifesaving support to Sigrid Cecilie Juel Hansen and Filip Laval.

I have not been permitted to examine any touchstone candidates in the important collections of several museums, following their rejections in late 2016. Although the theoretical basis for interpretation of the stone artefacts in question has changed radically in recent years (e.g. Ježek 2013b; 2014; 2015; 2016; Ježek & Zavřel 2011; 2013), the words of P.R.S. Moorey (1994, 219) concerning the Mesopotamian evidence – 'actual examples of touchstones are almost impossible to identify except through laboratory study' – not only remain true today, but even the laboratory study seems to be impossible. The University of Pennsylvania Museum of Archaeology and Anthropology, Philadelphia (Penn Museum), holds an unrivalled assemblage of so-called 'whetstones' from Mesopotamian burials, including the majority of finds from the royal cemetery at Ur, as well as a large assemblage of typical stone artefacts from other periods and other parts of the world (Cyprus, Egypt, Iran, Israel, Armenia, Siberia, Alaska, the Great Plains, etc.). Touchstone candidates from the Near East (including Mesopotamia), Egypt, Cyprus, Greece, Oceania, North America, etc., held in the British Museum, London, are likewise unavailable for our research.[1] It is to be expected that such circumstances will continue to prevail in museums that have purposes other than making their collections available for research.

1 In rejecting my request for permission to analyse artefacts kept in the Penn Museum, I was, for example, advised that I 'had not considered the archaeological and ethnographic contexts of the artifacts sufficiently. For instance, many of the Near Eastern objects identified as whetstones were actually found in close proximity to daggers or other blades.' Instead of exemplary nineteenth-century greetings, the rejection by the Department of Conservation and Scientific Research at the British Museum pointed to the limited capacity of its workplace: '[…] it is not possible to accommodate all requests for work […]'. Due to the fact that the world-wide collections of this museum cannot be examined anywhere else, it is only possible to wish one's colleagues there an improvement in the capacities of their inadequately equipped laboratory. However, there can be also other reasons for their insufficiency: see below, pp. 24-25.

I think Pindar is right when he says, 'Custom is king of all'.
Herodotus 3.38

Introduction

Archaeology, in focussing mainly on socioeconomic aspects or technological developments, only rarely asks the question that is of far greater importance for understanding ancient (and even recent) societies: what bound entire cultural complexes together? Each society lives according to its own ideology which gives it order and upholds its internal structure. However, archaeology does not like to concern itself with those aspects of human history about which archaeological finds have left no clear testimony, even if there is no doubt that they were closely linked to the lives of ancient peoples. The material culture on which archaeological knowledge depends rarely provides indisputable evidence of symbolic, or even ritual, behaviour. More often, such evidence depends on the correct 'reading' of the sources which are, however, usually burdened with the petrified sediments of period-contingent, uncritically adopted and generally shared opinions.

Touchstones are typically found in archaeological literature and museum catalogues under the designation of 'whetstones', 'hones', 'hone stones', 'stone pendants' (*brynen*, *Wetzsteine*, *Schleifsteine*, *oselki*, etc.), despite the fact that archaeologists are often amazed when these putative whetstones show no signs of having been used to sharpen any tools (see below). Until recently, the interpretation of the vast majority of the characteristic stone artefacts from prehistoric and early medieval graves has been based on the old belief of nineteenth- and twentieth-century archaeologists in an 'active' afterlife. These oblong stone artefacts of rectangular cross-section are often accompanied in graves by a knife. The knife as a grave-good was meant to serve the deceased individual as a versatile tool on his or her further journeys, and the 'whetstone' was thought to have been included for sharpening purposes. Archaeologists believed that knives and whetstones were tools useful even for children who had died at the tender age of only a few months. Moreover, they did not seem overly concerned when the alleged whetstone was not accompanied by a knife, as is the case with numerous burials. In any case, the seemingly logical construction connecting grave finds of knives and 'whetstones' has collapsed (e.g. Ježek & Zavřel 2011; Ježek 2013b).

At the moment of bidding final farewell, the objects placed in a grave were not directed toward the (posthumous) future: their symbolic role ended with the filling of a grave pit or the construction of a mound. The presence of these symbols among grave-goods does not mean that the deceased actually worked with the tools – or that they even owned them. What is important is the positive function that they performed in the ritual (by way of comparison, much like flowers on graves today). Each sweeping evaluation will be misguided because divergent myths, faiths and customs gave different meanings to the same expressions of final parting; if, of course, the survivors bothered with them at all. It is not necessary to attribute a specific meaning to grave-goods. In the words of I. Morris (1992, 24), 'the richer the context into which we set the burials, the more powerful the interpretation will be'.

The tools used to determine the value of precious metals were just one of many ways in which to express the affection of the survivors for the deceased (and, in some cases, even their social standing), who often – or even mostly – only came into close contact with these objects after their passing.[2] The origins of the symbolic function of metal touching tools, particularly those used to determine the value of metal, in funeral contexts date to as early as the period when gold ceased to be the only metal processed by man. In numerous (particularly early medieval) burials, touchstones occur together with balances and/or weights, objects to which the same symbolic meaning was attached during funeral rituals. These tools became widespread through the northern part of Europe during the ninth to eleventh centuries AD – the bullion-economy zone, *Gewichtsgeldwirtschaft*, as defined by J. Werner (1954) – where hack-silver (i.e. fragmented[3] and weighed pieces) was commonly used as currency (comprehensively Steuer 1987; cf. Ježek 2013b, 726). Similarly, 'touchstones [...] are an integral part of materials obtained at the Golden Hoard sites' in Russia, too (Valiulina 2016, 265, with refs.). In any case, unlike balances and weights, touchstones enable us to determine which metals were tested by ancient populations and, above all, which alloys they were producing.

During the prehistoric period and the Early Middle Ages, it was necessary to test a wide range of materials encountered by metallurgists, goldsmiths, jewellers, prospectors for deposits and everyone else who came into contact with non-ferrous metals. However, it was trade in particular, regardless of its specific form and social circumstances, that provided endless opportunities for the use of tools required to determine metal type and value. Regardless of whether the metal objects were luxury products, pieces intended for subsequent working or merely raw materials, all of them had to be authenticated. The simplest means for doing this was a quick and reliable tool – a touchstone.

2 Cf. Scull 1990, 205-209, with examples of touchstones found together with balances in two Anglo-Saxon graves (p. 185).

3 Preserved, for example, in the name of the Russian currency, the ruble, which is derived from the Slavic word *rubit* = to hack, to cut.

The advantage of this essentially non-destructive method was the speed of making tests without the need for laboratory equipment; however, such testing required considerable experience (see, e.g., Caley & Richards 1956, 150-153; Zedelius 1981; Oddy 1983; Schemainda 1988; all with refs.). The Renaissance scholar and metallurgist, Georgius Agricola, described how to use a touchstone for testing the quality of precious metals in the mid-sixteenth century (Hoover & Hoover 1950, 252-255; see also Ercker 1574, 54-57). Theoretically, comparison of the colour of a streak from a metal object on the smooth face of a touchstone with the colour of a streak from a reference needle from a needle set (for an example from the turn of the seventeenth century, see Heppe 1985), as recommended by the old masters, allowed one to determine the purity of precious metal with an accuracy of at least 2 % (see Caley & Richards 1956, 153-156; Oddy 1983, 55-56). However, no set of reference needles nor standard alloys in any form have been recognised among archaeological finds, including the numerous burials furnished with touchstones. An ancient user of a touchstone was probably able to ascertain the quality of the tested metal simply by studying the colour of its streak on the touchstone, solely with the naked eye.

Many thousands of touchstone candidates and their fragments have been found in early medieval trading centres, metallurgical workshops, elite sites, etc. (for examples, see Ježek 2013b, 723-727), including the Birka settlement area (or Black Earth) with c. 12,000 finds of this kind. Not even the (assumed) military context of numerous stone (mostly schist) artefacts of the characteristic form means that they were used to sharpen weapons, as demonstrated by the hundreds of alleged 'whetstones' from the Viking Age fortresses in Denmark (Trelleborg, Aggersborg, etc.). Such erroneous classification of archaeological material has important consequences for a site's profile (recently, e.g. Resi 2011 for Kaupang, Norway[4]; Resi 2014 for Aggersborg, Denmark; Schietzel 2014, 404-408, for Hedeby, Germany). Numerous typical artefacts appear among 'whetstones' from Iron Age and early medieval Ireland (e.g. O'Connor 1991, figs. 17 and 18), as well as from local Bronze Age graves. The number of Viking Age touchstone candidates rises rapidly in Ireland during the last decades, in both funeral and settlement contexts (e.g. Russell & Hurley (eds.) 2014, 169, 315-317). Nevertheless, in general, unlike the finds from settlement or production sites with their often unclear context and/or dating possibilities (cf. Ježek *et al.* 2010), burials provide valuable social context. For example, the archaeological evidence for Viking Age Denmark includes 238 certain burials furnished with weapons and/or horse equipment of which 18 % contain a 'whetstone' (Pedersen 2014, 129). If we include less 'rich' or even 'common' graves, the number of local burials furnished with touchstone candidates is far higher.

Around the settlement area of Birka there are several cemeteries, together containing more than 3,000 graves, of which over 1,100 have been excavated (Ambrosiani & Clarke 1993, 138). About 13 % of these graves contain weights (148 burials, both female and male, with 252 specimens), whereas (fragments

4 I have not been permitted to examine any touchstone candidates from Kaupang.

of) balances are rare; there is one from the chamber grave of a man and a woman (grave 644), and three from cremation burials, both male and female (graves 369 and 1040; Kyhlberg 1986a; 1986b; Hedenstierna-Jonson & Kjellström 2014, 194). Birka graves containing weights include both prestige burials and those without remarkable grave-goods. Touchstones (or touchstone candidates) were found in at least 154 of the total number of (excavated) burials (that is c. 13 %, identical to the weights), some of them containing two or three pieces. At least 175 specimens have been found; K. Sundbergh and G. Arwidsson (1989, 103) counted 187 objects classified as 'whetstones' (two of which had already been regarded as touchstones: Graham-Campbell 1980, no. 171; Oddy & Meyer 1986, 159). A small number of these grave finds are fragmentary, although some can be completely reassembled; however, several burials did not contain the missing part (or parts).

For the purpose of studying these artefacts, the method of chemical microanalysis (energy-dispersive spectroscopy), combined with surface observations of the objects (back-scattered electrons), using a scanning electron microscope (SEM), was utilised (for details, see Ježek 2014, 423). The research aim was to determine whether the stones bear streaks of iron, which would confirm their function as whetstones, or whether they would reveal traces of precious and/or other non-ferrous metals. The results given in weight percent (wt.%) are calculated at 100 % in the tables below; these data are semiquantitative. Their accuracy is not to be overestimated (see pp. 117-121); the tables present the results of microscopic measurements, not the precise chemical composition of the relevant metal. Nevertheless, they provide an overview of the presence or proportion of individual elements in analysed streaks and hence also a basic idea of the chemical composition of the tested metals.

The nature of the stone which tests gold is remarkable, for it seems to have the same power as fire, which can test gold too. On that account some people are puzzled about this, but without good reason, for the stone does not test in the same way. Fire works by changing and altering the colors, and the stone works by friction, for it seems to have the power of picking out the essential nature of each metal.
Theophrastus, c. 300 BC (after Caley & Richards 1956, 54)

General issues

The use of SEM is not new in the archaeological study of touchstones. Thirty years ago,[5] Ch. Eluère identified traces of gold on a touchstone from a Late Bronze Age settlement: 'We do not know the exact proces of assaying in prehistoric times, as the touchstones are used with mineral acids in modern times. It is generally admitted, therefore, that the ancient goldsmiths must have had to rely on the colour of the touchstone markings for assessing the characteristics of these alloys. However, it is perhaps possible that they knew how to modify the colours of the markings with organic acids of vegetable origin' (Eluère 1986, 61; cf. Eluère 1985, 205; Eluère *et al.* 1988; Caley & Richards 1956, 151-152; Ježek 2013b, 713). '*The Book of the Secret of Secrets* by [medieval 'alchemist' – M.J.] ar Razi contains 16 recipes for different 'acidy waters'. Some of them are suitable for the preparation of mineral acids […] However, known sources lack any references as to the use of acids during touchstone tests' (Valiulina 2016, 266, with refs.). Due to the great number of prehistoric and early medieval touchstones and their occurrence in various social contexts, we doubt the use of acids during the testing of metals in the distant past.

Before a touchstone could be used for testing a metal object, it was necessary to remove the remnants of previous tests. Touchstones were cleaned with salty water, wax, they were sanded, but the most productive way was using a non-metallic abrasion tool. This explains why numerous small grains of metal, often with a similar chemical composition, are more often documented on the stones than clear linear streaks, while also explaining the concave sides of

5 For early medieval finds analysed in a SEM, from (probably) legendary Reric (Groß-Strömkendorf), Germany, see Wietrzichowski 1993, 38.

some touchstones which have been thought to result from knife sharpening. At least one-fifth of the 51 artefacts from Birka selected for the SEM study have concave traces of abrasion (from graves 47, 362, 660, 711A, 750 – the specimen made of slate, 768, 776, 804A, 1020, 1043, 1059). Four of the specimens studied show grains or lines of iron (475, 524 – the longer specimen, 715, 973), in addition to streaks of non-ferrous metals. None of these four artefacts, however, has any concavity of the faces. On the other hand, no streaks of iron were found on artefacts with distinct traces of abrasion. The streaks of iron can also be the result of contact with an archaeological tool during excavation (see p. 107), and even if they are streaks from the Viking Age, due to their unique nature among the analytical results (including those from Birka), they do not constitute a reason to attempt a simplification in the identification of the stone artefacts under discussion by employing 'wise' speculation as to their multifunctional use.

Unlike touchstones, it is difficult to imagine that whetstones were thoroughly cleaned after use. Sharpening clearly leaves far heavier traces than those left by testing to determine the quality of a potentially valuable object. Therefore, if chemical microanalysis of a stone artefact of characteristic form and raw material, does not reveal streaks of metal, the object is not a whetstone. Or, conversely, touchstones that have been thoroughly cleaned, whether this was done in the distant past or during post-excavation procedures, need not preserve any streaks of metal. Moreover, the typical stone artefact could also serve as a symbol of social standing during the individual's lifetime, regardless of whether it was ever actually used to test a metal (see Fig. 1). This could be the case with massive objects of typical shape from the most prestigious graves – such as well-known 58 cm long artefact from Sutton Hoo ship burial (mound 1), for example (cf. Bruce-Mitford 1978, 311-350; Ježek 2013b, 716, with additional examples), which may have served as symbols of power – as actual sceptres; with their length having prevented them from being analysed in any available SEM. A portable XRF instrument could be able to detect possible traces of metal on the surface of the 'oversized' touchstone candidates. Similarly long touchstone candidates are known from Viking Age elite burials in Norway (see p. 74). However, they also have prehistoric counterparts, such as, for example, a 52 cm long stone artefact from the Early Bronze Age prestige tumulus at Kerhué Bras, Brittany (Fig. 2: 1; du Chatellier 1880; Nicolas 2016, pl. 29: 10), or a 27 cm long object (with a hole in one end) from the monumental tomb at Lefkandi, Greece, the tenth century BC (Popham *et al.* (eds.) 1993, 19, pl. 13).[6] Still unexplained is the function of an arch-shaped stone artefact, with a length of c. 48 cm and a perforation for suspension at one end, found together with two touchstone candidates of 'standard shape' in the eponymous Maikop kurgan (in the northern foothills of the Caucasus), from the fourth millennium BC (Fig. 3: B; Ivanova 2012, 6-10, with a description of this highly prestigious burial). Likewise, the elegant touchstones with gold finials from

6 I thank Prof. Irene Lemos for making the stone artefacts from Lefkandi available, also for future research.

A B

Fig. 1. A contribution to the issue of the functionality of symbols of social standing: (A) 'watch' from walrus ivory, late nineteenth or early twentieth century, coast of the Arctic Ocean, Siberia, Russia (The National Museum – Náprstek Museum, Prague, inv. no. 22643; see Halászová 1988); (B) young Surma man with a wooden 'kalashnikov', southern Ethiopia, 2007 (photo: the author).

prestige Scythian and other barbarian kurgans (see pp. 25-32) could hardly have belonged to anyone other than the rulers themselves or to persons close to them.

These are, however, exceptions among the thousands of burial finds of touchstones, and I must warn against my own wording in the early stages of research, which was based on the naive assumption that these tools were mainly deposited in the graves of their users, or even owners (e.g. Ježek & Zavřel 2011; 2013, 118). Common touchstones served as a widespread symbol at the moment of bidding final farewell across millennia, regardless of whether the deceased (including infants) ever used them, and many individuals only encountered these objects on the occasion of their own burial (see below). At least in the Early Middle Ages, the presence of any tool used to determine the value of metal in a grave does not mean that the deceased was a member of a 'higher class', just as the absence of these tools from graves does not mean that the buried individuals did not come from an elite environment. The range of means for expressing the extraordinary social standing of the deceased was much wider, and the customs of various cultures were much more diverse. As we shall see below, the appearance of touchstones and weights among burial furnishings was not limited by social factors. Nevertheless, touchstones (or touchstone candidates) over 20 cm in length, occurring in Langobard, Frankish, Anglo-Saxon, Viking and other contexts, come mainly from elite burials (for several examples, see Ježek 2013b, 714-716).

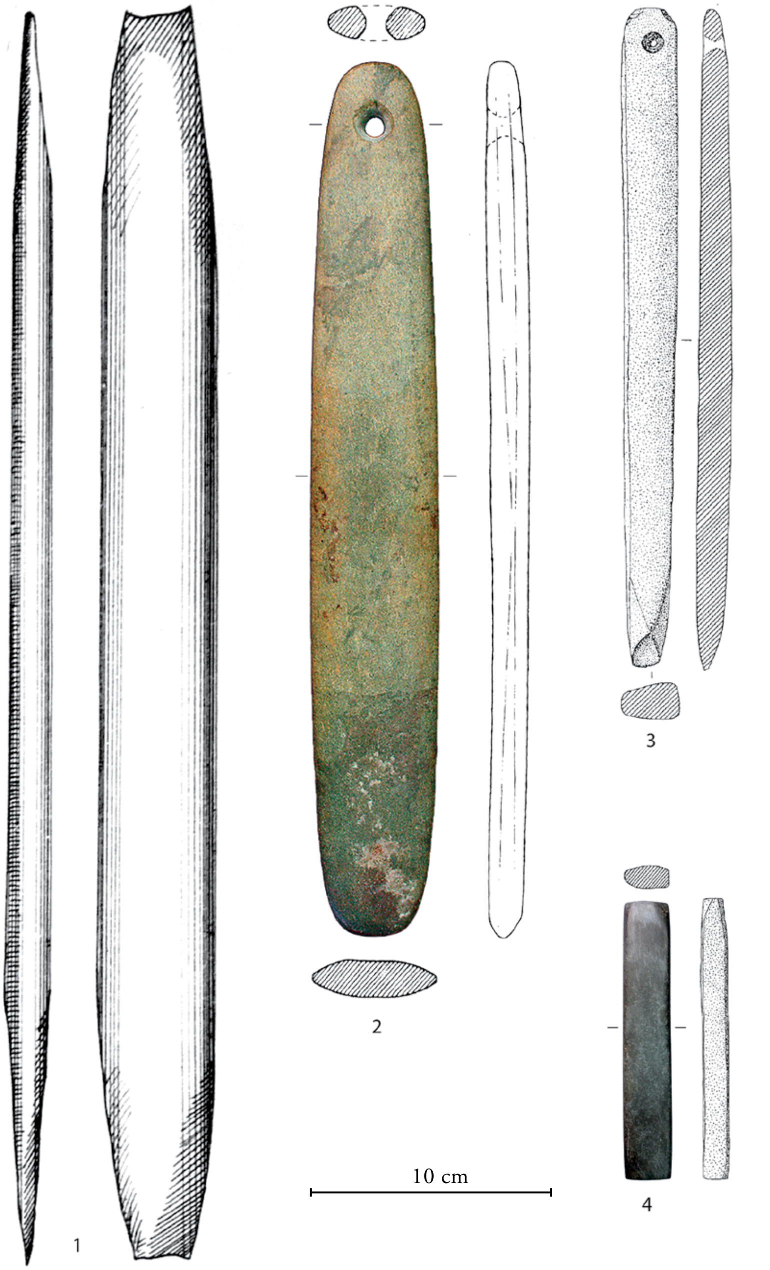

Fig. 2. Examples of stone artefacts from Early Bronze Age barrows in Brittany, France (the Armorican Tumulus culture): (1) Kerhué Bras near Plonéour-Lanvern (after archives of P. du Chatellier, Departamental Archives, Quimper; Nicolas 2016, pl. 29: 10; see du Chatellier 1880); (2) La Motta near Lannion, Côtes-d'Armor (Musée d'Archéologie nationale, Saint-Germain-en-Laye, no. 86179; drawing after Butler & Waterbolk 1974; photo: C. Nicolas); (3) Tossen Maharit near Trévérec, Côtes-d'Armor (after Balquet 2001); (4) Mouden Bras near Pleudaniel, Côtes-d'Armor (Musée d'Archéologie nationale, Saint-Germain-en-Laye, no. 72967; drawing after Balquet 2001; photo: C. Nicolas). Courtesy of Clément Nicolas.

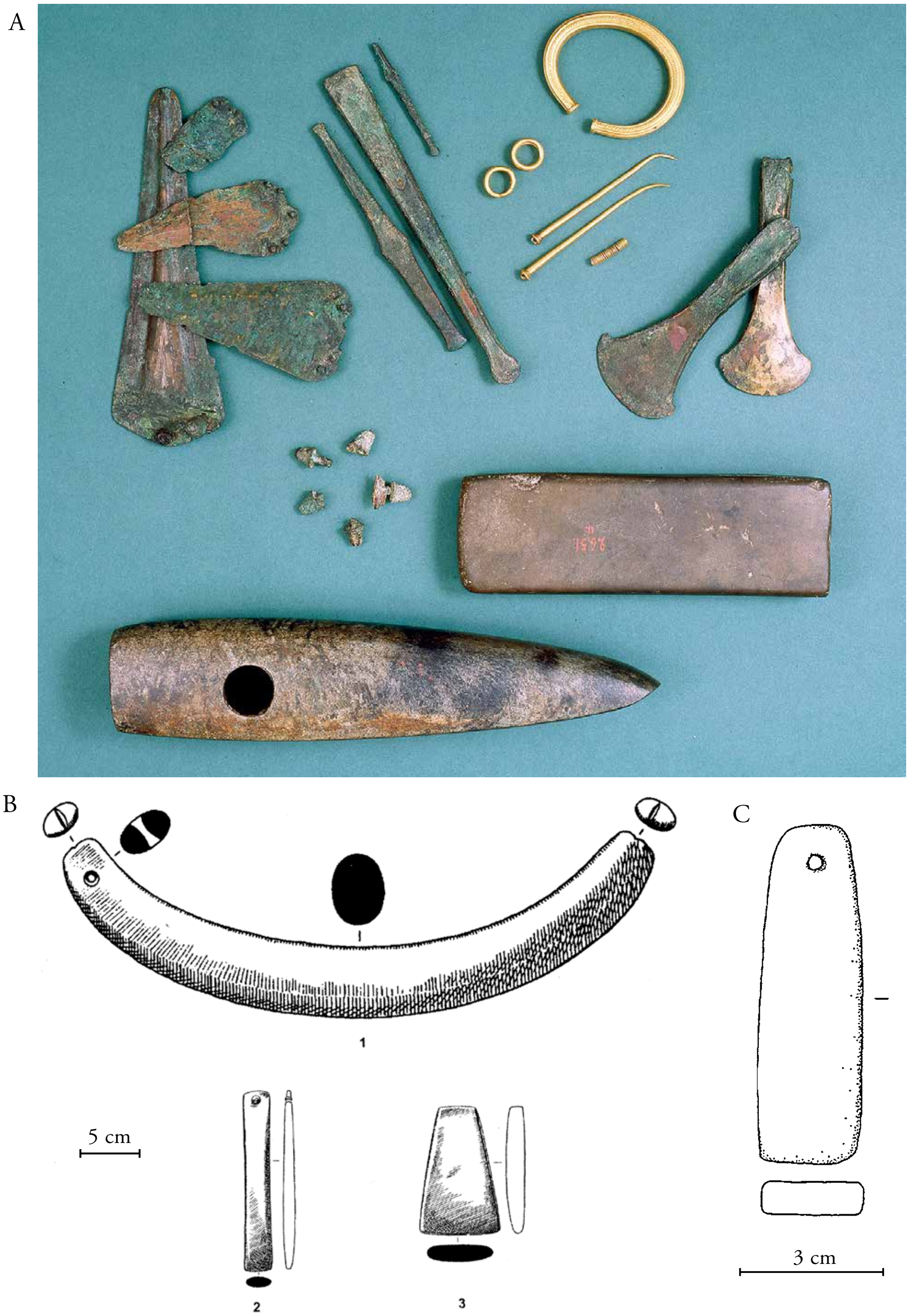

Fig. 3. Selected stone artefacts mentioned in the text: (A) Leubingen, Germany, the inventory of the Early Bronze Age (twentieth-eighteenth century BC) prestige mound, without scale (© Landesamt für Denkmalpflege und Archäologie Sachsen-Anhalt, E. Hunold); (B) Maikop, Russia, the fourth-millennium BC kurgan (after Piotrovskij 1998; Ivanova 2012, fig. 4); (C) Kourion-Kaloriziki, Cyprus, from prestige furnishing of a woman in burial 40, eleventh century BC (after Matthäus & Schumacher-Matthäus 2012, fig. 13).

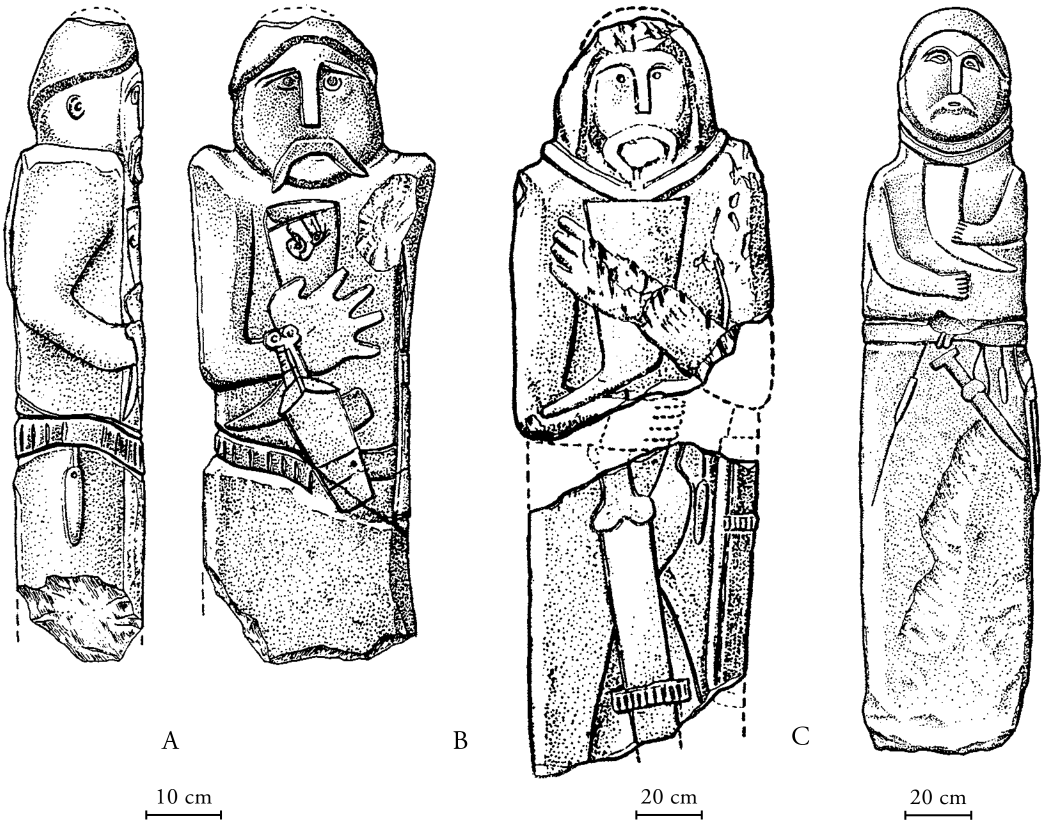

Fig. 4. Stelae ('stone grannies') from Ukraine, sixth-fifth century BC: (A) Ternovka; (B) Zolotaja Balka; (C) Erdelevka (after Olchovskij & Evdokimov 1994, figs. 8, 21, 42, p. 21).

Although knife-sharpening tools are no longer to be thought of with regard to the functional classification of the stone artefacts under discussion, a serious alternative for consideration is their use as smoothing tools for finishing metal artefacts or jewellery. The light colour of several artefacts with documented streaks of non-ferrous metals attests to this possible interpretation (as is also the case with forging or jewellers' tools in burial furnishings). Although such a classification cannot be excluded in some cases, several facts tell against its general application: (1) typical stone artefacts usually represent a relatively common component of women's and men's equipment, including the highest elites; they are also part of the equipment of armed individuals, as depicted on Scythian, Cimmerian, Turcic and other contemporary stelae between Ukraine and Mongolia (Fig. 4; see Chlenova 1975, figs. V and VI, pl. 2; Olchovskij & Evdokimov 1994; Hayashi 2005, 20-47); (2) the majority of the typical stone artefacts from burials are fitted for everyday use (with holes for their suspension from belts); (3) the quantity and the socio-geographical distribution of these tools in European burials, including rural ones, do not correspond to existing ideas about the number and distribution of goldsmiths' workshops; (4) the universal distribution of these stone artefacts correlates to the boom conditions for balances, weights, dirhams and use of hack- (fragmented) silver in general in early medieval north-eastern Europe, or in the bullion-economy zone; (5) the surviving traces of metal suggest that the artefacts under study were cleaned, which cannot be expected of smoothing and similar tools; and (6) not only metals but also minerals, and probably even speisses (see p. 114), left traces on the studied artefacts (including those of light colour). In any case, the potential use of (some of) the stone artefacts for goldsmiths' finishing work does not alter their symbolic role during the final farewell.

As a mere fragment of former reality, at least tens of thousands of touchstones have been found on northern and eastern European early medieval trade centres, elite sites and metallurgical workshops. The enormous number of damaged, discarded or lost touchstones from settlements and production contexts testifies to their low value (see Ježek 2013b, 723-725). However, these widespread tools, or even fragments thereof, became a symbol precisely and exclusively in the burial ritual, whereas their identical 'colleagues' used in everyday life never acquired this symbolic value. Like weapons, jewellery and other items, tools for determining the value of metal were also placed in children's graves, as the result of being directly adopted from adult reality, with their symbolic function not then differing from those in adult graves. In the same way as weights, touchstones also appear in many graves without any other furnishings. The absence of tools used to determine the value of precious metals among grave-goods is not a key issue for enabling a social description of graves.

Whereas some of the similar stone artefacts (being likewise oblong, with a rectangular cross-section, and of the characteristic material) among the thousands of examples from the Black Earth at Birka could perhaps be whetstones, it should be pointed out that no ancient whetstone of this shape from Europe has necessarily been confirmed to date by chemical microanalysis; massive streaks of iron would be expected. In any case, the stone artefacts of the shape and material typical for touchstones from settlement contexts at Birka have been set aside for now. For this phase of the research, 51 such artefacts from 48 Birka burials were selected, based exclusively on the likelihood of finding streaks of metal as suggested by an initial study of the artefacts under a binocular microscope. Undoubtedly, numerous other similar stone artefacts from the Birka graves also bear streaks of non-ferrous metals; however, at the same time, it is to be expected that the surfaces of numerous similar stones, from both Birka and other sites, will not reveal any traces of metal (for the reasons given above). In any case, the volume of results acquired during this phase of research is so great that it is better to hand over further research on these stone artefacts to more capable colleagues with better facilities. Furthermore, additional analyses would probably result in an increase in the volume of the same data that has already been collected (see below), and although surprises cannot be ruled out, they might happen only after additional weeks of analyses – or even never.

Post-excavation contamination has of course to be considered in the case of the tools under discussion, given that the possibility of modern contamination is naturally omnipresent. However, in fact, 'possible contamination' serves as a magic formula for defenders of the old order. If we regard the artefacts under discussion as touchstones on the basis of an anthropological approach (the reasons for the occurrence of specific objects in burial furnishing), the apparently scientific 'possible contamination' with precious (and other non-ferrous) metals remains just a manifestation of the fondness for wearing blinkers ('whetstones forever'). The problem of contamination can only be discussed over and above the analytical results, and it cannot be used as a reason to rule out undertaking chemical microanalyses.

Finally, the issues surrounding the subject of touchstones have so many various aspects ranging from the spiritual world of the given society, forms of exchange, archaeometallurgy and pre/historic mining, up to geochemical details or the history of science, that omissions – or even errors – made in the effort to achieve a comprehensive, albeit necessarily incomplete, approach are highly probable. I would like to ask readers to point out such parts in this work. Moreover, this text is inevitably just a mirror of logistic possibilities for chemical microanalyses of archaeological finds outside the author's home territory (Czech Republic). However, touchstones make it possible to determine which metals ancient people worked with, and metallurgical worksites in elite environments offer the best opportunity for such research. It is universally true in the case of touchstones that the deeper into the past one looks the more remarkable is the image obtained of ancient society.

The (pre)historic background – in brief

Touchstones are known from the ancient Indus Valley and Mesopotamian civilizations (e.g. Bisht 1982; Oddy 1983; Eluère 1985; Moorey 1985, 72-73; with refs.).[7] Burials furnished with stone artefacts used in metalworking appear in the Old World in the Eneolithic (for selected refs., see Ježek 2015, 126). In the narrower focus of this text, it is not surprising that at least dozens of Late Neolithic and Early Bronze Age burials in the territory of modern Sweden have yielded typical stone artefacts – oblong with a rectangular section and also with a hole in one end (e.g. the finds from Foss Järmunderöd, Jörlanda, Örsta, Norra Säm and Sorunda).[8] This is important to keep in mind when attempting to explain the massive quantity of touchstones from early medieval northern Europe, or the difference in numbers between Scandinavia and other parts of Europe – regardless of all the cultural, ethnic and other transformations, migrations, etc., that have taken place over more than 2,500 years.

In Early Bronze Age Brittany, touchstone candidates occur in richly furnished burials (Fig. 2; Nicolas 2016, 11, 17, 34, 59, and see pp. 227, 232, 264 for 'English' examples). A. Woodward and J. Hunter (2015, 76-80, with refs.) present selected artefacts under discussion from Early Bronze Age England as 'perforated stones'. However, a perforation is no basis for any functional classification; naturally, the same environment has also produced numerous similar objects without a hole (Woodward & Hunter 2015, 81-82). But, for example, the majority of over 100 Bronze Age stone artefacts of this type recorded along the Middle Loire (France) have a hole (Cordier 2009, 570-629). The same is true, for example, for the Early Bronze Age 'stone pendants', including marble specimens, from both settlement and funerary (a child's burial) contexts, and in one case even a ritual context, in Romania (Popa

7 I do not know the characteristics of 'whetstones' from burials excavated at Hengdalu (Yunnan), Maoqinggou (Inner Mongolia: Neimengguzizhiqu ... 1986, 239: 2), Xiaotun (Henan), Xibeigang (Henan) and numerous other ancient sites in north-western China. These stone artefacts (for an eloquent example, see Yang 2012, fig. 9: 22) appear relatively often in graves containing weapons or as a part of the furnishing of sacrificial burials. Due to the history of precious metal in ancient China, prehistoric touchstones can be expected particularly in the contact-zones influenced by central-Asian practices.

8 The Swedish History Museum's store was undergoing reconstruction during 2016-2017 so that the artefacts mentioned were not available for research purposes.

2013; see p. 36 for selected finds from neighbouring countries). We doubt whether the classification is correct of numerous finds of such Eneolithic and Bronze Age stone artefacts, as, for example, those from Velika Gruda grave 1 (Montenegro), Ostrovka kurgan 1A, Popovka (Crimea), and other pieces from Ukraine and south-western Russia (e.g. Primas 1996, 113-118), and Varna cemetery II grave 3, Bulgaria (Fol & Lichardus (eds.) 1988, 219-220, fig. 150). Typical stone artefacts from settlement features of various epochs at Uruk (Iraq) are classified not only as whetstones, but also as weaving needles (Becker 1993, nos. 1452-1469, pls. 127-128), or – in the case of fragments with a hole in one end – as loom-weights (a use which broken touchstones could eventually have served: nos. 1319, 1320, 1327).

Among the most famous Early Bronze Age burial sites also to have provided touchstone candidates are Maikop, Russia (see p. 16), Megiddo, Israel, with four weighing pans, 31 weights, etc, in grave 912 B (Guy 1938, 69-72, pls. 124-132), and the royal cemetery at Ur, Iraq, with dozens of burials, including female burials, e.g. RG1054 with a dagger (Woolley 1934, 412-459).[9] Counterparts are available from various parts of the Old World (for selected examples, see Ježek 2015, 126-127). D. Brandherm (2010, 324-325) considers that the metalworking tools from elite Bronze Age burials on the Iberian Peninsula (sometimes also containing typical stone artefacts) might have served as symbolic indicators of power, as does F. Bertemes (2010, 154) with a perfectly worked artefact from the well-known Leubingen Tumulus, Germany (Fig. 3: A); the author mentions its possible function as an anvil or touchstone. Even the ancient function of the tool from the grave-furnishing of this leader is not as important as the move away from the naive notion of the revered craftsman (cf. Ježek 2015). But for us it will be a surprise if the stone artefact from Leubingen does not bear any streak of precious metal. The same can be expected with typical stone artefacts from other European prestige burials, as – for example – from Early Bronze Age barrow at La Motta near Lannion, Brittany (Fig. 2: 2; Butler & Waterbolk 1974), Tiszafüred-Majoroshalom grave B 115, Hungary (Kovács 1995, fig. 5: 4), to Early Iron Age grave 186 at Klin Yar, Kuban, southern Russia, furnished also with an Assyrian helmet, etc. (Belinskij 1990, fig. 3: 4).

An example of the pitfalls of stereotyped interpretation of archaeological finds comes from Amesbury, England. The Bell Beaker culture grave, known as the 'Amesbury Archer' burial, contains a typical stone artefact that is black and rectangular, with smoothed faces (Fitzpatrick 2011, fig. 38, pl. 39).[10] The

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9 Penn Museum nos. B16959, B16993, B17090, B17091, B17092, B17093, B17094, B17095, B17565, 30-12-540, 30-12-594, 30-12-624, 30-12-654, 31-16-496, 31-16-497, 31-16-498, 31-16-499, 31-16-500, 31-16-501, 31-16-502, 31-16-503, 31-43-269 (marble), 33-35-123, 35-1-44, 35-1-45, etc..

10 Grave G54 at Amesbury produced an elegant streaky specimen, and further touchstone candidates are known from Wiltshire: e.g. Winterbourne Monkton and Upton Lowell, in this case even with identified streaks of gold (Fitzpatrick 2011, 115-116, with refs. and additional examples including Newgrange, Ireland). In any case, Amesbury can serve here as an eloquent example precisely because its publication is prepared exceptionally well and with an attempt to place the find in a broader context.

following quotation best clarifies the core of the problem: 'The microscopic and XRF examination, concentrating particularly on scratches and other recesses, failed to find any evidence for metal traces; likewise, none were noted by Needham during his inspection of the whole surface under low magnification in the British Museum. In contrast, the later analysis using Scanning Electron Microscope in Freiberg identified metal traces of two distinct compositions – silver and copper-rich gold – and as neither of these compositions is recorded for the north-west European Chalcolithic and as they were not apparent when the stone was examined previously, they are regarded as modern.' (Cowell & Middleton 2011).

Employing the methods used in the Department of Conservation and Scientific Research at the British Museum, it is not surprising that S. Needham (2011) failed to identify any streaks on this stone artefact and that his German colleague (E. Pernicka) later recorded streaks of precious metal with the use of a SEM; the explanation for this can hardly be found in contamination by the specialists to whom this artefact was entrusted. Instead, the surprise is somewhat different: finds of silver artefacts from the Bell Beaker environment, and from much earlier burials and hoards, are by no means rare in Europe. A number of such finds are recorded in central Europe from the Eneolithic (e.g. Págo 1981; Dvořák & Peška 1993; Dvořák *et al.* 1994; Guckenbiehl & Schreiber 2009; Zápotocký & Šikulová 2010, 408; Malach & Štrof 2015), and the figures increase toward the Balkans and the Mediterranean (for silver weapons, see e.g. Born & Hansen 2001, especially pp. 13-44). The above mentioned 'copper-rich gold' can be left aside, given that dozens (if not hundreds) of citations are available for the relevant period. It is a piquant fact in the case of the 'Amesbury Archer' that the origin of the buried individual, based on strontium and oxygen isotopes, is to be found in central Europe or Scandinavia (Chenery & Evans 2011).

The publication of the 'Amesbury Archer' burial, regarded as 'the earliest grave of a metalworker found thus far in Britain […]', also provides an example to illustrate the naive interpretation of the 'profession' of the deceased (Fitzpatrick 2011, xvi, 208-226, with an inventory of similarly classified graves, especially from central Europe). Disregarding the overall faulty nature of such a concept (see below), the grave furnishing of the 'Amesbury Archer' does not contain any evidence to justify such speculation (if a nodule of iron pyrite is not to be regarded as such). On the other hand, there is no doubt about the elite (albeit not prestigious) standing of the deceased, as is the case with many other prehistoric and early medieval graves furnished with touchstones (see Ježek 2015).

At the same time, a majority of prehistoric and medieval prestige burials do not contain any tools for determining the value of metal or for metalworking. Still, the number of burials furnished with typical stone artefacts is unlimited. We have selected here (and elsewhere below) just a few examples from classical antiquity.[11] Cyprus has provided numerous more-or-less prestigious Bronze Age burials furnished with touchstone candidates,[12] including burials at Pyrgos: tomb 21 contains at least five specimens, with c. 100 other artefacts (Belgiorno 1997; 2002a), and tomb 2a, with 59 'burial gifts', contains two typical stone artefacts (Belgiorno 2002b, 13, 21, fig. 10). There are numerous other examples, e.g. Toumba tou Skorou (Sørensen 2013, 199: with a weight, etc.), Amathus E tomb 269, Alambra 102, Vounous A 161, Lapithos 837, Kourion-Kaloriziki 39 and 40 (for refs. and additional examples, see, e.g., Matthäus 1985b, 27; Keswani 2004, 76; Schuster Keswani 2005, 356, 365-366; Matthäus & Schumacher-Matthäus 2012, 52, 72, 77, fig. 13). Balance pans are also present: a burial at Limassol even contains three pairs (Matthäus 1985b, 285-288). Palaepaphos-Plakes is another important Cypriot Late Bronze Age and Early Iron Age cemetery (for the stone artefacts, see Fig. 5). Tombs 144 and 145 contain gold objects, weapons, dozens of vessels, etc., as well as weights[13] and touchstone candidates (Karageorghis & Raptou 2014, pls. XXVIII: 38, XXXIX: 47). The richest local tomb (146) provided balance pans (see Petruso 2014), whereas no other tombs contained tools used to determine the value of metal. Recent excavation of 16 tombs and two pyres at Palaepaphos-Skales provided at least nine touchstone candidates from four or five tombs (185, 203, 210, 235, maybe 195?) and both pyres: tomb 203 contains three pieces, and tomb 210 two pieces (Fig. 5; Karageorghis & Raptou 2016, cf. p. 106; for the earlier excavations at this site, with at least twelve touchstone candidates from ten tombs, see Karageorghis 1983, or below, pp. 145-146).

'The only Early Iron Age collection of balance weights yet published in the region outside the Levant was excavated in Lefkandi […] from an élite 9th-century tomb' (Petruso 2014, 130). Another, monumental, so-called 'Heroön' tomb from this site in Euboea Island (Greece), an apsidal structure 45 m long and 10 m wide, contained two burials, dated to c. 950 BC. The skeleton of a woman was covered with several gold objects. The cremation burial of a man was furnished in a much simpler manner: beside a bronze amphora lay a sword, spear and an elegant stone artefact with a hole, a remarkable 27 cm long (Popham *et al.* (eds.) 1993, 19, pl. 13). Regardless of whether the buried horses represent the earliest evidence of a quadriga in Greece, the idea about the 'big man' buried at Lefkandi is correct. Another local grave with a suspicious stone artefact, Toumba 50, was also furnished with a spear, bent sword, etc. (Popham & Lemos 1996, pl. 57: 5). Whereas typical stone artefacts were part of the

11 S. Hansen (2016, 204), in his revealing study (unfortunately assuming a connection between weights and/or balances from burial furnishings and the activities of the buried individual: see Hansen 2016, fig. 17), points to the significant differences in the volumes of gold deposited in individual shaft graves at family cemetery A in Mycenae (Greece); some graves contained kilos of gold, others mere grams (Graziadio 1991). A similar situation occurs, for example, in the early medieval burial site at eponymous Vendel, Sweden (Stolpe & Arne 1927). The question remains if – or how – these differences reflect the social standing of the individual members of the given family (see below).

12 The touchstone candidates kept in the Department of Antiquities in Lefkosia, Cyprus, were not available for investigation in a SEM.

13 For finds of Bronze Age weights in Cyprus, see Petruso 1984.

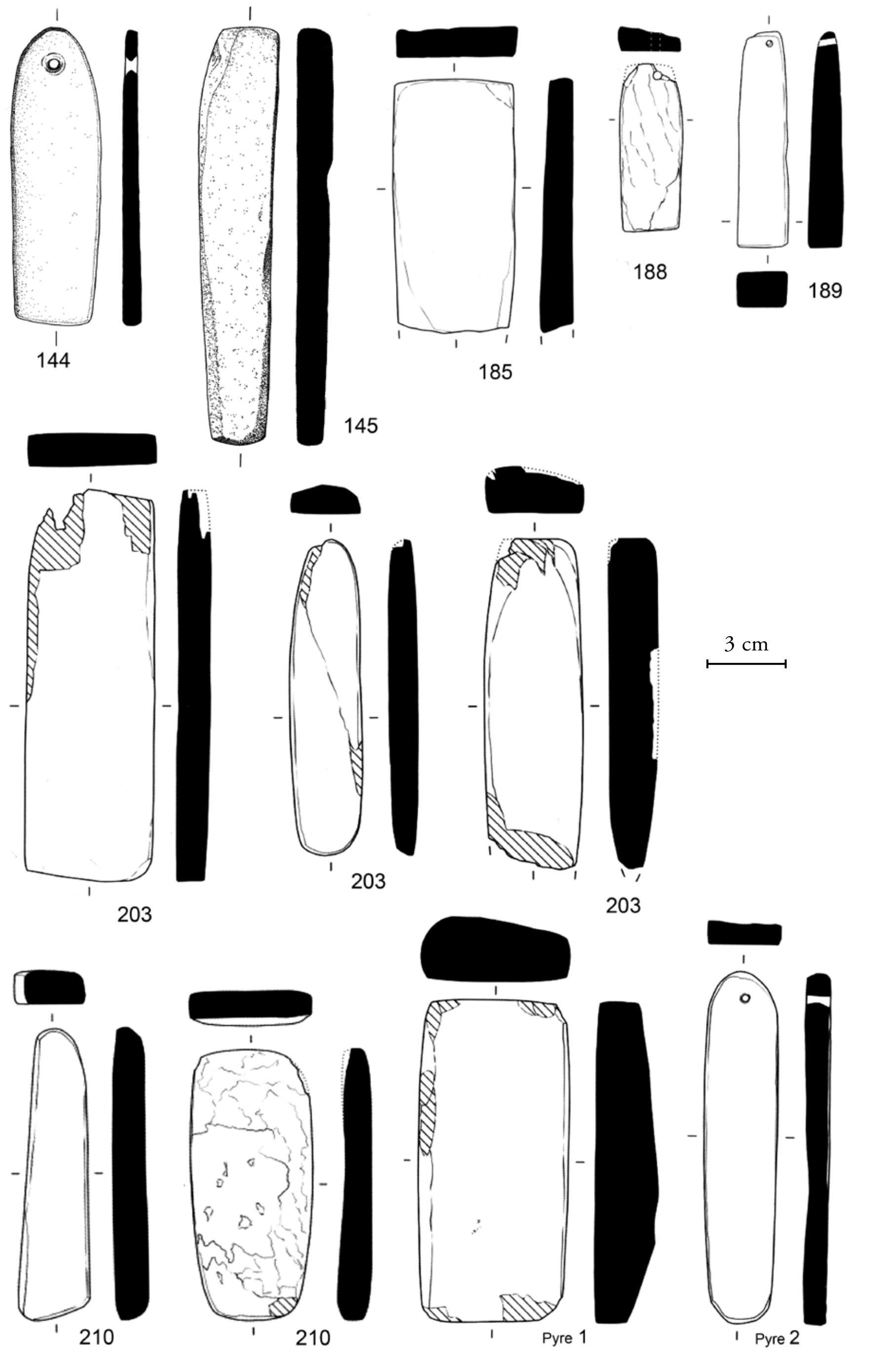


Fig. 5. Selected stone artefacts from the Late Bronze Age and Early Iron Age cemetery at Palaeapaphos, Cyprus, with tomb numbers. Nos. 144 and 145 from Palaepaphos-Plakes (after Karageorghis & Raptou 2014, pls. XC: 38, XCII: 47), nos. 185-203 from Palaepaphos-Skales (after Karageorghis & Raptou 2016, pls. LXXV: 9, LXXIX: 4, LXXXII: 37, XCIII: 58, 61, 70, XCVII: 19, 21, C: 2, CI: 2 (courtesy of Prof. Vassos Karageorghis; fig. L. Raslová).

furnishings of – for example – few burials in the North cemetery at Knossos (nos. 186, with two specimens, and 294: Coldstream & Catling (eds.) 1996, figs. 163 and 186),[14] a 'whetstone' was found immediately outside the entrance of the 'Tomb of the Double Axes' at Knossos (Evans 1914, 41; Preston 2007, 260, as a 'hone'). Similar burial finds are probably less frequent in mainland Greece, even from its 'pre-coin' period (for an example, see Graziadio 1991, 413). A touchstone candidate was found with a sword, two spearheads, horse bits, at least one chisel and other objects in grave XXVII at the Athenian Agora, from c. 900 BC (Blegen 1952, 290); however, this artefact is also too long (21.8 cm) for any available SEM chamber.[15] Numerous 'whetstones', sometimes regarded as 'pendants' (with a hole), have been found in settlement layers of the same period on Greek sites, including Lefkandi (Evely (ed.) 2006, 271, fig. 5.3, pl. 78), Kastanas, Kourtes, Nichoria, Vrokastro, Vouvesi, etc. D. Evely points out (and comments on) the frequent occurrence of schist and phyllite among raw material of these touchstone candidates from Lefkandi (for additional finds from Greece and refs., see Blitzer 1995, 441-444).

Although the disproportion in the number of burial finds of touchstone candidates from contemporary Cyprus and Greece could be a reflection of the publication status, the difference is striking. At the same time, the number (two dozen) of Late Bronze Age hoards from Cyprus is also significantly higher than the number of contemporary hoards from Greece; in the Levant only a few cases have been recorded (Bartelheim *et al.* 2008, 182; see below). The role of Bronze Age and Early Iron Age Cypriote society in the transmisssion of behavioural practices across regions is apparent.

Elegant 'whetstones' without any traces of sharpening appear relatively often in both more and less richly furnished Late Bronze Age and Early Iron Age burials from central Europe, in Scythian, Sarmatian, Cimmerian and other graves from the Crimea to central Ukraine, from the Carpathian Basin and many other areas. Half of the 28 selected Cimmerian burials furnished with, among other objects, typical stone artefacts, included by M. Burghardt (2012, 51, 136-140, tabela 5) in his overview of 'whetstones' of the Late Bronze Age and Early Iron Age east European Steppe cultures, evidently belong to the elite, and at least one fifth of them to its highest level (cf. Metzner-Nebelsick 2002, 400, for Kuban and the northern Caucasus). Naturally, the number of touchstone candidates from the Cimmerian environment is far higher. According to A.I. Terenozhkin (1976, 149), the alleged 'whetstone' is 'a general, almost obligatory attribute in Cimmerian warriors' graves'. For south-eastern Pannonia during the Urnfield and Hallstatt periods, C. Metzner-Nebelsick (2002, 398, with numerous examples and refs.) states that 'whetstones form a fundamental feature of the furnishings of male graves'. The importance of the tools under discussion in the

14 In the summary comment on the stone artefacts from Knossos North cemetery, D. Evely (1996, 624) wonders: 'Given the frequent accompaniment of the deceased's ashes by any number of iron, and even some bronze, weapons and tools, it is astonishing that more devices for preserving the sharpness of an edge were not recovered […]'.

15 I thank Sylvie Dumont for her kind assistance with the objects from the collection of the Agora Museum at Athens.

Fig. 6. Selected fourth-century BC touchstones from Scythian and other barbarian environments in the north Black Sea region. (A) Chertomlyk kurgan (inv. no. Dn.1863-1/446), length 18.4 cm; (B) Karagodeuash kurgan (inv. no. 2492/37), length 15.4 cm; (C) Kul'-Oba kurgan (inv. no. KO.-36), length 17.3 cm; (D) Malaya Bliznitza kurgan (inv. no. Mal.B.-14), length 18.5 cm; (E) Talaevsky kurgan no. 1 (inv. no. Kr.1891-1/25), length 11.6 cm; (F) Ahtanizovka hoard (inv. no. Aht.-16), length 13.4 cm (State Hermitage Museum, St. Petersburg; photos: A & E: L. Kheifets; B: A. Ju. Alekseev, C: A. Koksharov; D & F: P. Demidov).

Cimmerian, Scythian, Turcic and other steppe environments is illustrated by the fact that they are commonly depicted on stone stelae, albeit in a very schematic manner and often capturing only the most important attributes (bow, quiver, sword, axe, etc.), instead of anthropomorphic traits (see Chlenova 1975, figs. V and VI; Olchovskij & Evdokimov 1994).

Numerous authors have pointed out the absence of sharpening traces on 'whetstones' from the Eurasian steppes (from e.g. Terenozhkin 1976, 146, to e.g. Burghardt 2012, 52; with additional refs.). Besides the alleged function as amulets, the proposed explanations include the deposition of brand new artefacts in the graves (despite a simultaneous alert as to the unsuitability of the raw material for sharpening, including white marble), with finds from settlements being thought to have been lost by their owners even before they had been used… (e.g. Bessonova & Skoryj 2001, 108). In fact, these notions serve mainly as a warning about how archaeology manages obstinately to perpetuate its erroneous interpretations, which can be justified within the prevailing paradigm. Not even the erudite suggestion made by D. Williams and J. Ogden (1994, 142), who classified the Iron Age examples with gold finials from the Eurasian steppes as touchstones, has altered this situation in subsequent years.

As the word 'rich' can be a relative term in various cultural contexts, two illustrations are provided from the Scythian environment. (1) The 'central' chamber 5 of the Chertomlyk kurgan, Ukraine, containing (e.g.) six swords with gold hilts, a gold forging from a scabbard, etc., included a typical stone artefact with a gold finial and three 'empty' gold finials (Rolle *et al.* 1998, pl. 46, cat. nos. 129, 151, 194, 195); other local grave chambers provided two additional typical stone artefacts. (2) The Crimean Kul'-Oba kurgan contained large amounts of gold jewellery, including diadems, bracelets, etc., a sword with a finely decorated gold scabbard and hilt, a knife with a gold scabbard, several gold and silver vessels, two silver rhytons, together with the ivory facing of the sarcophagus (see Artamonov 1969). Other prestigious kurgans have also produced typical stone artefacts with gold finials, in several cases finely decorated (Fig. 6). Naturally, in Crimea and the Eurasian steppes (for dozens of selected finds from kurgans, see e.g. Anikeeva 2010, 193-194; Burghardt 2012, 59-75, 140-145), there are numerous less impressive touchstone candidates from fourth-century BC settlements, including some from monumental buildings (for an example, see Rogov 2002, 269-270). As usual, unpublished finds far outnumber those that are regarded as whetstones in the literature.

Recently, O.V. Anikeeva (2010) identified two typical stone artefacts with decorated gold finials as touchstones, from two male burials in Scythian prestige kurgan 29 at Filippovka in the south Ural region, near Orenburg (comprehensively Aruz *et al.* (eds.) 2000, 21-30, 73-179), from an excellent chemical microanalysis in which streaks of precious metal, traces of tin and also of iron, in one case, were documented. One of the touchstones from Filippovka provides a nice detail: the stone itself has two holes; however, its gold (later?) finial has only one hole, corresponding with one of the holes bored in the stone (see Anikeeva 2010, fig. 2). One at least of these touchstones is made of reddish-grey sandstone (see Aruz *et al.* (eds.) 2000, 82). To both A. Alexeyev (2012, 222; or Alekseev 2000) and Yu. Kalashnik (2014, 126-127), it is clear that these objects did not serve as whetstones. This does not, however, apply to contemporary stone artefacts of the same shape that are other than black in colour. During the recent excavation at Arzhan (Tuva, Russia) of the richest Scythian kurgan so far known in Siberia, dated to the seventh–sixth century BC, two elegant greenish-grey artefacts were found, both of which are rectangular in cross-section, with a hole in one end (Čugunov *et al.* 2010, pl. 98: 11; 104: 4; 112: 6; 115: 4). Neither of these comes from a local princely burial, but from two other graves, at least one of which is undoubtedly older than the kurgan itself. This grave (22), which also includes gold, turquoise,

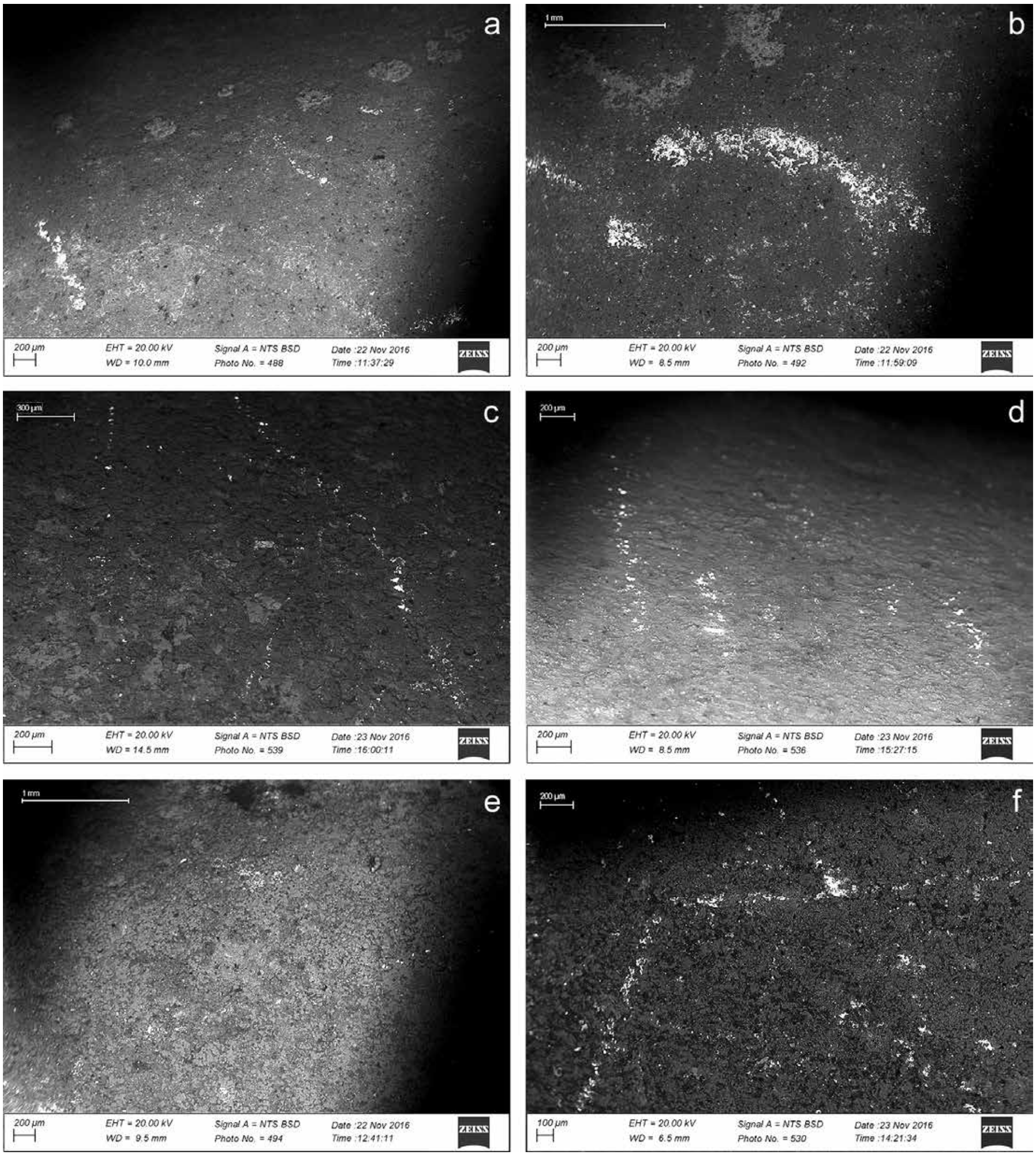


Fig. 7. Examples of the streaks of metal on touchstones from: **a** *Ahtanizovka, silver with an admixture of copper (and mercury), see Table 1: 8;* **b** *Ahtanizovka, an alloy of gold and silver with an admixture of copper, see Table 1: 9;* **c** *Chertomlyk, gold;* **d** *Karagodeuash, gold;* **e** *Kul'-Oba, gold;* **f** *Talaevsky, an alloy of gold and silver with an admixture of copper (photos: Ks. Chugunova).*

amber, etc., contained the skeleton of a woman aged 20-21, who died from four heavy blows to the head (Schultz *et al.* 2010, 298-300); the relatively poorly furnished grave 26 belonged to a man aged 23-25 (Čugunov *et al.* 2010, 88-90, 94-95).

Thanks to the understanding of colleagues from the State Hermitage Museum in St. Petersburg, and especially for the generous assistance of Andrei

An. No	Ag	Au	Cl	Cu	Hg	Pb	S	Sn	Fig.
1	2		2	37		39	2	18	
2	37	44	3	13			3		
3			1	11		37		51	
4	22		10	47		15	6		
5	70	3	8	10			9		
6	72		7	7	3		11		
7	67		17	12			4		
8	69		6	10	3		12		7: a
9	31	63	2	4					7: b

Table 1. Selected results of chemical microanalysis of the traces of metals preserved on the touchstone from Ahtanizovka, Kuban, southern Russia (Fig. 6: F; State Hermitage Museum, inv. no. Aht.-16). The data given in weight percent (wt.%) and calculated at 100 % are semi-quantitative. The geochemical background, i.e. elements deriving from the raw material of the stone, is excluded. Measurements: Ks. Chugunova.

Ju. Alekseev, it was possible to analyse several finds from the fourth-century BC kurgans between Crimea and the Altai Mts., attributed to the Scythians and their contemporaries. Stone artefacts with gold finials from five graves of the highest elite of the north Black Sea region (Chertomlyk, Karagodeuash, Kul'-Oba, Malaya Bliznitza, Talaevsky) and from a hoard of the fourth or third century BC (Ahtanizovka, Kuban) have a circular cross-section, with lengths of between 11.6 and 18.5 cm. Their colour is black, grey or dark purple (Fig. 6). While it can take hours in a SEM laboratory to find streaks of metal on touchstones from other sites, with these touchstones streaks of precious metals appear at any place in the visual field of the SEM. Numerous streaks of gold have highly similar chemical qualities: the vast majority involve gold with a small admixture of silver and copper, in rare cases pure gold; nickel is also marginally represented (c. 1 %) in gold with an admixture of copper. Streaks of iron were not found on any of these artefacts. The form of many streaks of gold testifies to the intentional testing of gold objects (see Fig. 7: c-e). Nevertheless, given other theoretical possibilities for their origin (for example, during the fixing of their finials, which are made of pure or almost pure gold, i.e. with a marginal admixture of silver and/or copper), we made a selection from the results of two dozen analyses of metal streaks preserved on a dark purple touchstone from Ahtanizovka (Fig. 6: F). The analytical results from this artefact (the only non-burial find from 'our' Hermitage assemblage) had, however, also been selected already during the observation phase, having numerous streaks with similar values at different locations on the stone (Table 1; Fig. 7: a, b).

It is difficult to imagine any reason for the omnipresent streaks of non-ferrous metals, in particular of gold, on the touchstones from Iron Age 'royal' kurgans between Crimea and the Altai Mts. other than as tests for the quality of the metal. I consider the question of the social environment in which these touchstones were used to be of greater significance. The gold finials and rings are a clear testimony to the ownership of the instruments. But why did the barbarian rulers need to test the quality of precious metal? The commonly shared notion of king or a 'kingdom' typically includes individuals on whom rulers bestowed authority, entrusting them with important functions. Would not Iron Age rulers have had specialists for this and other tasks? This question naturally also concerns the highest elite buried with virtual stone sceptres, for example, at early medieval Vendel and Valsgärde, Sweden (see Ježek 2013b, 717; 2016, fig. 1: B), Early Iron Age Lefkandi, Greece, or at Bronze Age Kerhué Bras and La Motta near Lannion, France (despite the absence of gold finials on these touchstone candidates), or individuals buried in graves containing even analytically confirmed touchstones. Reports written in antiquity contain little about the internal organisation of Scythian and other contemporary societies between Crimea and the Altai Mts., and the same is true of those about European societies to the north and east of the borders of the medieval Holy Roman Empire prior to the twelfth century AD.

If we do not wish to look for an explanation in ritual activities, in the light of touchstones apparently belonging to the highest elite, it is possible to question the image of 'kings', i.e. rulers with a large ensemble of servants. Prominent individuals, or 'big men', lacking the service of their 'court' appear instead of them. In principal, this difference corresponds with the definition of heterarchical and hierarchical societies (see Crumley 1979; 1995). Naturally, an important issue is hereditary rule; however, little is known about this matter for the barbarian world, including – for example – the Scythian environment. Although family origin could be a good foundation for a ruler's candidacy, it was by no means a guarantee of success (not to mention children who died in their infancy). This was and remains true in indigenous American societies, in which chiefdom has never been hereditary, nevertheless, the children of chiefs had/have a higher chance than others of becoming chiefs themselves (e.g. Zelený Apatana 2016, 185). At the same time, it was/is common for indigenous American groups to have several chiefs in charge simultaneously.

Early medieval burial sites in Swedish Uppland can be recalled in this context. Some of the men buried at Vendel, Valsgärde, Tuna in Alsike, etc., were actual rulers: graves of this type are found at all the listed sites, but always constitute a distinct minority. On the other hand, a higher number of elite graves, less lavishly furnished, also occur at all these cemeteries, together with graves that are relatively poorly furnished. The question is whether these are the cemeteries of families whose members competed for ruling positions, and thus also a strengthening of the power of their own family/clan, with luck always favouring one side or the other.[16] There could naturally have been many more local families involved in the struggle for power and, alternatively, some of their successful members need not have been buried in the family cemetery. The mounds at Gamla Uppsala are clearly the graves of leaders from the Vendel period (see Ljungkvist 2005). Gamla Uppsala, where the seat of a widely-acknowledged ruler can also be assumed, is located 3 km from Valsgärde and only a few dozen kilometres from the two other mentioned cemeteries, being

16 Moreover, it is probable that at least some of these families were related by blood.

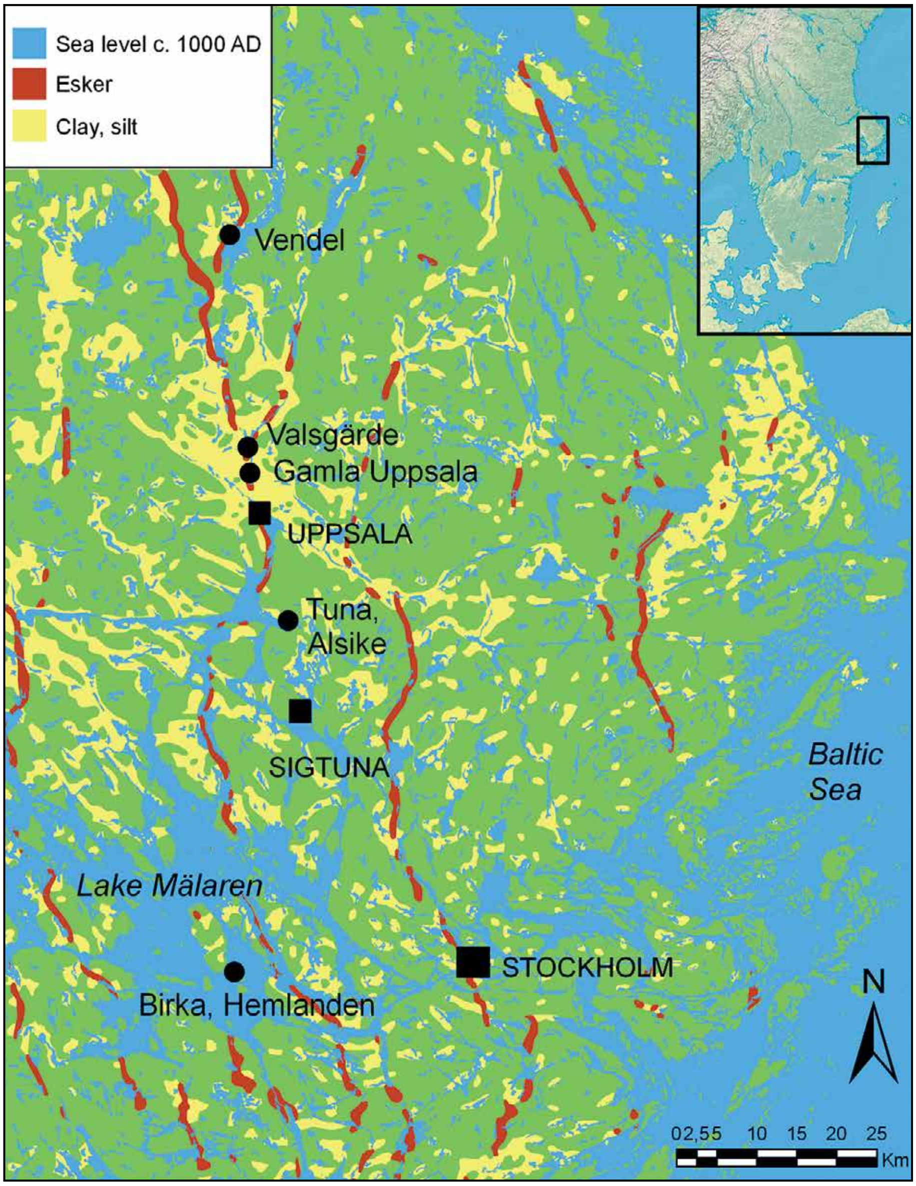


Fig. 8. Selected sites in Uppland, Sweden. As long ridges of pebbles (river tunnels during the Ice Age), the eskers offer an ideal terrain for roads in the countryside of central Sweden, unlike widespread morains, moors, etc. (courtesy of the author of the figure, Thomas Eriksson, on base map from the Sveriges geologiska undersökningar).

approximately halfway between them (Fig. 8). Of course, the archaeological inventory and the power of the early medieval 'big men' of Swedish Uppland extend beyond the mentioned cemeteries.

It would be inappropriate to characterise Iron Age (or barbarian) society on the basis of some stone artefacts. Nevertheless, the extremely rich grave furnishings of Scythian and other contemporary barbarian leaders are striking.

European archaeology leans toward the insightful observation of G. Kossack (1974) that luxuriously furnished graves appear as a response by indigenous elites to a crisis. Many richly furnished early medieval graves can be connected with written reports documenting subsequent changes in power relations and support such a notion (see, e.g., Randsborg 1991, 69, 150-153; Klápště 1994, 36; Biermann 2008; Brather 2009, 261). Or, a *circulus vitiosus*? These cases involve societies affected by Christianity, the introduction of which often went hand in hand in Europe with the formation of the first states. 'Oversized' grave furnishings then relatively quickly (within several generations) disappear with the stabilisation of social circumstances – or under the influence of Christianity? In any case, early medieval pre-Christian graveyards exist in which rich graves occur over the span of entire centuries (e.g. Vendel and Tuna in Alsike, Sweden). Prehistoric burials and their social circumstances are not reflected in written sources. It seems to be more probable that ostentatious grave-goods are linked directly and exclusively to the relevant individuals and their cultural context, regardless of the actual socio-political situation, or even a crisis, in any region.

Prehistory in archaeology and prehistory in practice

Among dozens of alleged 'whetstones' from the royal cemetery at Ur, Mesopotamia (see above, note 9; Woolley 1934, 412-459), are specimens with a gold ring for suspension, such as those of lapis lazuli (Penn Museum, no. B16695)[17] and grey schist (British Museum, no. 121681; Fig. 9: A, B). Naturally, the absence of a ring from a hole (or even the absence of a hole) has no significance – see, e.g., the touchstone candidate from the tomb of Queen Pu-abi from Ur (c. 2600 BC; British Museum, no. 121682; Fig. 9: C). A magnificent Middle Babylonian stone artefact, 22.5 cm long and made of green serpentine with a bronze ram's head finial, bears the name of Tukulti-Mer, king of the land of Mari (British Museum, no. 93077; Fig. 10: A).[18] At Vani, the most prestigious Colchian burial place in Georgia, burial 9, dated to the fourth century BC, was furnished with armour, large amounts of gold and silver jewellery, etc., together with a 14.4 cm long 'whetstone' with a gold finial (Georgian National Museum, no. 10-975:8; see Kacharava *et al.* 2008, pl. 35c). This is also the case with one specimen from the Viking Age settlement of Hedeby, Germany (Resi 1990, 35, tab. 10: 1; cf. Ježek & Holub 2014). Several touchstones from burials at Swedish sites, such as Vendel and Birka, are equipped with a silver ring for suspension. Another example is a 26.7 cm long 'whetstone' with a fine decorative bronze finial from early medieval settlement context at Llanbedrgoch (Wales), along with weights, silver ingots and other evidence for non-ferrous metalworking and trade (Redknap 2004, fig. 14).

One of the Old Babylonian hoards uncovered in the E.babbar temple of the sun god Shamash at Mesopotamian Larsa, Iraq, dated to the eighteenth century BC, contained 66 weights, scraps of precious metal, jewellery, beads, etc., and also a touchstone (Arnaud *et al.* 1979, 20-21, fig. 8; cf. Bjorkman 1993). Noteworthy among numerous finds of this kind from sacred environments (for the Mediterranean, see p. 151) is an object discovered in the Middle Elamite

17 As noted above, I was not permitted to investigate any touchstone candidates kept in the Penn Museum. Without conducting a chemical microanalysis of the artefact made of lapis lazuli, it is premature to attempt to resolve the question as to whether or not it served 'solely' as a prestigious symbol (of a touchstone?), as seems (also?) to be the case with typical stone artefacts made of marble (see p. 50).

18 As noted above, I was not permitted to investigate any touchstone candidates kept in the British Museum.

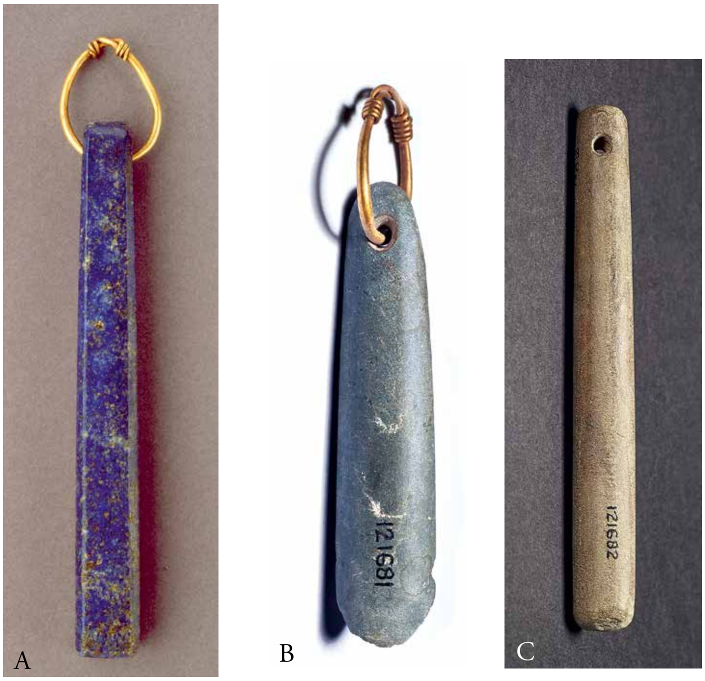


Fig. 9. Examples of stone artefacts from the royal cemetery at Ur, Mesopotamia (Iraq): (A) lapis lazuli with gold ring, from the 'King's Grave' PG 789, c. 2550-2440 BC, 11.1 × 1 × 1.3 cm (Penn Museum, no. B16695; © Penn Museum, image 152223); (B) fragment of grey schist with gold ring, c. 2600 BC, overall length 7.5 cm (British Museum, no. 121681; © The Trustees of the British Museum); (C) stone from the tomb of Queen Pu-abi, c. 2600 BC, length 11 cm (British Museum, no. 121682; © The Trustees of the British Museum).

Fig. 10. (A) Green serpentine artefact with bronze finial in the form of a ram's head, with nose terminating in a ring. The stone bears a dedication to the sun-god of Sippar by the local king Tukulti-Mer, length 22.5 cm, weight 680 g, Sippar (Abu Habba), Iraq, eleventh century BC (British Museum, no. 93077; © The Trustees of the British Museum); (B) stone and bronze, without context, 'Transcaucasia', 'ca. early first millennium B.C.', dimensions (overall): 20.2 × 12.7 × 29.7 cm (after the Metropolitan Museum of Art, acc. no. 1991.314.2; © 2016, image copyright of the Metropolitan Museum of Art/Art Resource/Scala, Florence).

Fig. 11. Susa, Iran: thirteenth–twelfth-century BC, black schist artefact with gold finial in the shape of a lion's head, length 15.8 cm (Musée de Louvre, Paris, no. Sb 2769; © RMN-Grand Palais (Musée de Louvre); © Christian Larrieu).

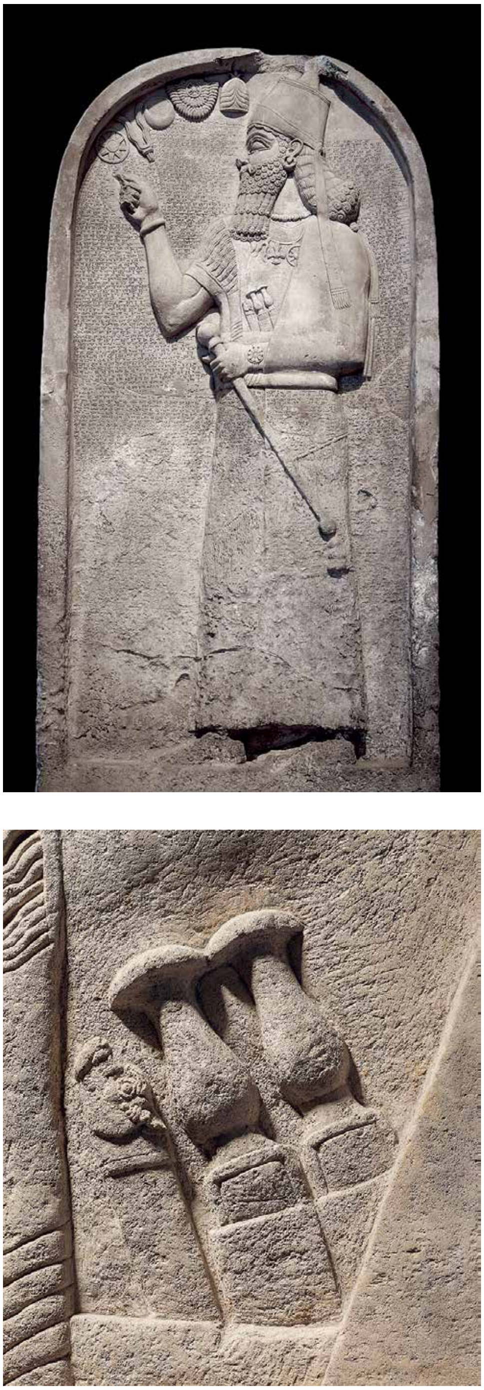
period temple at Susa, Iran, from the twelfth century BC. Regarded as a royal offering, the cache contained two (identical) figures of a king, one sculpted in gold, the other in silver, numerous different objects made of precious materials (gold, silver, lapis lazuli, carnelian, agate), nine earthenware statuettes of praying figures, two animal statuettes, animal bones, and also a typical stone artefact (Musée de Louvre, no. Sb 2769). This putative 'whetstone' is made of black schist and its end is finely decorated with a gold finial (or handle, if preferred) in the shape of a lion's head (Fig. 11). According to F. Tallon (1992, no. 91, with refs.): 'The stone itself bears no signs of use, and there are inexplicable traces of gold on it. It is undoubtedly a votive or ceremonial object […] Whetstones have long existed in the Near East. The earliest, without handles, are common in Mesopotamia […] They are pierced with holes at the top to hold rings […] One of the most precious examples of such a sharpening tool is the one in lapis lazuli with a gold ring found in the royal tomb of Meskalamdug at Ur.[19] Whetstones with zoomorphic handles appeared in the Early Iron Age […] Luristan has provided the most numerous and best known examples'.

Indeed, the luxurious touchstone from the temple in Susa, evidently in a votive context, raises the question of its role in ritual. This we are unable to answer, unlike the issue of the power of a fallacious paradigm. It is possible to continue with the words of another expert, O.W. Muscarella (1988, 183, with refs.): 'Whetstone handles are among the most common class of objects associated with the Luristan repertory, and hardly a museum or private collection lacks some in its possession. Given the large quantity of bronze and iron weapons attributed to Luristan it is not surprising that many whetstones also derive from there. […] It is not known just when whetstones were first embellished

19 Cf. Fig. 9: A. This artefact, however, comes from another tomb at Ur: PG 789 (the note by M.J.).

Fig. 12. Examples of the finials of stone artefacts from Early Iron Age Luristan, Iran: (A) cast copper-alloy finial in the form of an ibex head attacked by a lion, ninth-eighth century BC (British Museum, no. 122190; © The Trustees of the British Museum); (B) bronze, seventh-fourth century BC (Museum of Fine Arts, Boston, acc. no. 30.585; © 2017 Museum of Fine Arts, Boston); (C) fragment of grey stone with a lost-wax cast copper-alloy finial in the stylised form of a hero grappling two lions, ninth-eighth century BC (British Museum, no. 132058; © The Trustees of the British Museum); (D) bronze, eighth-seventh century BC (Metropolitan Museum of Art, acc. no. 56.28; © 2016, image copyright of The Metropolitan Museum of Art/Art Resource/Scala, Florence); (E) bronze, early first millennium BC (Metropolitan Museum of Art, acc. no. 57.51.43; © 2016, image copyright of The Metropolitan Museum of Art/Art Resource/Scala, Florence). Not to scale.

A



B

Fig. 13. Assyria, Nimrud (Kalhu), Iraq, 865-860 BC: (A) limestone stela of Ashurnarsipal II, height 294 cm (British Museum, no. 118805); (B) relief (gypsum wall-panel) depicting a protective spirit (British Museum, no. 118874). © The Trustees of the British Museum.

with zoomorphic protome handles, but one with a bronze ram's head inscribed with the sun god of Sippar[20] from Mesopotamia of eleventh-century B.C. date and one with a gold lion's head from the Inshushinak deposit at Susa[21] of thirteenth–twelfth-century B.C. date are considered to be the earliest examples known […] The next best dated examples of zoomorphic-headed whetstones […] are those with horse and calf heads on ninth- and eighth-century Assyrian reliefs […] Whether zoomorphic handles on whetstones were in use in Iran during the Achaemenian period remains a problem. Moorey (1971, 99) believes that the Achaemenians made whetstones handles in exactly the same manner as the Elamites, and he cites several unexcavated gold examples of protomes. […] Given the connection of whetstones with weapons used in battle and in the hunt, one might assume that the zoomorphic handle had an apotropaic or magic value that rubbed off, literally, onto the honed weapon.'

Typical stone artefacts with zoomorphic bronze handles – or better finials – were widespread in Early Iron Age Luristan, western Iran (for a few examples, see Fig. 12).[22] Along with daggers in belts, these objects form the equipment of genies (or protective spirits) on Assyrian reliefs and a ruler on the stela from Nimrud, Iraq, ninth century BC (British Museum, reliefs nos. 98064, 102487, 118804, 118874, 118877, 124530, 124531, 124564, 124565, 124566, 124567, 124578, 124586; stela 118805; see Fig. 13). Anthropomorphic finials were also produced, as is demonstrated, for example, by a grey touchstone candidate with a lost-wax cast copper-alloy finial stylised in the form of a hero grappling two lions (Fig. 12: C; British Museum, no. 132058). However, completely free-standing specimens probably also occurred at the same time, such as a stag, the torso of which forms an otherwise typical stone artefact (Fig. 10: B; Metropolitan Museum of Art, New York, acc. no. 1991.314.2), which remains in need of chemical microanalysis. Nevertheless, a majority of typical stone artefacts lack a metal finial (which, significantly, makes them unattractive to collectors). From those to be mentioned below, we can cite one of many: the 'whetstone' from the 'the toolkit of a worker' found at Tell Asmar, Iraq, containing a small copper chisel, two pointed gravers, a borer, etc. (Frankfort 1939, 5; for the finds from, e.g., Nippur and Harradum, see McCown & Haines 1967, 110; Kepinski-Lecomte 1992, 398-399).

At least hundreds of other artefacts used in either exchange or metalworking are also known from ancient Mesopotamia, in the form of weights which appear in various shapes. Their function is mostly clear for a number of reasons (including the inscriptions on some of them); however, the identical forms (oblong, ovoid, spherical, etc.) of many of the artefacts so classified are also known alongside later

20 See Fig. 10: A (the note by M.J.).
21 See Fig. 11 (the note by M.J.).
22 From numerous specimens: e.g. Museum of Fine Arts, Boston, acc. no. 30.589, 66.954; Harvard Art Museum, obj. no. 1931.4; Metropolitan Museum of Art, New York, acc. no. 32.161.13.

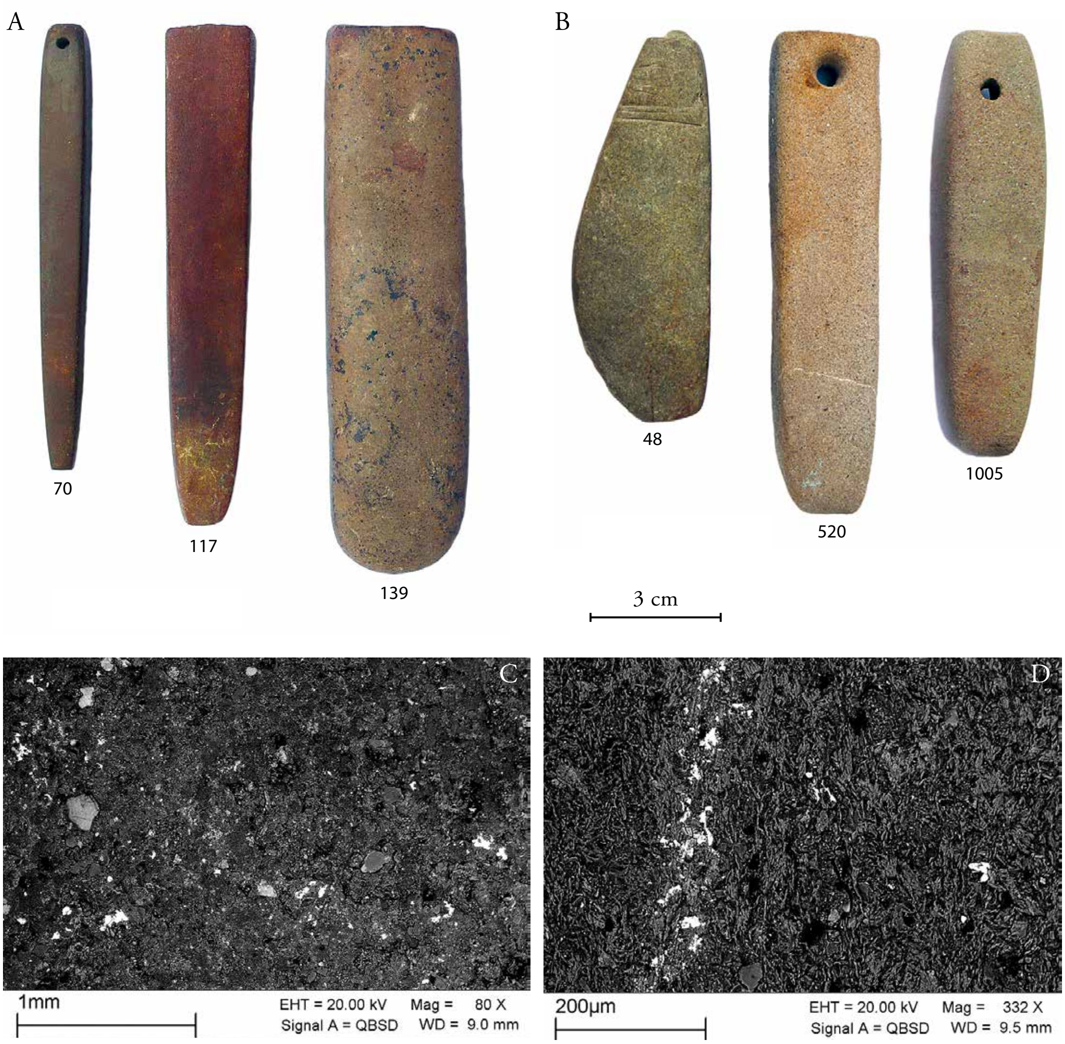


Fig. 14. Examples of finds from La Tène period cemeteries in Lower Austria: (A) Mannersdorf am Leithagebirge, graves 70 (?ceramic: see Ramsl 2011, 662), 117 (fragment of fine-grained sandstone) and 139 (fragment of sandstone); (B) Pottenbrunn, graves 48 (fine-grained quartzite), 520 (medium-grained sandstone) and 1005 (medium-grained sandstone; see Ramsl 2002, 367-368); (C) gold on the touchstone from grave 139 at Mannersdorf; (D) bronze on the touchstone from grave 48 at Pottenbrunn (courtesy of the Bundesdenkmalamt Wien and the Stadtmuseum St. Pölten; photos: M. Mehofer and the author).

European touchstones.[23] Of greater significance is the fact that the Mesopotamian weights clearly display a tendency that is virtually universal in the archaeology of the widest range of epochs and regions: 'By far the largest numbers of weights with

23 In the fine processing of the assemblage of weights from Nippur, Iraq, W.B. Hafford (2005, 348) states honestly: 'I weighed long, pierced objects noted as whetstones. These objects were similar to one another in form and could have been used as suspension weights; however, they did not show any significant sequence in the statistical program.' For example, a grave uncovered at Early Bronze Age (Mesopotamian) Mari, Syria, was furnished with 14 (?) 'weights', including one specimen with a hole for a ring (Rahmstorf 2014, 433, fig. 3: 5).

Grave no.	An. no.	Ag	Au	Cl	Cu	Fe	Ni	Pb	S	Sn	Zn	Note
Mannersdorf												
70	1			8	4			88				
	2			2	93				5			
	3							100				
117	4				39			5		56		
	5				63		11				26	Numerous grains
	6	2			75				23			
139	7		100									Numerous grains; Fig. 14: C
Pottenbrunn												
48	1			3	47				2	48		Numerous lines; Fig. 14: D
	2					100						One long line
520	3				86					14		
	4			21				79				
	5									100		

Table 2. Results of chemical microanalysis of the streaks of metals preserved on stone artefacts from La Tène burials at Mannersdorf am Leithagebirge and Pottenbrunn, Lower Austria (for the find-context, see Ramsl 2002; 2011). The data given in weight percent (wt.%) and calculated at 100 % are semiquantitative. The geochemical background, i.e. elements deriving from the raw material of the stone, is excluded. Measurements: M. Mehofer.

recorded find-spots at Ur come from funerary contexts. […] weights were probably buried with the people who used them in their everyday lives, such as merchants or metalsmiths. If the belief were that people continued their work in an afterlife, they would need their tools to do so. Nonetheless, nearly a third of the graves with weights contained only a single example, which is not a functional tool. A set is needed to evaluate almost anything. Scales are also needed […] Perhaps all that was deemed necessary was a representation of weights and weighing in order to continue work in the afterlife, or identify profession to the gods. […] The majority of graves with weights are poor in overall burial goods. Many have weights and no other grave-goods. […] Thus, those using weights were seemingly low in social standing […]' (Hafford 2012, 47-48).

The starting points of this paper dealing with (burials furnished with) tools used to determine the value of metal are completely different. We have not yet been able to handle any Mesopotamian, ancient Greek, Cypriot (etc.) touchstone candidates. All our present knowledge is dependent on the willingness of museums to lend their collections for chemical microanalyses. If we want to abandon the level of 'touchstone candidates' and deal with actual touchstones, an illustration of a 'whetstone' in a publication, the study of an artefact in a museum store, or even its observation under a binocular microscope, are insufficient.

Of the many finds from Iron Age Europe, the touchstones from two La Tène period cemeteries in Lower Austria are offered as examples. Typical stone artefacts were found in three of the 96 inhumation burials excavated at Mannersdorf am Leithagebirge (Fig. 14: A; Table 2). Numerous grains of gold were observed on

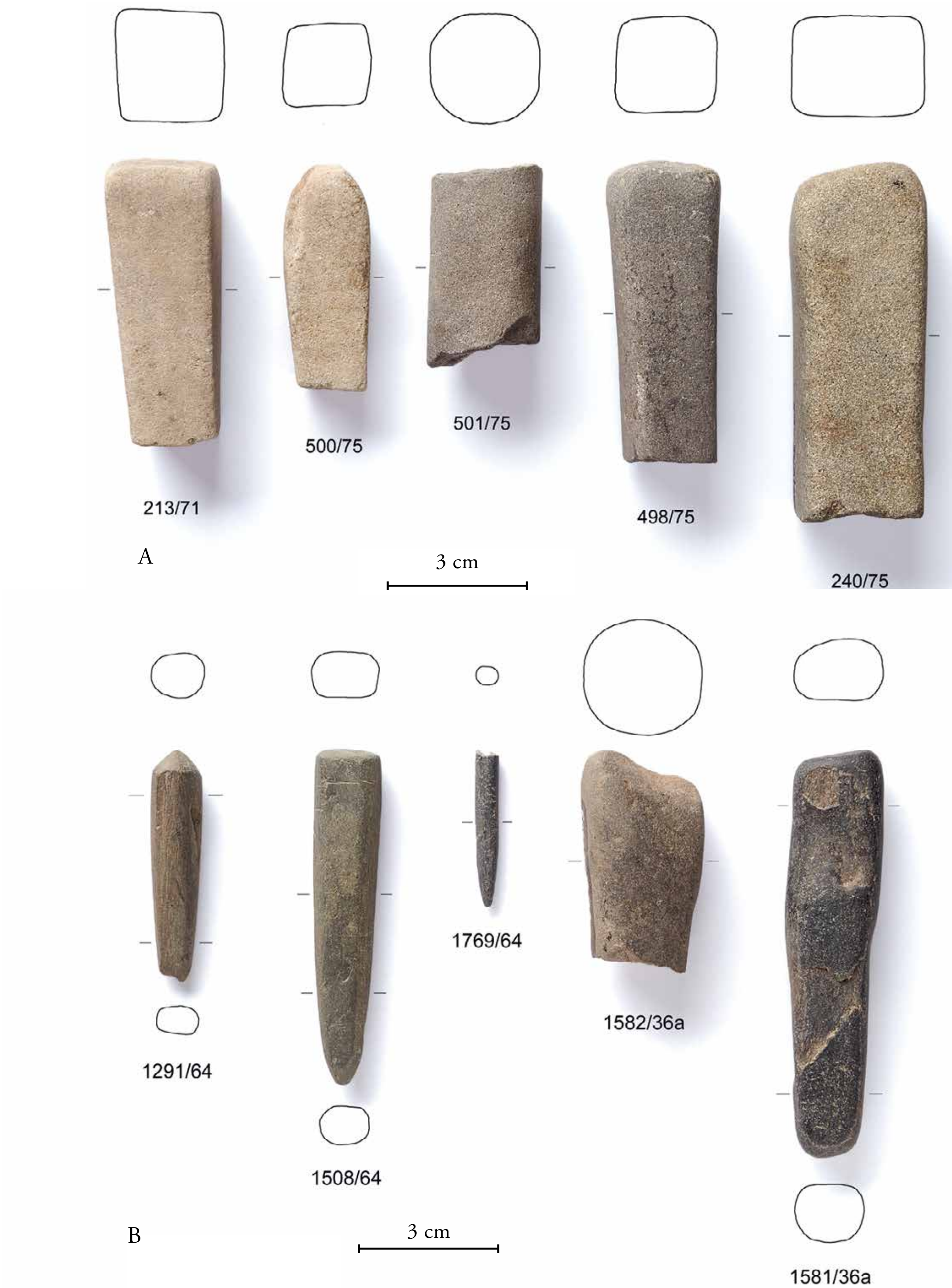


Fig. 15. La Tène period sites of (A) Bořitov and (B) Staré Hradisko, Czech Republic, settlement contexts: selected stone artefacts with preserved streaks of non-ferrous metals (inv. nos. after the Moravian Land Museum, Brno). (Photos: Z. Kačerová; fig. L. Raslová).

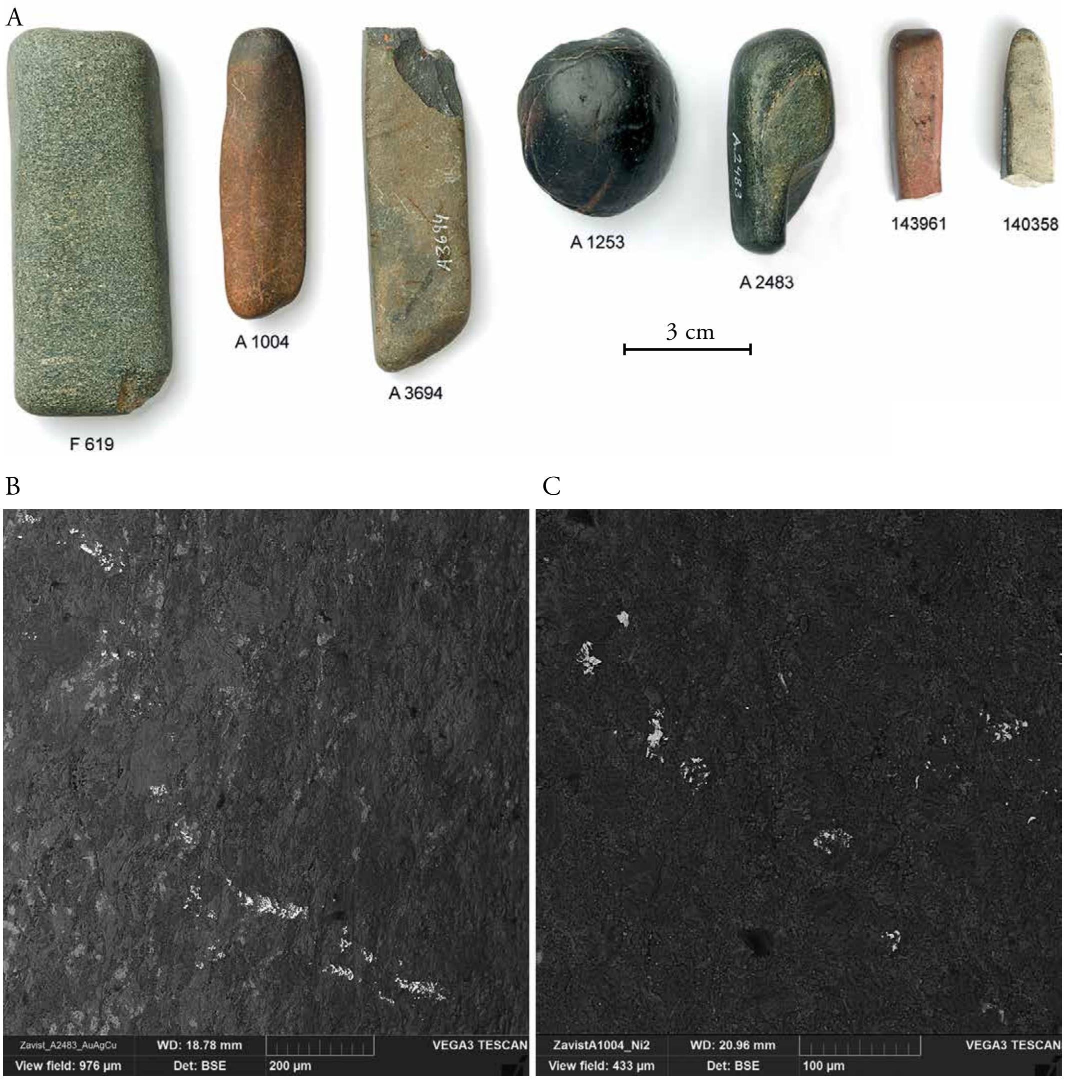


Fig. 16. La Tène period oppida Závist and Třísov, Czech Republic, settlement contexts: selected stone artefacts with preserved streaks of metals: see Table 3. (A) Závist: F619 medium-grained amphibolite, fluvial cobble; A1004 fine-grained fluvial cobble rich in silica (?quartz, ?quartzite, ?hornfels); A3694 quartzite (?), fluvial cobble; A1253 hornfels (metasediment); A2483 fine-grain amphibolite, cobble; Třísov: 143961 fine-grained quartzite, fluvial cobble; 140358 fine-grained aplite (?diorite-type). (B) Závist: A2483, streak of gold with a content of silver. (C) Závist: A1004, streak of nickel. Inv. nos. (Třísov) after the National Museum in Prague and (Závist) the Institute of Archaeology, Czech Academy of Sciences, Prague (photos: V. Böhmová and Z. Kačerová).

the fragment from grave 139. Streaks of bronze, brass and copper, with a marginal accompaniment of silver, were documented on the fragment from grave 117. The elegant and finely worked tool with a hole at one end, from grave 70, bears streaks of copper, lead and lead with a content of copper. This artefact is probably made of ceramic (Ramsl 2011, 56, 154, 662), but a reliable determination of the material cannot be made without seriously damaging it. In any case, high-quality ceramic could have fully replaced stone for the purpose of metal testing, and it is in fact

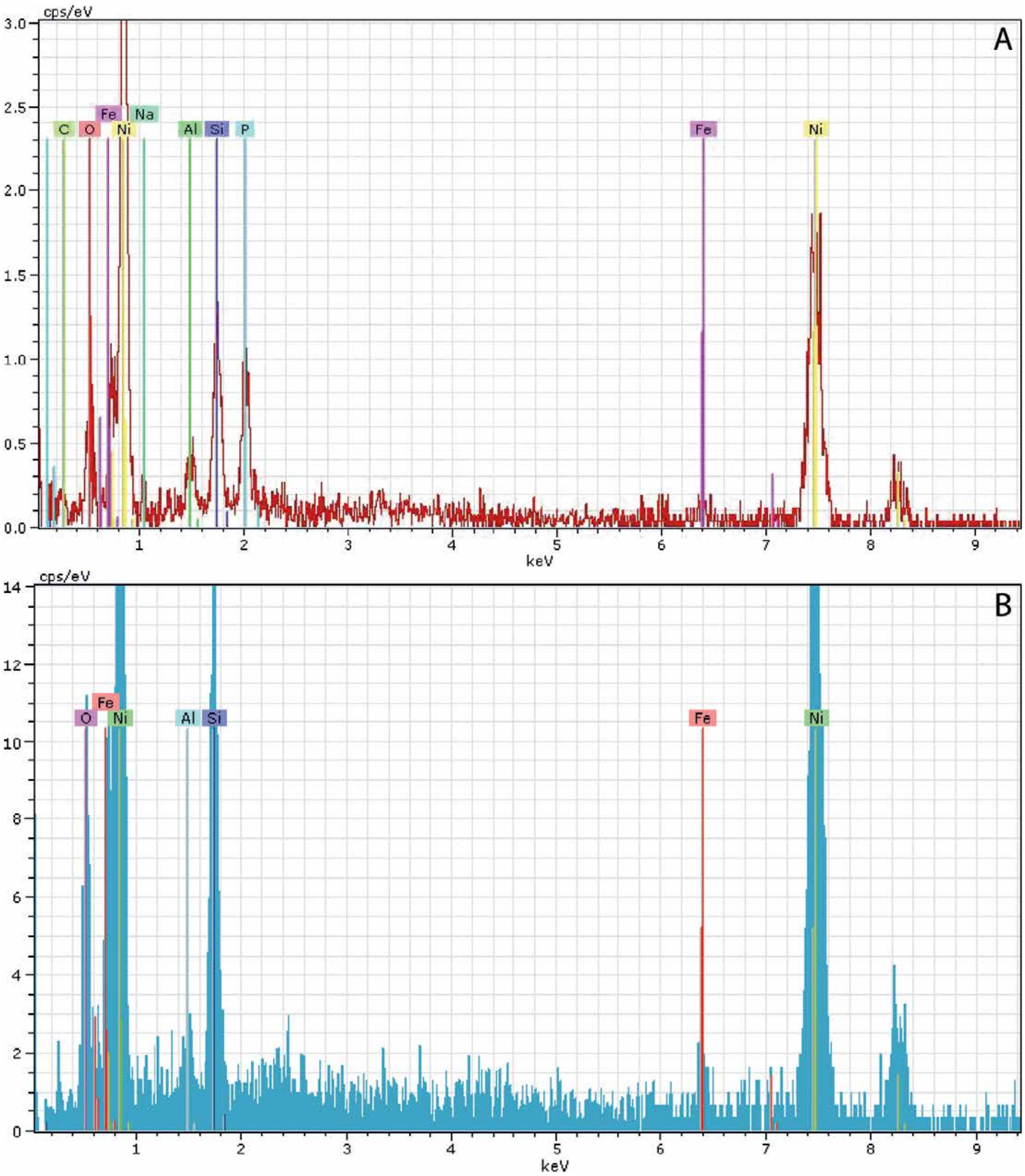


Fig. 17. Spectra of the streaks of nickel on the La Tène period stone artefacts from (A) Závist (inv. no. A1004) and (B) Třísov (inv. no. 143961).

curious that only this one example thought to be made of this material has been recorded thus far.

Touchstones were found in three of the 25 inhumation graves in the elite cemetery at Pottenbrunn (Fig. 14: B; Ramsl 2002, 88-89, 367-368). Two of these burials are among the six local graves containing a combination of a sword and a lance, or, in the case of grave 520, probably a standard; this grave also contained other exceptional objects (see below; Ramsl 2002, 131,

Inv. no.	An. No	Ag	Au	Cl	Cu	Ni	Pb	S	Sn	Zn	Fig.
Závist											
A1004	1					100					16: C, 17: A
A1253	2	26	62	12							
	3				62					38	
A2483	4	15	76	9							16: B
A3694	5	100									
F619	6		100								
	7						21		79		
Třísov											
140358	1						100				
143961	2			7	16			8		69	
	3					100					17: B
	4				8		88	4			
	5									100	

Table 3. Results of chemical microanalysis of the traces of metals preserved on selected stone artefacts from the La Tène oppida of Závist and Třísov, Czech Republic. Inv. nos. after the National Museum in Prague (Třísov) and the Institute of Archaeology, Czech Academy of Sciences, Prague (Závist). The data given in weight percent (wt.%) and calculated at 100 % are semiquantitative. The geochemical background, i.e. elements deriving from the raw material of the stone, is excluded. For the streaks of nickel, see Figs. 16 and 17. Measurements: Z. Korbelová and Š. Jonášová.

142-143, 152). Grave 48 has been interpreted as the burial of a craftsman or smith on the basis of the presence of bronze waste, semi-finished forms (Ramsl 2002, 139, 152, 154). As yet unanswered is whether all three graves belong to individuals of similar social standing, despite being furnished with different artefacts, as is also the case with other local burials. Streaks of bronze, lead, tin and iron are preserved on the touchstones from graves 48 and 520 (Table 2). No trace of metal was observed on the artefact from grave 1005, meaning that the artefact is not a whetstone.

Naturally, typical stone objects appear not only in graves. Several touchstones from Iron Age gold mines in Gaul have been published by B. Cauuet (1994, fig. 24; 1999, fig. 47). The oppidum of Bibracte probably produced many more touchstones than were identified by F. Fleischer and W.-R. Teegen (2004). Traces of non-ferrous metals are preserved on stone artefacts from the La Tène oppida of Závist, Staré Hradisko and Třísov, in the Czech Republic (Figs. 15-17; Table 3; see also below). Metallurgical activities are usually present in oppida. The site of a mint, Stradonice oppidum, has produced finds of blacksmith's tongs, hammers, numerous 'whetstones' and a balance, as also Třísov oppidum (e.g. Píč 1906, pls. 35: 30; 46: 1, 2, 9). There are 42 'whetstones' known from the contemporaneous archaeological site of Bořitov, Czech Republic (Čižmář 2003, 53-55, 80-81; Leichmann 2003), of which we have analysed only five, all with streaks of non-ferrous metals. Silver, nickel, brass, a metal composed of gold, silver and copper, a metal composed of copper, lead and zinc, and metals composed of copper, zinc and nickel were all observed (see below). However, in the case of settlement finds, the question of their functional classification remains open, particularly given the shape of several of them; the occurrence of smoothing tools for finishing work on metal artefacts is also to be expected in La Tène period oppida (see pp. 115-116, the case of Ohrozim).

Traces of precious metals have been observed on stone artefacts of various shapes from Early Bronze Age workshops (e.g. Delgado-Raack *et al.* 2016, with refs.) as well as from Eneolithic and Early Bronze Age burials (e.g. Bertemes *et al.* 2000, with refs.). Some of these stones are rounded and/or light, which casts doubt on (but does not rule out) possible thoughts on their function as touchstones. Indeed, at least some of them, including finds from graves and grey oblong artefacts, most likely were not used as touchstones, but as working tools (e.g. Drenth *et al.* 2013; Pernicka 2015; Ernée *et al.* 2015, 129-140, 152-155). However, unlike their counterparts from prehistoric workshops and settlements, grave finds offer limited orientation. The choice of artefacts used in burial furnishings in the distant past was not based on the naively practical perspective characteristic of modern archaeology, but rather on much richer and complex contexts of the spiritual world (see Ježek 2015). In any case, the occurrence of the stone artefacts in question in ancient burials cannot be just cause for identifying them as the graves of metallurgists, goldsmiths, jewellers, their masters, etc. (see below).

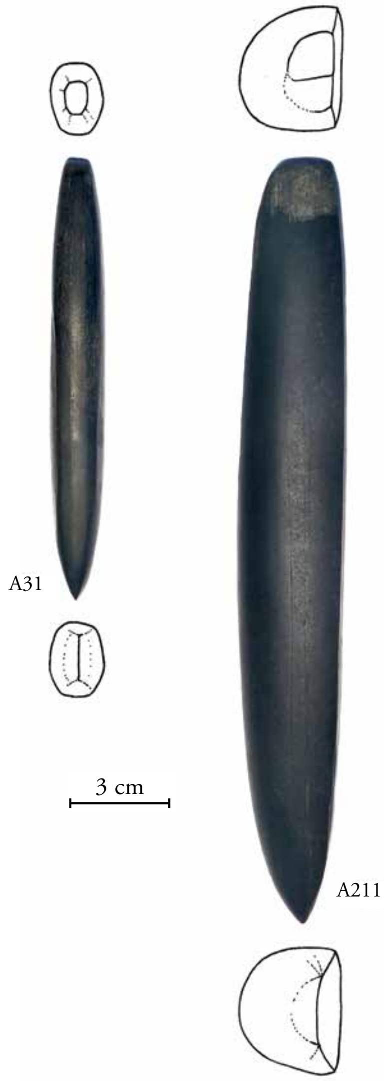
Countless archaeological finds of this type have been made in Europe and beyond, both prehistoric and medieval. To represent them, we can select a house at Bronze Age Knossos where 'a curiously shaped whetstone with tortoise-like head' was found (Evans 2013, 629), and a house uncovered in el-Lahun (Egypt), dated to the Middle Kingdom period, in one room of which were found flint and copper implements, alabaster vases, a fine metal mirror and other remarkable artefacts, together with several tools, including two chisels, a piercer, a 'whetstone', etc.; 'the overall impression they give is of a group of ordinary possessions belonging to a workman and his wife' (David 2003, 135).

Neolithic tools with streaks of precious metal are also known, as illustrated by a Neolithic object, identified from metal streaks as a touchstone by V. Zedelius (1981, 4), that forms – together with a balance and weapons – the final furnishing of an individual belonging to the Frankish elite. Two Neolithic axes found in Prague, in the nineteenth century, are covered with streaks of precious metals and lead, which can hardly stem from the Neolithic (Fig. 18).[24] The raw material and the perfect smoothing of Neolithic polished stone artefacts, found by chance in the distant past, were ideal for secondary use as a touchstone; so, for example, a fragment of a 'Neolithic axe polisher' found among touchstones in the medieval trading site of Fribrødre Å, Denmark, causes no surprise (Skamby Madsen & Klassen 2010, 271, classified as 'whetstones').

Turning attention to raw materials suitable for touchstones, the most common are metamorphic rocks such as schist, slate (or phyllite), quartzite, various types of fine-grained and solid metasediments or hornfels; fine-grained sandstone also served this function well. Nevertheless, stone artefacts of the characteristic

24 I thank Jan Zavřel for drawing my attention to these artefacts, which lack any detailed find-context, held in the Museum of the City of Prague (inv. nos. A31 and A211).

Fig. 18. Neolithic axes found in the territory of Prague in the nineteenth century, with numerous later streaks of silver, lead and alloys of gold, silver and copper (Museum of the City of Prague, inv. nos. A31 and A211; object A211 was found near Prague Castle; photo: J. Zavřel; fig. L. Raslová).



shape made of various shades of marble occasionally appear among grave-goods. The sides of these stones are usually so smooth that their suitability for touchstone use is to be suspected; in fact, no traces of metal (including iron) have so far been identified on any marble 'whetstones'. The same is true for an extraordinarily fine artefact from grave 12, with otherwise rather common grave-goods, from the Migration period cemetery at Klučov, Czech Republic (Fig. 19; see Svoboda 1965, 246). However, due to its length of 23.4 cm, we could only observe central parts of this elegant and smoothly polished artefact in the SEM chamber. The only certainty is that it is not a whetstone. It is made of calcareous siltstone, most probably not of Bohemian provenance. In addition to its light beige colour, this specimen is presented here above all because, unlike marble, lapis lazuli (see above) and some schist artefacts of this kind from prehistoric burials, it does not have a hole for suspension. Its role as a visible indicator of the social standing of its bearer in daily life is very doubtful – unlike the role of an occasionally used (or even symbolic?) tool. This is also the case with the longest touchstones from early medieval aristocratic burials at Vendel, Sweden, for example (Ježek 2016, fig. 1: B).

Finally, a technical note on the issue of touchstones in general. The early medieval bullion-economy zone, and the activities conducted at Birka in particular, resulted in the 'production' of an extremely large number of metal streaks on touchstones. The results of the analysis of selected touchstones from contemporary Hedeby, Germany (Fig. 20; see Ježek & Holub 2014)[25], or from

25 With two serious errors: 'Gr. no. 28' in the final catalogue (Ježek & Holub 2014, 203) should be replaced by 'Gr. no. 32', as used elsewhere in the paper. However, grave 26 appears everywhere in the paper: the typical stone artefact from grave 26, as also depicted and described there (Ježek & Holub 2014, fig. 1, p. 203), is lost. The analytical results connected with the object from grave 26 in the paper in fact concern artefact no. KS 11779 IV. It is impossible to determine in this case, excavated in 1904, whether it comes from a grave or settlement. I thank Volker Hilberg and Inga Sommerfeld for kind help.

Fig. 19. Klučov, Czech Republic, Migration period burial (no. 12). Length 23.4 cm, max. cross-section 2.8 × 1.7 cm (Regional Museum at Kolín, inv. no. A15388; photo: J. Zavřel).

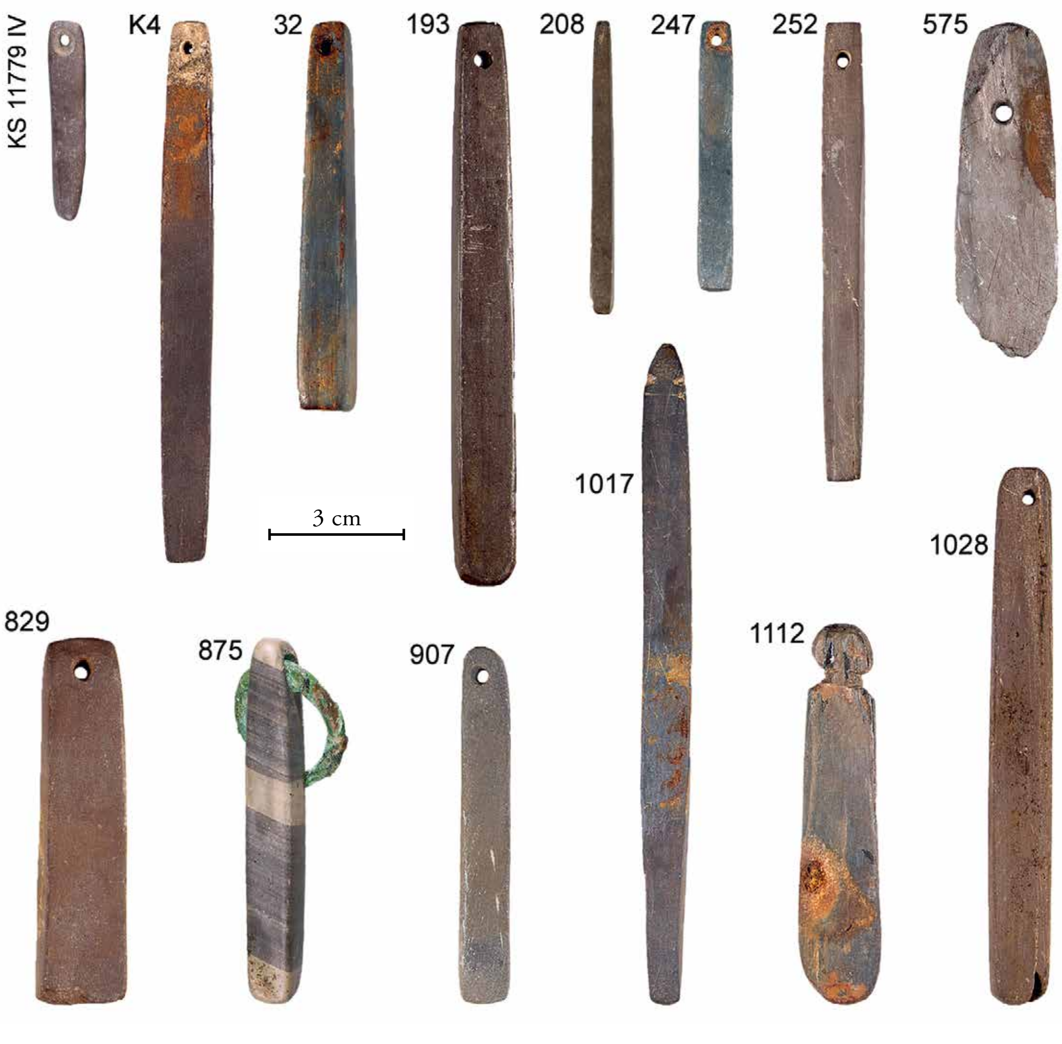


Fig. 20. Hedeby, Schleswig-Holstein, Germany. Touchstones with analytically confirmed streaks of non-ferrous metals. Burial nos. in the figure (horizontally) after Arents & Eisenschmidt 2010. For the analysis results, see Ježek & Holub 2014: there, analytical results presented erroneously as concerning the find from grave 26 (which is lost, and therefore should not appear in the mentioned paper, including its fig. 1) belong in fact to the artefact no. KS 11779 IV (without any detailed context). Archäologisches Landesmuseum, Stiftung Schleswig-Holsteinische Landesmuseen Schloss Gottorf, Schleswig (photo: C. Janke; fig. V. Hilberg).

eleventh–twelfth-century Poland (Ježek 2013a; Ježek & Płociński 2013; Ježek *et al.* 2010; 2013), are incomparably 'poorer'. Consequently, I do not anticipate a similar situation to that encountered at Birka with Bronze Age or Iron Age finds, or with early medieval finds from the regions outside the bullion-economy zone. I estimate that only sporadic streaks – or rather just grains – of precious metals are preserved on many prehistoric and early medieval touchstones, and even their absence should not be surprising. Birka serves as an example below; however, even if the results from this site can be taken as illustrative of the range and variety of metals that have left traces on touchstones, this example is extraordinary. I am sure that touchstones without any preserved streaks appear also among local burial finds, not to mention the finds from the 'Black Earth'. Generally, for the Bronze Age, the absence of streaks of bronze means that the artefacts in question did not serve as whetstones, as likewise the absence of streaks of copper on typical stones from the Eneolithic. Beginning with an advanced Iron Age, the absence of streaks of iron could be a good guide as to the correct classification of such stone artefacts.

Not just stones

Archaeology provides numerous examples to demonstrate the fact that a clear and specific explanation cannot be found for symbols used in burial rituals. These are elements that have accompanied humanity for millennia, and with the transformation of entire ethnics, cultures and belief systems, the original meanings of symbols have been long forgotten, sometimes replaced by others in connection with local/period faith and myths. However, the phenomenon itself, or rather its formal expression, has been maintained. An example is offered by the occurrence of forging tools in ancient burials (Ježek 2015; for early medieval cases from the western part of central Sweden, see van Vliet 2013; for a part of southern Europe, see de Vingo 2012; with numerous refs.). Although many forging tongs are known from prehistoric and early medieval European burials, only three of them are longer than one metre (Fig. 21). Grave I at eponymous Vendel (Uppland, Sweden), from the seventh century AD, also furnished with a typical helmet, two magnificent swords and many other exceptional objects, contained a forging hammer and tongs 116 cm long. Forging hammers have been found in three further local burials (Stolpe & Arne 1927; Ohlhaver 1939, 135, pl. 18: 4; for the touchstones from this cemetery, see Ježek 2016). The eighth-century boat grave 7 from the similarly prestigious burial site at Valsgärde (Uppland, Sweden) contained forging tongs 117 cm long, together with a Vendel helmet, two exquisite swords, etc. (Arwidsson 1977; for the touchstones from this site, see Ježek 2013b, 717). The superb tongs from the extremely rich Germanic 'royal' burial, dated to the second century AD, at Mušov (south Moravia, Czech Republic), are 108 cm long (Feugère 2002; see Ježek *et al.* in press).

In archaic societies, the highest power was in the hands of those individuals who performed the most significant, periodically repeated, rituals (e.g. Green 1998, 199-202; Krausse 1999, 344, 355), including those dividing periods of several years (for early medieval or Late Iron Age Sweden, see, e.g., Sundquist 2002; Line 2007, 338, both with refs.; cf. also Dobat 2006). Ritual metallurgy played an important role, beginning with the period when uses for metal were being discovered, and 'ritual leaders represented the highest authority' (Kristiansen 2012, 382). This does not mean that these leaders had themselves mastered the art of metallurgy; experts were undoubtedly in control of the performance, which was not allowed to fail. In any case, forging tools belong to the traditional funeral furnishings of ancient elites, regardless of whether the

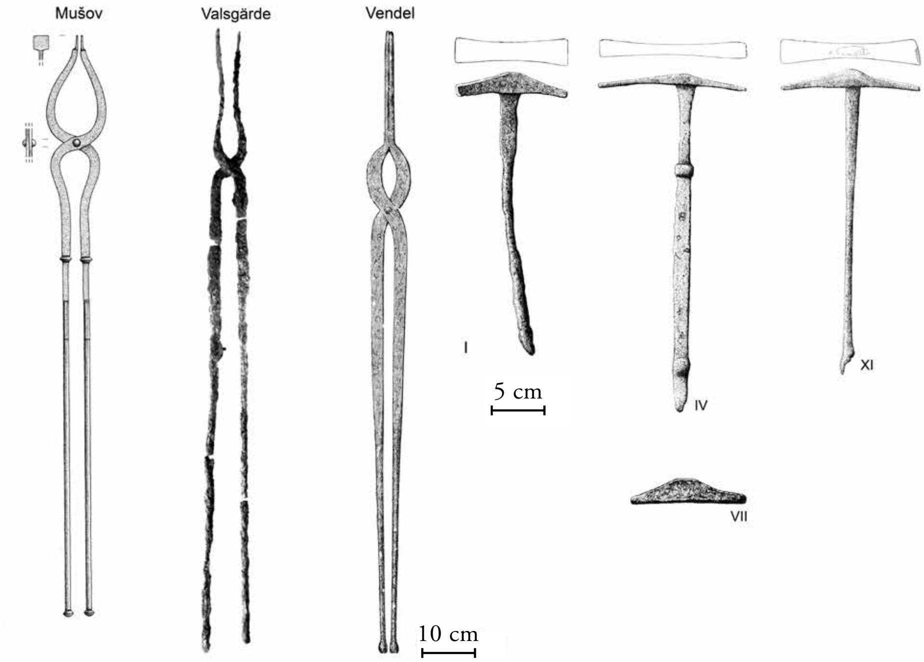


Fig. 21. Forging tools from the 'royal' burial at Mušov, Czech Republic, second century AD; from boat grave 7 at Valsgärde; and from boat graves I, IV, VII and XI at Vendel, both Sweden, seventh–ninth centuries AD (after Arwidsson 1977, pl. 33; Feugère 2002, 561; Ohlhaver 1939, pl. 18: 4; Stolpe & Arne 1927; from Ježek 2015).

buried individual actually used them or not. However, as with other spheres of human culture, a phenomenon originally connected with leaders spread to lower levels of society. Tools used in metalworking appear in both richly and simply furnished graves, including female and children's burials, having become a universal symbol, or an expression of affection. As symbols of this kind they were used in funeral contexts that had no connection with metallurgy (Ježek 2015, with refs.).[26]

Rituals typically persist much longer than their period of justification and, over time, even 'empty' rituals change into customs of which the origins are obscured by layers of interpretation reflecting the current social situation and the justification for which acquires new content. Regardless of whether or not we can perceive the meaning of the above-mentioned ostentatious forging tongs in their role during ritual performance, the symbolic function of metalworking tools in elite Germanic burials is obvious. The question should be asked as to the origins of this custom, which reaches back into the period when metal began to be processed by man.

One example comes from the Early Bronze Age (Maikop culture) cemetery at Klady (Russia), below the northern base of the Caucasus. One of the local

26 Among early medieval chamber graves from (e.g.) eastern Europe, goldsmith's tools were found in burial 29 at Peresopnica, and smith's tools in burial 36 at Schestovica (both Ukraine: Janowski 2015, 69, with refs.).

kurgans (no. 31), with an extant height of 4 m and mound diameter of 28 m, contained five burials (Rezepkin 2000, 62-67). Burial 5 featured extraordinary grave-goods: in addition to numerous gold and silver objects (including a human tooth in a gold casing and a silver figure of an animal), over 100 carnelian beads, gaming pieces, etc., it contained a range of bronze vessels, weapons (four axes, one sword, 13 daggers), and other items (including two axe-hammers, one of which has the remains of a silver binding, a figure of a dog, a disc and a wheel with an inner cross), some of which (including the daggers) were evidently used for cult or ritual purposes. Of particular interest here are the tools: two bronze chisels and three awls, two oblong touchstone candidates made of sandstone, 15.7 cm and 22.6 cm long (Rezepkin 2000, pl. 53: 13; 56: 19), and at least two other stone artefacts, one dark and the other green (Rezepkin 2000, pl. 53: 9, 15). Four additional touchstone candidates (Rezepkin 2000, pl. 59: 9-12) were found together with other objects (figures of animals, astragals, beads made of jasper, nephrite, etc.) at a 'sacrifice' area located 4 m from this burial. In comparison with its opulent nature, unrivalled at this site, kurgan 31 has just one counterpart at Klady: Kurgan 28, with an extant height of 5.5 m and a mound diameter of 41 m, containing, among other objects, five bronze daggers, one axe, over 170 silver and carnelian beads, and a fragment of a 'whetstone' (Rezepkin 2000, 59). Another local example comes from burial 26 in the large kurgan 11 (so-called 'Silverkurgan').

Crimea, south-eastern Ukraine and the northern base of the Caucasus have yielded dozens of Eneolithic and Early Bronze Age burials furnished with metalworking tools (e.g. Bátora 2002; Kaiser 2003, 162-169; 2005; with numerous refs.), and also touchstone candidates. Traces of gold and silver have been found on stone artefacts with the shape typical for touchstones, but which are regarded as 'stone anvils', from Novosvobodnaya, Russia (Korobkova & Skharovskaya 1983, 88-94). In contrast with finds of casting moulds, tuyeres and crucibles, which are the subject of far-reaching deliberations (as well as the cause of whimsical classifications regarding the deceased's professional and social status), touchstone candidates remain only marginally mentioned in surveys (e.g. Kaiser 2003, tab. 13, 30). Typical stone artefacts naturally occur also in burials which contain no objects linked to metalworking, including those of females and the young (e.g. Moiseevka kurgan 1 grave 8: Kaiser 2003, tab. 3). Likewise, and as in other regions and cultures, neither a boy aged c. 13 years buried at Pershin, near Orenburg (Russia), during the Early Bronze Age (Chernykh *et al.* 2000, 70), nor a woman aged 18-20 years buried with casting moulds at Aksay, site Muchin I, near Rostov-na-Donu (Russia), during the Middle Bronze Age (Vlaskin 1999), are to be regarded as individuals who processed metals (see Ježek 2015, 127, for additional examples and refs.).

Several forging hammers from Birka burials will be discussed below, but our immediate attention is attracted to the miniature hammers called 'Thor's hammers' by archaeologists (e.g. Zeiten 1997; Jensen 2010; for the finds from Russia, see Musin 2012; all with numerous refs.). These artefacts are widespread in the Viking world, including Birka (Ström 1984). Not only iron, but also silver, gold and amber specimens are known from the northern part

Fig. 22. Fragment of a touchstone hung on the door of a nineteenth-century house at Whitby, England, 'as an amulet against witches pixies & the like'. Length 5.1 cm (Pitt Rivers Museum, University of Oxford, acc. no. 1985.51.667; photo: S. Prior).

of Europe, including the northern coast of Poland (for the finds of 'Thor's hammers' from Poland, in substantial numbers from early medieval Truso/ Janów Pomorski, near Elbląg, where three amber miniatures of axes were also found, see Gardeła 2014, 67-76, 100-102, 129-135). The cult significance of these pendants is clear, unlike the answer to the question as to whether the Vikings linked them to Thor. It could even be true for the Viking world, in which (and not only there) local myths gave new meaning to objects in common use. Heavy hammers served as cult objects in 'pagan' shrines in Sweden even in the twelfth century (Saxo Grammaticus 1886, 421). However, whereas the Lithuanians also had their divine smith even into the fourteenth century, they revered the hammer because the signs of the zodiac helped free the imprisoned sun using a hammer (Hirsch *et al.* (eds.) 1870, 237-239). Much eighteenth-century evidence that a hammer was used in the wedding ceremony to ensure the prosperity of the newlyweds has been collected (exclusively) in southern rural Sweden (Elgquist 1934); recent irreverent interpretations (as apparently fertility wishes) are once again just a reflection of (our) period.

Traditional symbols of good luck have always found explanations and expressions depending on their local cultural context.[27] A 'rectangular ?whetstone with a perforation at one end', in fact a fragment of a touchstone, in the Pitt Rivers Museum, Oxford (acc. no. 1985.51.667; Fig. 22), has a context description written by folklorist Edward Lovett on an envelope: 'This holed stone hung upon the door of a home (inside) at Whitby for many years, as an amulet against witches pixies & the like. The old people died & the rising generation scoffed at superstition, so I got the stone. Per Mrs Snowdon Whitby 1st Sept 1908.' The question is naturally whether (improbably) any trace remained in the awareness of the inhabitants of this English town in the nineteenth century of an ancient symbol representing wishes for good luck, or whether (probably) beneficial influence from other specific motives was attributed to the odd stone – most likely an accidental find that was unrecognized by its new users (as not even by the educated folklorist) – as was the case with 'thunderstones' (e.g. Blinkenberg 1911; Sklenář 1999). Several 'whetstones' concealed in houses from the seventeenth-nineteenth centuries have been documented in Turku, Finland (Hukantaival 2007, 67), as well

27 One example is provided by horseshoes hung in many (not only) European houses today. The question of the origin of this custom, widespread throughout the 'Christian' world in both its eastern and western forms, remains unanswered.

as in southern Sweden (Falk 2008, 115). A typical soapstone artefact with a runic inscription from medieval Uppsala has also been interpreted as an amulet (Elfwendahl & Kresten 1993, 29-30, fig. 12b).

During a dark period in modern European history, early medieval Scandinavian burials with forging tools gave rise to an emphasis on the importance of iron processing in ancient Germanic society (e.g. Ohlhaver 1939). After World War II, the habit of highlighting the significance of these finds for the image of ancient German society came to an end. However, the frequency of forging tools in Germanic burials has been confirmed by modern research (e.g. Müller-Wille 1977; 1983; Wallander 1988-1989; Henning 1991). An explanation for the occurrence of forging tools in north European early medieval burials used to be derived from archaeological tales of the magical power of smiths.

Unsurprisingly, due to modern political circumstances, it is especially popular in Norway even today (e.g. Hedeager 2011, 139; Jørgensen 2015). Although these notions are linked to the ideas of M. Eliade (1956), dating back over half a century, they pretend to be 'new perspectives' (cf. Ježek 2015, 132). 'The smith's work requires the esoteric kind of knowledge enabling him to manipulate the dangerous forces' (Hedeager 2002, 7; cf. Hed Jakobsson 2003, 157-175; both with numerous refs.). Ideological stereotypes manage to snuff out even the most hopeful students (e.g. Guldberg 2014, with an exhaustive summary of Norwegian finds and literature) and have a major impact not only on the future of 'national archaeologies', but also the direction of society as a whole. It is no coincidence that it has been Norwegian researchers who, in recent decades, have made great endeavours (with financial support from the Norwegian, particularly state, foundations) in the ethnoarchaeological study of African ironworking in an attempt to expand their understanding of the ritual aspect of early medieval Nordic metallurgy (for selected refs., see Ježek 2015, 127-128). The author of this text regards as a dead end the application of ethnographic knowledge concerning the symbolic aspects of recent ironworking in Africa or South Asia to prehistoric and early medieval European metallurgical, especially non-ferrous, evidence – let aside funeral matters (see below).

Not even his excellent acquaintance with (albeit mostly futile) archaeological works on this topic led F.-X. Dillmann (2006, 354-358) astray in his in-depth and insightful study of Old Icelandic sources, and his conclusion on the absence of the magical role of ancient blacksmiths is an example of masterful treatment of period writings. Unfortunately, Dillmann's brilliant analysis did not change the opinions of archaeologists caught in the own ideological traps. With regard to the number of smiths over the course of millennia, it is doubtful that ancient Europe was abounding with esoteric experts, not to mention the evident disproportion between the number of the Bronze Age and Iron Age metalworkers and the much smaller number of so-called smiths' or metalworkers' burials. Under the auspices of an internationally shared consensus, early medieval 'smiths' even enjoy appearances in recent literature dealing with extraordinarily furnished graves, typically without ideological or methodological 'palaver' and, on the other hand, limited to the material side of artefacts (comprehensively, Rácz 2014). In any case, this clearly no longer concerned only the Germans, although ancient archetypes survived the longest in the culture of the Germanic inhabitants of Scandinavia.[28] Ideas developed in Nazi and in modern Norwegian archaeology, today clad understandably in the attractive attire of anthropological theory, result from a simple misunderstanding of the fact that the frequency of graves furnished with metalworking tools does not reflect characteristic, or even extraordinary, traits of the given population, but are instead testimony to the perseverance of customs long abandoned elsewhere – or, in other words, of 'backwardness'. During the Late Bronze/Early Iron Age in which burials furnished with forging tools decline in the Mediterranean, their numbers grow in central Europe; their occurrence peaks and ends in Migration period and Viking Age Scandinavia, and in medieval Norway in particular.

Numerous (not only) European Bronze Age and Iron Age (not only) prestigious burials contained tools used in metalworking, scraps of precious metal, slag or even fragments of ores (for non-tendentious interpretation, see Kaiser 2003, 201-205; Brumlich 2005; Stöllner 2007; Tobias 2009; Brandherm 2010; cf. Ježek 2015, with additional refs.). As is the case with the above mentioned Knossos North cemetery (Coldstream & Catling (eds.) 1996, 210), numerous continental Early Iron Age prestige burials were also furnished with rasps, files, chisels, etc. (see Teržan 1994). La Tène period burials containing metalworking tools are sometimes found with atypical orientation (N – S or S – N: e.g. Ramsl 2014, 72; Sankot *et al.* 2007: the grave of a teenager). However, it is rather forcing the matter to interpret (e.g.) two swords with scabbards in one such grave (Au am Leithaberge grave 13, Austria), with two chisels, a hammer, probably an anvil or a die, etc., as 'scrap material from a smith's workshop', or the fragments of an iron bracelet, small bronze fragments or 'a collection of scrap' in the grave of a young woman (Mannersdorf am Leithagebirge grave 22, Austria), considered from its other furnishings to be 'probably one of the highest social members of the community', as evidence of 'the access of the individual or of the *familia* to a range of resources', etc. (Ramsl 2014, 72-73). It also is not a question of whether 'craftsmen were also warriors when needed', as has been suggested (e.g.) in the case of La Tène graves in Serbia furnished with weapons and craft tools (Filipovič & Tapavički-Ilič 2014). Similarly, one can dispute the opinion that 'the anvil in the bronze hoard of Ikervár must certainly be the legacy of a bronze-smith' (Nagy *et al.* 2012, 41). This hoard with the anvil, weighing more than 4 kg, semi-finished metal products, sheets,

28 Miniature hammers, tongs, anvils, shears and other tools, including agricultural, hanging as pendants on the Migration period gold necklace from Szilágysomlyó (Romania) were hardly connected with Viking beliefs; nevertheless, they also belong to the Germanic environment. The finds assemblage from this site which, besides producing the above-mentioned unique object, most likely having a ceremonial and undoubtedly a display purpose, includes 13 gold medallions of Roman emperors spanning three generations, pointing to the ruling circles of local Goths (or Gepids) with political ties to Rome (Capelle 1994, 7-8, 93-97).

etc., also contains two typical stone artefacts, regarded as 'polishing stones'.[29] The authors offer a good interpretation of this noteworthy find from Hungary, with clear find-circumstances, which attempts fairly to take into account the symbolic aspects. Archaeobotanical finds also play a significant role here: 'In addition to the sacrificial ceremony, healing could have been associated with the site, because a preponderance of the floral remains found in the immediate vicinity of the hoard have medicinal properties' (Nagy *et al.* 2012, 41).

The presence of forging tools in a grave does not necessarily 'indicate the occupation of the deceased and the intimate connection of smithing tools with particular individuals', and by no means does it 'imply special status for the smith' (Harding 2000, 239, for the Bronze Age; similarly Kristiansen & Larsson 2005, 52-60; cf. Ježek 2015, 127). Ritual practices need not be dependent on an actual belief system (Bell 1992). On the other hand, their form can reach various, even excessive dimensions, particularly in relation to political circumstances, and especially in unconsolidated regions. Regardless of whether forging tools, pendants called 'Thor's hammers', balances, weights, touchstones, as well as weapons, jewellery or any other traditional symbol used during the funeral ritual are discussed, it is significant that grave furnishings disappear in hierarchically organized societies of Europe much earlier than in areas resisting the efforts of state organization. And regardless of whether the local heterarchical society survived in Norway while state forms were being built in medieval Europe, it is remarkable that the greatest number of burials (c. 340) furnished with forging tools appears in Viking Age Norway (for refs., see Guldberg 2014; cf. Ježek 2015, 130, 134). The consequences of the relatively recent foundation of the Norwegian state, stemming by right particularly from national interests which society in the twentieth century – and even later – had to face, have thus also affected archaeological interpretations.

Unlike in the early period of metallurgy, when the deposition in graves of tools for both forging and determining the value of metal could indeed have been an expression of the prestige of the deceased,[30] in later prehistoric periods, and even in the Early Middle Ages, the earlier socially-contingent link had long been replaced by widespread burial customs practised by the broad spectrum of social classes. Weights, which began to be used in everyday life as early as the Bronze Age for the same purpose as touchstones, and which were already being used in the furnishing of contemporaneous (not only?) prestige graves (later also balances; Ježek 2015, with refs.), only increased the range of the survivors' possibilities for expressing their affection for the deceased. Nevertheless, the evident change in the 'social distribution' of tools used to

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29 One of them is oblong and rectangular, with a hole in one end (Nagy *et al.* 2012, pl. 5: 6); the second, which is neither described nor illustrated, is 'abraded'.

30 This is, however, not the case with alleged 'smiths' of the Bell Beaker culture, as formulated (e.g.) by Z. Van der Beek (2004, 186): 'The complex procedure by which an ore was transformed into liquid and thereafter made into a specific object must have been a remarkable and possibly magical event. Smiths may therefore have been associated with magical and religious characteristics, and may because of their particular qualities also have had some kind of political power.' In our context, the fact that the mentioned procedure did/does not belong to the work of smiths seems rather marginal.

determine the value of metal that occurred in northern and eastern Europe, in the ninth century AD, is undoubtedly related to the increased availability of precious metal and to the use of its forms unauthorised by the local ruler. In this trend, the role of the Vikings and their spread to the East, or to the Caspian Sea, is of key importance in the economic, political and behavioural patterns of north-eastern Europe.

The question of the numerous early medieval silver hoards from the northern part of Europe should not be overlooked here. They connect the landscapes of the early medieval Baltic region and have been subject to many attempts at explanation. Opinions as to the concealment of silver during periods with a threat of war belong irrevocably to the past. The reasons for depositing silver in the ground obviously do not rest solely in the economic sphere, but it is not within our capacity here to conclude the vain effort to clarify the motives of those owners who gave up their silver voluntarily in this way. It is evident, however, that this phenomenon may not be explained without insight, on the one hand, into the period of the first metal hoards, i.e. into the Early Bronze Age (see Bradley 1987), and, on the other hand, into the waters of lakes, wetlands, springs, rivers, wells, etc., into which individual objects or even assemblages of valuable items, often arms, were thrown for ritual purposes. A list of finds would be exceedingly long (for Bronze Age rivers, e.g. Fontijn 2012; Frost 2013; Hansen 2000; Huth 2011; Maraszek 1998; all with numerous examples; the Rhine and the Thames were especially popular, see Yates & Bradley 2010; Mullin 2012; with refs.). The list of La Tène, Roman and early medieval period ritual watery sites in the northern part of Europe would also be very long (e.g. Blankenfeldt & Rau 2009; Coulston 2008; Kurz 1995, 100-104; Lund 2008; Raffield 2014; Raftery 1997, 182-185; comprehensively Bradley 2016; all with numerous examples; see also below).[31]

The number of early medieval silver hoards from Sweden (including Gotland, with an extraordinary number of these hoards), Denmark (including Bornholm with 100 hoards: Tarnow Ingvardson & Nielsen 2015), north-eastern Germany, Poland, the East Baltic, etc., appears to be ‘only’ a consequence of the confluence of three contemporary factors: (1) the three-thousand-year continuity of an identical manifestation of ritual behaviour and, in particular, the topicality of, or even boom in, such behaviour precisely in northern Europe in the Early Middle Ages (best illustrated by the occurrence of graves with tools for metalworking and for determining the quality of metal: see above); (2) access to silver, mediated by the Vikings’ eastern activities; and (3) absence of mechanisms related to distribution, control and employment of precious metal, i.e. the method of handling precious metal in the bullion-economy zone of early medieval Europe.

Any attempts to interpret the early medieval (or Viking Age) northern European hoards of precious metal (including dirhams) and other valuables,

31 The thousands of objects from the hot ‘Giant spring’ near Duchcov, Czech Republic, can serve as an illustrative example from the La Tène period (see Kruta 1971; before 1882, the spring spewed 27-42 litres per second).

restricted exclusively to this period and region and not respecting the European millennia-long history of this phenomenon, must necessarily fail in the explanation of ideological background of ritual activities (see also Bradley 1987; Hines 1989). Particularly, today's trendy considerations on the importance of the slave market for the influx of Islamic silver to northern and eastern Europe are to be viewed as misleading. Even this revived concept has its ideological, and even nationalist roots reaching, again, back to the nineteenth century when the motive of extensive trade with abundant human loot gained in heroic fights played an important role in the wishes of historians creating romantic images of early European states (for an example, see Ježek 2011, 635-637).

Regardless of ethnic, religious or cultural boundaries, this part of early medieval Europe with its Germanic, Slavic, East-Baltic and Finno-Ugric populations, displays behavioural patterns completely different from its south-western neighbour, the Holy Rome Empire, even with its Germans and Slavs. A major topic is the mechanism that led the Slavic population in the north-eastern part of the continent to adopt traditional customs from Norsemen or from the East Baltic area around the beginning of the second millennium AD (see p. 128 for the brass/bronze bowls). No direct line seems to exist connecting the Migration period populations with the Slavs in the territory of early medieval Poland; the hiatus in the behavioural and other patterns spans at least four centuries. A simplified explanation is to be found in the adoption of actual Norse customs, specifically in the effort by the Slavs, who were in direct contact with Scandinavians, to copy a culture they deemed to be superior. A similar process undoubtedly also occurred among the Slavs in Bohemia, where, however, it was tied to the completely distinct (and far more advanced, if it can be said, at least in the light of the history of metal hoards) behavioural patterns of the Carolingian or Holy Rome Empire, which Bohemia had been part of both culturally and politically since the beginning of the ninth century – unlike Moravia. The reader might get the impression that this involves a local issue from the eastern corner of central Europe, or from the author's native area. But that is not the case. Just the difference between (prehistoric and) early medieval Bohemia and Moravia (later joined in a common state) provides a proper contrast for understanding the diversity of behavioural patterns tied to relevant super-regional cultural spheres.

Although silver hoards from the tenth to thirteenth centuries have been recorded in Bohemia and Moravia, both parts of the Czech Lands, their number is far smaller than those found to the north of the modern Czech – Polish, i.e. Czech – Silesian, border. Unminted, or even hack-silver is extremely rare among them in the Czech Lands (Ježek 2012, 45-46), such is also the case with the 'German' parts of the Holy Rome Empire. Only three hoards with Arabic dirhams are known from the Czech Republic: all come from the border of Silesia and Moravia, with none from Bohemia (for the finds, see Novák *et al.* 2016, with fanciful culture-historical comments). Balances were also used in tenth- to twelfth-century Bohemia and Moravia, but just a few balances and a few dozen weights are known. No early medieval Slavic burial furnished with balances or weights is so far known from the Czech Republic or from the Danube region.[32] Similarly, in contrast to the thousands of early medieval touchstones from Poland, their number is at most several dozen in the Czech Republic, Austria and Slovakia (see Ježek & Zavřel 2010; 2011). Most grave finds of touchstones – even if only few in number – from this part of Slavic early medieval Europe come from the period of the enigmatic 'Great Moravia' (the ninth and early tenth centuries). They are, however, more frequent in the Avar environment (Ježek & Zavřel 2013), which inevitably adopted the behavioural patterns of Gepidic (i.e. Germanic) society and which heavily influenced 'Great Moravian' culture and behavioural patterns. Again, neither ethnic nor religious borders played a role, the difference being in cultural affiliation, including the rules for handling precious metal.

32 The same is true for the so-called Thor's hammers (and not just for burial finds). These pendants are also known from Poland, including from two chamber graves (Janowski 2015, 88).

Archaeology, myths and archaeological myths

Early medieval graves furnished with balances and/or weights were interpreted until recently as the graves of merchants, goldsmiths, etc. If they contained additional rich furnishings, they were then regarded as the graves of wealthy merchants or craftsmen of high status. Many of the graves contain weapons; wealthy merchants from north-eastern Europe undertook distant trade expeditions and armed themselves accordingly… In the existing paradigm, with a tradition of nearly two centuries, archaeology is capable of explaining almost anything. However, it is enough to rearrange the figures and the graves of merchants or craftsmen vanish from the scene of ancient Europe (Ježek 2013b, 719-720). Disappearing along with them are women involved in exchange, the wives of traders, or even children prepared for a 'future position as […] matrons', which led the classic scholar of gender archaeology, A. Stalsberg (1991; 2001), to express the traditional opinion that 'the deceased should be given the due honour and necessary equipment for the next life or for life in the mound'. The consequences are her deliberations on the heritage of 'a bourgeois and capitalist' epoch of archaeology that removed women, including 'trading women', from their area of interest, banishing them to household care, and on the pitfalls of modern languages, which are unable to reflect the position of women in Viking society, etc.

Although the 'occurrence' of craftsmen in ancient burials throughout the ages is common in archaeological literature, it has always depended entirely on the current notions of archaeologists. Bell Beaker (Late Eneolithic) burials furnished with arrowheads or tools for the production of arrows provide an example. 'This deposit may be interpreted as a symbolic production package that enabled the deceased person to produce strategic goods even on the way to the other world' (Turek 2004a, 150). Time has eliminated the possibility of so regarding graves containing metalworking and other tools as: 'in the Bell Beaker funerary practices these metalworking tools demonstrate kind of ritualised control over the ideologically important technology that is connected to a certain social status of the buried person' (Turek 2004a, 155; cf. Ježek 2015, 128, for additional examples of this type from various periods), as well as the concept of the 'archery production package'. The Frankish cemetery at

Fig. 23. So-called 'smith's burial' (no. 99) from Tauberbischofsheim-Dittigheim, Germany, from the sixth century AD, furnished with several weapons, forging tools, artefacts of gold, silver and glass, a touchstone (between the balance pans in the photo), etc. (Landesmuseum Württemberg, Stuttgart, inv. no. F 95,51; photo: H. Zwietasch).

Tauberbischofsheim-Dittigheim (Germany) can serve as an example from the opposite end (chronologically). Four alleged 'smiths' burials' were 'identified' there, based on the occurrence of tools used in metalworking among their furnishings. Two of them also contained touchstones (von Freeden 2003, 5-6, fig. 1). One of these burials was of a woman (grave 405); the second (grave 99) was also furnished with numerous weapons and other artefacts, including

Fig. 24. So-called 'smith's burial' (chamber grave l4) from Frankish cemetery at Wallerstädten near Groß-Gerau, Germany, furnished with weapons, riding gear, balance, touchstone, crucible, gold coin, Byzantine weight, etc. (Stadtmuseum Groß-Gerau; photo: Reiss-Engelhorn-Museen Mannheim, Jean Christen; after Die Franken 1996, figs. 471 and 472).

a balance (Fig. 23). As an illustration of the current approach, the case of the burial at Wallerstädten, near Groß-Gerau (Germany), from the same period (*Die Franken* 1996, 986), is even more eloquent. In the catalogue, the furnishings of this burial (regarded as that of a 'goldsmith') are divided between two photos (Fig. 24): one depicts weapons, riding gear, and other artefacts typical for elite graves, the other shows 'metalworking' tools (*Die Franken* 1996, figs. 471 and 472). In fact, all these artefacts held the same meaning during the final farewell. Just as comical is the denial of the sex (female) of the individual buried in the Frankish cemetery at Mülhofen (Germany) on the basis of the inclusion of a balance and a touchstone in her grave-goods (Grunwald 1998, 131, with examples of Frankish burials containing touchstones from the Lower Rhine).

Archaeology can fall into a trap in its natural, albeit occasionally even successful, attempts to explain discovered phenomena using other sources. In particular, the interpretation of archaeological finds based on epic literature is a dubious tactic, as an example of which can be taken the sophisticated attempt to explain the presence of (putative) whetstones in Viking Age elite burials by S.A. Mitchell (1985). After a brilliant analysis of Old Norse written sources, the author, as an innocent victim of archaeological interpretation, reaches a conclusion concerning the symbolic meaning of whetstones in society at the time… Based on Old Norse poetry containing tales of mythical heroes, numerous recent works offer an explanation of the occurrence of weapons, horses and other items in graves. This typically involves highlighting certain marginal episodes or references to an unclear legacy used to support an archaeologist's ideas. However, if attention is focused on Viking society, one cannot overlook the fact that passages concerning the afterlife in such medieval literary works as the sagas have little in common with 'archaeologised' manifestations of funeral rituals. Viking society lived (and buried) according to the rules of its own world, while its poets sang about an entirely different one.

Poets typically speak mainly about themselves, and even more so about their dreams. Not even ancient poetry which, moreover, strongly reflected period myths, provided a mirror image of the 'common' mentality at that time. Although 'the gods of ancient Greece lived in the heavens, a citizen of Athens would have been surprised to actually see them in the sky' (Veyne 1999, 31). Thirty years ago, in his excellent work on the perception of ancient Greek myths, P. Veyne deciphered Pindar's *epinikia* (odes celebrating athletic victories): 'When Pindar extols a hero in a lyric poem, he does not provide his listeners with a particular message related to their values or them personally: he builds with them a relationship in which he alone, the poet to whom the myths are accessible, has a dominant standing […] Pindar never uses a reference to a myth to glorify the aristocracy but rather to emphasise his own status in relation to other parties to the dialogue; it is not the victor himself but the poet who elevates the person he is lauding up to his own level […] Instead of comparing the aristocracy to heroic mythical figures, Pindar thoroughly separated the world of myths from the world of mortals' (Veyne 1999, 35-36).[33]

Attempts to interpret archaeological finds from the Aegean based on ancient Greek mythology are already a thing of the past. On the contrary, efforts to connect Viking archaeology to Norse mythology, mostly written down in the later centuries, not only remain popular but often even boast an interdisciplinary research ranking, in the respectable tradition of the approach of the nineteenth and the first half of the twentieth centuries (comprehensively e.g. Ellis 1968). However, it is not necessary to overstate the impact of any forceful literary description of Valhalla and other tales from a 'lost world' on the everyday life (and death) of early medieval Scandinavians. Even more so because the furnishings of their graves reflect similar customs as the grave-goods of, for example, distant Gepids or Langobards, as well as of much earlier societies, such as those from the Bronze Age Near East, the eastern Mediterranean and the northern Black Sea region (Ježek 2015). Regardless of what Europeans in prehistoric times and the Early Middle Ages thought about the afterlife, it must have been clear to them that the deceased would not need tools, weapons, jewellery, horses, dogs or even other people.

Pre-Christian Europe, in this regard, behaved in the same manner as ancient Mesopotamia, Israel, Greece, etc., where 'the realm of the dead was nothing more

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33 From the Czech edition (Veyne 1999), translated by D.J. Gaul; cf. the dissimilar English translation of this passage (Veyne 1988), and, particularly, the original French publication.

than a shadowy realm far from meaning and from the divine', or in other words, 'the dead are nothing other than dead' (Assmann 2005, 10-11). J. Assmann (2005, 14-19, 186-209, 414-417) reveals the difference in the approach to death in ancient Egypt, where the belief in (or desire for) immortality and an afterlife played a significant role, especially in the extraordinary efforts made by Egyptians to come to grips with death, resulting in funeral monumentality, mummification and other practices. 'The dark side of death was not covered over but remained present. The counterimages generated an excitement that sounded a call to action. This impetus was what was special about Egyptian religion. Where others sat back and let matters take their course, the Egyptians took things into their own hands.' (Assmann 2005, 19). However, Egypt is the cradle of archaeology. The impressive image of its burial rites has inevitably, if inconspicuously, influenced the interpretation of archaeological finds in other parts of the Old World, despite the fact that B. Spinoza had already revealed the extraordinary nature of Old Egyptian culture in connection with death long before the advent of archaeology. Nevertheless, even in ancient Egypt, the furnishing of burials was aimed at one goal: the opening of the last gates (Assmann 2005, 343-348). 'The experience of death, together with longing for freedom from the yoke of transitoriness, were at the core of Egyptian religion. In late antiquity, therefore, Christianity, which promised the same thing, must have exerted a fascinating power on the Egyptian mind' (Assmann 2005, 414). Although 'with Christianity […] something returned to Egypt that had already mostly dried up and fallen into oblivion there' (Assmann 2005, 417),[34] not even Christian Europe has forgotten its ancient roots. Egypt, however, did not form part of them – until the early nineteenth century (AD).

I assume that no one believes that rosaries, prayer books and pilgrimage tokens were placed in late medieval and early modern graves so that good Christians could use them in heaven or before its gate. Likewise, the role of artefacts in European prehistoric and early medieval funeral rituals was limited exclusively to the world of the survivors, especially to meet their need to satisfy traditional customs. Archaeology has gone to great lengths to explain the reasons for furnishing graves with goods (comprehensively and with numerous refs., Härke 2014); however, it is not overly important which tales a particular community used (or not) to support their customs. Traditional customs also included placing precious metal in graves. During the Middle Ages and the early modern period in Europe, it was easiest to use coins for such purposes. Sixteenth-century eastern European sources record the deposition of coins in graves in order to soothe the soul of the deceased, to allow them to purchase food, etc. Ethnographers in the nineteenth and twentieth centuries described a wide variety of similar, but also many more different, explanations in east European rural environments, where even banknotes were/are deposited in

34 'In Egyptian thought, kingship and the overcoming of death were a combination to which the Jewish notion of a Messiah was foreign. I shall not go so far as to say that these ideas came from Egypt […] but I shall affirm that they represented an approach […] to Egypt. No matter whence Christianity derived these ideas, they brought it closer to the world of Egypt, and this perhaps contributed to the fact that Christianity enjoyed so early and such an overwhelming success in Egypt.' (Assmann 2005, 417).

coffins (e.g. Miechowicz 2007, 90-92, with refs.); in 2005, the placement of a small sum of money (the equivalent of half an American dollar) was recorded in a Polish rural setting so that the deceased would not return due to hunger. Money was/is commonly also placed in graves in recent Ukraine, Romania, etc., for the ferryman, St. Nicholas, the Virgin Mary and even the devil, depending on the direction of the voyage, or for the keeper of the gates of heaven (most often St. Peter). Nevertheless, in most cases studied by modern ethnography in late-twentieth-century Poland, the survivors could not explain why they furnished 'their' deceased with money (Miechowicz 2007, 92, 95).

What does this suggest for the prehistoric and early medieval periods? Simply that customs handed down from 'time immemorial' have always found current explanations depending on the period and cultural context – and, in many (or even most) cases, no justification or explanation was needed. Explaining the custom of placing coins in graves was already difficult for past scholars who found various justifications for such actions in their contemporaries (Stevens 1991). The coins were placed in a wide variety of positions in early medieval burials and were sometimes simply tossed into the grave with the fill, as was the case in eastern Europe into (at least) the twentieth century. Survivors' explanations for the different behaviour again vary (Miechowicz 2007, 93-94). However, for constructs aimed at linking the material manifestations of burial customs to ancient mythology, archaeologists took a particular liking to folk tales of a 'penny for the ferryman', otherwise known as 'Charon's obol'.

Birka burials also provide other intriguing finds. An iron rod with a handle, originally at least 74 cm long, was found in the grave of a woman and an armed man in the remarkable chamber grave 834, also containing a horse with tack (cf. Price 2002, 132-139). A similar object, with a reconstructed length of at least 70 cm, was found in the burial of a young woman (grave 845), which, among other items, also contained a touchstone (Arbman 1943, 305-307, 320). The best preserved iron rod from Birka, at least 72 cm long, was attributed to the extraordinarily richly-furnished female grave 660, including a touchstone (cf. Arbman 1943, 232, 278). N.S. Price (2002, 181-200, with refs.) has presented a list of three dozen such enigmatic artefacts from Viking Age northern Europe, known mainly from female graves and, in connection with early literature, has described their use in prophetic rituals. I. Gustin (2010) has since convincingly rejected his opinion, and we can add additional reasons. A granulated silver-gilt crucifix on the breast of a woman buried in the early tenth century at Birka (grave 660: Arbman 1943, 231; Price 2002, 130, with refs.) raises serious doubts about linking her to pre-Christian practices. A similar question arises over the woman buried in a wagon-body (grave 4) in the cemetery beside the royal fortress at Fyrkat (Denmark); this most richly furnished grave (including a touchstone candidate) contains the remains of an artefact that was perhaps similar to the rods from Birka (Price 2002, 185).

Fig. 25. (A) Amber miniature from early medieval Truso (Janów Pomorski), Warmia-Masuria, Poland (Museum of Archaeology and History in Elbląg; photo: L. Okoński; after Jagodziński 2010, fig. 213); (B) amber miniature from the Black Earth at Birka (Swedish History Museum, inv. no. SHM 5208:2000; photo: G. Hildebrand; courtesy of the Swedish History Museum).

The buried individual obviously belonged to the elite of late tenth-century Denmark which, however, commonly adhered to Christianity.[35]

The tenth-century boat grave (59: 3) from Köpingsvik (also known as Klinta), Öland (Sweden), one of four extraordinary furnished burials in the local cemetery – as in the island as a whole – contained the cremated remains of a woman and a man, furnished with silver and bronze objects from central Asia, an axe, the cremated remains of numerous animals (including a bear), etc. The iron rod (with a polyhedral bronze knob) from this burial is c. 70 cm long and has its top decorated with a miniature building (Price 2002, 147; Svanberg 2003, 132-133, 253, with refs.). N.S. Price (2002, 203-204) sees miniature versions of these rods ('staffs' in his terminology) in pendants from Birka, Klinta/Köpingvik and other sites. L. Gardeła (2014, 112-113; 2016, 117-123, with refs.) presents additional miniatures from northern and eastern Viking Age Europe, including an iron specimen, with a length of 5 cm, discovered during the excavations at Truso (Janów Pomorski, Poland), where additional suspicious iron artefacts have also been found, including one with a cubo-octahedral segment (Jagodziński 2010, fig. 233). Most of these northern European objects are made of silver; sometimes they were grouped on one ring with other amulets, including 'Thor's hammers', weapon miniatures, etc.

The sensational identification of Prussian or Viking Age Truso brought about the discovery – in addition to a large quantity of both remarkable and ordinary finds[36] – of another miniature. It is described as a 'trapezoidal pendant tapering

35 A high quality bronze holy-water sprinkler, placed together with two iron rods (!), etc., in a probably female Viking Age elite boat grave at Vinjum, Sogn og Fjordane (Norway; Bøe 1926), can be just a result of loot.

36 For examples of balances, weights and touchstone candidates from Truso, see Jagodziński 2010, figs. 188-197, 303; an amber workshop was also uncovered in Truso, containing a deposit of raw amber (Jagodziński 2010, figs. 216 and 217).

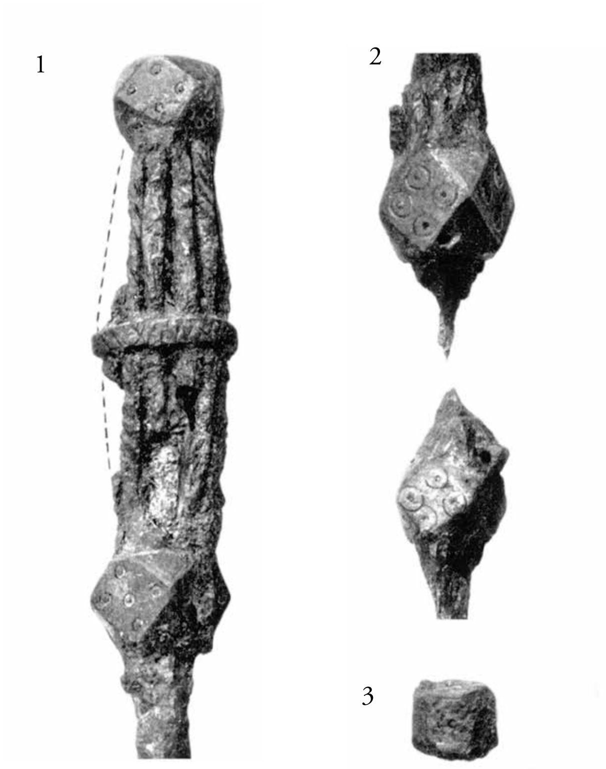


Fig. 26. Decorative knobs on iron rods from Birka graves: (1) 834; (2) 845; and (3) 760. (After Arbman 1940, pl. 125).

towards the top and rectangular in cross-section, with an hourglass-shaped hole at the top […]. The whole piece was carefully polished' (Jagodziński 2010, 151, fig. 213). The classic forms of a touchstone could be described in the same words; in this case, however, they concern an amber artefact, with a length (height in this case) of 3.8 cm, featuring on each of its four sides a set of four shallow bored points forming rhombs and a square (Fig. 25: A). This decoration, typical for northern weights of the period, distinguishes this particular piece from the many trapezoidal amber pendants known from prehistoric and early medieval Europe, including one from the Black Earth at Birka (Fig. 25: B). These are usually flat, but several specimens of squared cross-section have been found in the early medieval Baltic region (e.g. Bliujiene 2001, fig. 6: 37, 38, 40). Perhaps it is only a matter of time before miniatures (or symbols) of touchstones made of various materials will be also identified in (not only) Viking contexts, similar to the well-known miniatures of hammers, axes, etc.

Returning to the enigmatic iron rods, some of which – namely the finds from Birka – can pave the way for their interpretation. These artefacts from graves 834 and 845 have small bronze-plated elements, clearly reminiscent of cubo-octahedral weights (mostly with four, in one case five, bored points), imbedded in their handles and connecting rods (Fig. 26; after Arbman 1940, pl. 125). Similar elements also decorate the prestige rods from, for example, Gnesta, Asta (Sweden; Gardeła 2014, fig. 2.6), Gnëzdovo (western Russia; Price 2002, 182-183, 199), and Hopperstad, Sogn og Fjordane (Norway; Gardeła 2016, 300-301). In this context, I. Gustin (2010, 350-352) has pointed out the necessity for the existence of a social authority to control the accuracy and reliability of tools used for weighing and measuring. She connects the length of the rods with standard length references and, due to the fact that the majority of rods come from female graves, emphasises the relationship with textiles. L. Gardeła (2016, 114-116, 222) rejects her suggestion after an exhaustive study of the 'staffs', also with regard to their diversity in length, and argues for their magical function, with numerous examples from Baltic and Slavic areas.

The majority of the Viking Age iron rods under discussion are not decorated with elements in the form of such weights. Even if X-ray analyses (not yet conducted) of the Birka specimens were to show that these are actual weights set into the rods during their production (which is less probable than their being 'simple' decoration), this would naturally not simplify the connection of the objects with the position of the deceased in the organisation of exchange. These iron artefacts decorated with symbols of tools used to determine the value of precious metal are in fact counterparts of the most imposing early medieval touchstones, which served to demonstrate the social standing of their bearers while they were alive (see Ježek 2013b, 714-721; 2014, 428-429). Not even the Sutton Hoo 'sceptre' represents the longest candidate, and it is also irrelevant whether precious metals were actually tested on such 'oversized' touchstones or whether these heavy, impractical, objects served exclusively as symbols of power in living culture – as true sceptres (their length does not permit their analysis in the available SEM; for the case of Vendel, with touchstones even c. 30 cm long, see Ježek 2016). In any case, these stone 'giants' from the most prestigious contexts are no novelty from our perspective, although the function of (e.g.) the typical stone artefact with a length of 52 cm from the Early Bronze Age prestige mound (6 m high and 60 m in diameter) at Kerhué Bras, Brittany (Fig. 2: 1; Nicolas 2016, 56-59, with refs.), remains unknown; perhaps a portable XRF instrument could offer a solution.

It is also possible, conversely, to ask of the early medieval examples: Did the longest stone objects serve simultaneously as both touchstone (or symbolic touchstone) and standard length reference (or symbol of a reference unit)? The 'whetstone' from the Viking Age farm at Knafahólar/Keldur, better known as Rangá, Iceland, with its nearby cemetery furnished with weapons, horses, etc., is 78.8 cm long; a similar object from Þverárdal í Hunavatnsýslu has a length of 70 cm (Fig. 27: A and B; Eldjárn 2000, 352; Friðriksson 2000, 602). They are identical to the artefacts from the cargo of the eleventh-century shipwreck excavated near Mølen, Vestfold, Norway (Nymoen 2011), which are regarded as whetstones according to nineteenth-century analogies, including the finds from (another) well-documented shipwreck (Nymoen 2009). Nevertheless, remembering the lengths of the rods from Birka, it should be pointed out that textiles were the most frequently used means of payment in Viking Age Iceland (Ebel 1987, 286). However, another stone artefact of typical shape, from Skallakot í Þjórsárdalur, where one of the largest Viking Age halls in Iceland has been excavated (and where the only piece of raw material for typical stone artefacts known from Iceland has been found), measures 49 cm (Eldjárn 2000, 352; Gestsdóttir 2002; Gísladóttir 2004). The function of these stone giants remains unknown. Both the typical stone artefacts from one of the richest

Fig. 27. Stone artefacts from Viking Age Iceland (A and B) and Norway (C and D). (A) Knafahólar/Keldur (Rangá), length 78.8 cm, max. width 6.3 cm (National Museum, Reykjavík, inv. no. 2450/1883-299); (B) Þverárdal í Hunavatnsýslu, max. dimensions 70 × 4 × 4 cm (National Museum, Reykjavík, inv. no. 5037/1903-17). (C) Langeid, grave 6, 50.9 × 2.4 × 2.3 cm (Museum of Cultural History, Oslo, no. C58880/44); (D) Langeid, grave 20, 61 × 4.1 × 3.5 cm (Museum of Cultural History, Oslo, no. C58893/13). Photos: (A and B) Í. Brynjólfsson, courtesy of the National Museum, Reykjavík; (C and D) V. Vike, courtesy of the Museum of Cultural Heritage, Oslo, CC BY-SA 4.0.

burials in Iceland, at Eyrateigur (Friðriksson 2000, 586), are 40 cm long. Due to their length, it is not possible to analyse these touchstone candidates in a SEM, as also the stone artefact, 37 cm long, from the burial at Vað. In any case, the display function of these impressive tools is apparent (see p. 78 for the case of Galtalækur).

The relatively high representation of stone 'sceptres' from Viking Age Iceland, which is extremely poor in finds of precious metal, is rather more significant than striking. The number of 29 (known) Viking burials furnished with touchstones (about 35 pieces; see Friðriksson 2000, 602) is also relatively high: it represents almost one-tenth of all local (known) burials.[37] In societies suffering shortages, the prestige of valued objects increases as their availability decreases. Ethnology and plain human experience provide countless examples of the exaggerated significance not only of scarce goods, even in cult dimensions, but also of objects used when handling goods that are scarce – and thus in greater demand. In any case, the lengths of these objects (the longest stone artefacts of their kind) are too diverse for us to be able to deduce anything from their size other than their display role. This applies also to their much earlier counterparts from continental Europe. The Icelandic case is extreme, and therefore illustrative.

Nevertheless, back to the Viking Age enigmatic iron rods, because their geographical distribution is also noteworthy. Whereas nine finds have been recorded in Sweden (including Birka), two each in Denmark, Iceland and north-west Russia, and one in Ireland, there are at least 18 known from Norway (Gardeła 2016, 220-221; cf. Bøgh-Andersen 1999, 92: type III; Gustin 2010, 344), with the vast majority from graves. This picture is similar to the distribution of Viking Age burials furnished with forging tools, with the number of such graves in Norway far exceeding that from other parts of medieval Europe. Previously, we have attempted to argue that forging tools served as traditional symbols of social standing in ancient graves; the (extreme) Norwegian situation is explained as the result of power relations, or better of the fragmentation of power in the Viking Age territory of Norway (Ježek 2015, 130). The number of contemporaneous graves furnished with the iron rods in Norwegian territory can also be explained in a similar way. Instead of their use in magic rituals, we should expect a symbolic function for these artefacts; their disappearence is to be connected with socio-political transformations rather than with religious change. And what of the balances from early medieval Norway? Forty years ago, E. Jondell (1974) listed 63 burials containing these tools (for additional finds, see Steuer 1997, 382, with refs.). The number of 'buried' weights is much higher.

We can select one recent (2011) Norwegian discovery for illustration here. At the burial place at Langeid, Bygland, which is famous for one of the most

37 However, less than half of the known burial sites in Iceland have originally been studied by archaeologists, and just 46 local graves provide a 'complete knowledge' (Eldjárn 2000, 263). About fifteen hundred typical stone artefacts are recorded in Viking Age Iceland, both from elite and common sites (Hansen 2009, 43-68; 2011).

beautiful swords from the Viking Age (grave 8), at least 18 graves have been excavated (see Glørstad & Wenn 2017; Wenn 2017). Six local graves stand out among the rest from the character of the grave-goods, and four of them (with no preserved skeletal material) produced also touchstone candidates. The last, fifth grave (20), containing an oblong stone object, clusters together with one (18) of the previous four. Burials 18, 28 and 29 were also furnished with several weapons (and other objects), and therefore it can be assumed that men were buried in these graves. The lengths of touchstone candidates from these graves are 7.6, 15 and 20 cm, and there is also one fragment with a preserved length of 4 cm. However, burials 6 and 20 contain highly elegant, precisely worked, stone artefacts with lengths of 51 cm and 61 cm (Fig. 27: C and D). The sex of the individuals buried with these imposing 'sceptres' remains unknown. Grave 6, also containing an axe, balance, six weights and an additional 'whetstone' with a length of 9.6 cm and a hole in one end, is regarded as a double burial of a woman and a man. Although not poor, grave-goods from badly preserved grave 20 reveal nothing about the sex of the buried individual; in any case, no weapons, but two weights (and other small objects), were found.

The mound at Gunnarshaug, Rogaland, produced three 'whetstones', 58, 43 and 33 cm in length (University Museum of Bergen, no. B6056). Neither the find circumstances nor additional objects – e.g. a rasp and weight – make it possible to determine whether they come from one, two or even more graves in this mound. From Nord-Roldnes, Troms, comes a 61 cm long specimen, from Re, Rogaland, a 70 cm long one (Petersen 1951, 254). The (for example) Rogaland evidence shows that similarly long touchstone candidates appear in male graves in the Viking environment. One of five touchstone candidates from the grave excavated at Erøy, Suldal, also containing a sword, forging tools, etc., is 53.7 cm long (no. S4066). The burial at Sele, Klepp (no. S5768), was furnished with a sword, forging tools and fragments of four 'whetstones', 8 to (at least) 15 cm in length. At least hundreds of touchstones (for examples, see Petersen 1951, 251-257) are known from Viking Age graves in Norway, one of the last outposts of archaic behavioural patterns in medieval Europe. The prestige Migration period burial from Vestly, Jæren, with two specimens (and numerous forging tools), serves as an eloquent example (for the broader context and refs., see Ježek 2015, 131). In any case, there is an issue more important than the 'gender distribution' of metal-touching tools in ancient burials – it is quite possible that the buried individuals never even held these tools in their hands during their lifetime. The main question is whether Scandinavian archaeologists wish to perpetuate naive stereotypes, as do British colleagues (see, e.g., the case of the Viking boat burial excavated recently at Swordle Bay, western Scotland, with a 'whetstone' – typically, not even depicted: Harris *et al.* 2017, 194).

Longue durée symbols of elite status

Regardless of whether or not the Viking Age iron rods were a symbol of power, an artefact similar to that from Fyrkat was preserved in an enigmatic Late La Tène or Early Roman period cremation (grave 41) at Żukowice, Silesia (Poland), also furnished with weapons and other objects, including at least four surgical tools and a touchstone candidate (Demidziuk & Kokowski 2003).[38] E. Künzl (2002a, fig. 1; see also Künzl 1982; Matthäus 1985a, 10-12) has recorded c. 80 Roman period 'physicians' graves' from Spain to Romania, and from England to the Levant (for additional burials, see e.g. Jackson 2002, 91-92; Baker 2004b, 164, 167, 171, 179-180, both with refs.). Such finds are again increasing, especially from elite cemeteries, including a recent example from Stanway, near the Roman oppidum of Camoludunum, England. This clearly high-elite burial (so-called 'Doctor's burial'), dated to the mid-first century AD, is also remarkable for other reasons, including the presence of a board game, unexplained iron and brass rods, etc. (Crummy 2002; Crummy *et al.* 2007, 201-245: for additional examples of burial finds of surgical instruments, see R. Jackson in Crummy *et al.* 2007, 245-250). Whereas the concentration of graves furnished with surgical instruments in Germania Inferior and Germania Superior could be a reflection of the current state of (discovery and) publication, it more probably reflects the ideological world and, in particular, customs passed down through the population of these territories (for Asia Minor, see Künzl 2002b, 12-20, 28-43). The most frequent finds are scalpels, bone elevators, blunt hooks, forceps and cupping glasses, as well as oblong stone artefacts, with flat sides, interpreted either as tools for crushing medications or as whetstones for sharpening scalpels. In addition to dozens of surgical tools, a grave from Reims (France), dating to the third century AD, contains balances and weights; the grave of an individual buried in the same century in Paris contains a large assemblage of surgical tools, as well as 75 coins, etc. (see Künzl 1982; Matthäus 1985a). A scalpel with bronze and silver inlay was found in a Roman period child's burial (Künzl 1982, 78, pl. 53).

Richly furnished La Tène burials likewise containing surgical instruments are known from Germany, Hungary, etc. (e.g. De Navarro 1955; Künzl 1982, 126-127, with refs.). In the elite La Tène period cemetery at Pottenbrunn, Lower Austria (see pp. 47-48), one local burial (520) furnished with a touchstone, a

38 I was not permitted to investigate this stone artefact from the Muzeum Archeologiczno-Historyczne at Głogów.

sword, a lance or a standard, etc., also contains a metal artefact, interpreted as a surgical tool, and a unique bone object giving rise to thoughts concerning the individual's occult involvement – a druid (Ramsl 2002, 131, 142-143, 152; cf. Ramsl 2014, 72). M. Dizdar *et al.* (2014) pose a similar question in the case of the La Tène prestige burial from Zvonimirovo (Croatia), furnished with, among other things, a 'special tool' with a scalpel edge (these researchers have presented further finds from La Tène Europe; see also e.g. Frölich 2009, 61-63; Pieta 2014, fig. 4). However, the ritual sharp tools (e.g. Čižmář & Kruta 2011, with examples from Dürrnberg burials, etc.) do not provide any reason for the recalling druids. The common denominator of the examples presented above is the high social standing of the buried individuals, a status apparent from their other grave-goods.

No obvious finds of surgical instruments are known from Bronze Age graves in Europe north of the Alps, although ample evidence of trepanation is proof of an advanced knowledge of surgery. Surgical tools appear to the north of the Alps only more than a thousand years after such implements were placed in the Late Bronze Age chamber tomb at Nauplion, Greece (Arnott 1996, 269, with refs.), which is nonetheless probably still exceptional; rare later Greek finds date to the fifth century BC (Künzl 1982, 125). The custom of depositing surgical tools in Roman period burials in Gaul, the Rhineland, the Upper/Middle Danube regions and other border areas of the Roman Empire is typically interpreted as the result of contact between barbarians and Roman civilisation/culture. The 'sudden growth' in the number of burials furnished in this manner in Roman period Europe, including the Mediterranean (and Asia Minor), is apparent (Jackson 2002, 87; Baker 2004a, 9-15; 2004b, 15-16), and the Greek and Roman influence on the La Tène and Roman periods in transalpine Europe is highly evident. At the same time, it is obvious that the occurrence of surgical tools in central and west European Roman period burials did not depend solely on direct contact with the Romans; the above-mentioned burial 41 at Żukowice is not the only example to have been found in territories far from the *limes Romanus*.

Instead of thinking about the graves of druids, physicians, patients, the infirm, or even barbers, we suggest addressing the question – without any answer – of why surgical instruments became a means for expressing the high status of the deceased in the burial ritual (see Baker 2004a, 19-21; for the symbolic function of collyrium stamps, including finds from burials, Baker 2011, 167-174). Along with the putative 'warrior and surgeon' combined in one individual (e.g. Künzl 1991), female physicians and surgeons (e.g. Künzl 1994; 1995; Künzl & Engelmann 1997) disappear from the Iron Age and Roman period scene. 'Professional interpretation' of burials based on the objects with which they are furnished is nothing more than a reminder of the beginnings of archaeology in the first half of the nineteenth century. Archaeology conducted in this *ad absurdum* manner manages to discover the graves not only of physicians, blacksmiths, metalworkers, arrowhead producers, weapon-makers, flint-workers, and polished stone industry producers, but also even of spinners, weavers, tanners, painters (on the grounds of a box and/or stone mortar with traces of red paint, etc.), and priests (based on musical instruments), etc., etc. (e.g. Pustovalov 1994, 88-97; Bátora 2002; Fitzpatrick 2009, 180-183; 2011, 212-229; Keil 2012, 366; all with numerous refs.). The truth is, however, that archaeology already has this formula in its genes; it is no coincidence that V.G. Childe's Marxist-informed work was so influential. The ideological climate of the first half of the nineteenth century which, among other things, produced Marxism as well as 'modern' archaeology, plays even unwittingly a major role in today's interpretation of not only grave furnishings but also hoards and other manifestations of symbolic behaviour (for exceptions, see, e.g., Rowlands 1971; Budd & Taylor 1995; Hänsel 1997; Fitzpatrick 2005; Oras 2015; with numerous examples).

Instead of the long list of unflagging problems concerning the interpretation of Bronze Age hoards containing anvils, hammers, casting moulds, etc. (comprehensively Harding 2000, 352-368), or of prestige burials furnished with metalworking tools, recent papers in (e.g.) the best archaeological journals from Ireland to eastern Europe (e.g. Boutoille 2012; Salaš 2014; Jaeger & Olexa 2014; all with additional refs.) continue to illustrate the hopelessness of the traditional – or rather, naive – approach. Numerous Bronze Age hoards contain metalworking tools, sheet metal and casting moulds, even together with their direct products, besides weapons and/or jewellery (e.g. Hänsel & Hänsel (eds.) 1997, 110-225; Chvojka *et al.* 2009, fig. 12). The same is true for many finds from later periods. La Tène hoards containing metalworking and other tools in addition to weapons, etc., are known (not only) from central Europe (comprehensively Kurz 1995, 26-31). Examples include the sets of Roman period surgical instruments thrown into rivers as sacrifices (see Baker 2004a, 16-18, with refs.), the famous Viking Age chest containing numerous forging and other tools from Mästermyr, Gotland, and the agricultural and other tools in the hoard deposited on the bank of Hammar Sjö at Nosaby, Sweden (Arwidsson & Berg 1983; Lund 2006, with additional examples and refs.). Two Roman period surgical instruments were found at Stonehenge (Cleal *et al.* 1995).

Various grave-goods are connected in archaeological literature to the personal interests or profession of the deceased. For example, numerous European graves from different periods contain fishing gear. Among the best-known examples from early medieval Scandinavia are prestige burials in Loffos and Eltdalen (Norway), which also contain forging tools (Müller-Wille 1977, 166, with refs.). Again, we can trace this custom, which has nothing in common with a 'profession' of fishermen, deep into the past. For example, fish-hooks are present in male and female burials at the eponymous Hallstatt site, and at other Iron Age sites, mainly in richly furnished graves (Stöllner 2007). They have also been found in Aegean Bronze Age prestige burials. A copper harpoon was present in the unique grave 67 at el-Gerzeh, Lower Egypt, dating to 3200 BC (for refs., see Rehren *et al.* 2013). However, we also meet another phenomenon here.

Out of over 300 Viking Age burials in Iceland, fish-hooks are known only from three. A burial at Kaldárhöfði ranks as one of the richest in Iceland, containing the remains of two individuals, including a child, buried in a small boat (Friðriksson 2000, 560). All that is known about the burial furnished with fishing equipment, an inhumation discovered at Tindar (in 1937), with a horse, together with a spearhead and a ringed pin, is that it was a 'shallow, round grave, approximately 95 cm in diameter […] it has been suggested that this was the grave of a man who drowned in the lake' (Friðriksson 2000, 567). A grave with a horse excavated at Galtalækur contains three fish-hooks (and one additional iron hook), weapons, riding gear, lead weights, etc., as well as fragments of a vice and charcoal (Friðriksson 2000, 555, 607); the length of the grave pit was 1.5 m, i.e. too short for an adult individual. The famous burial at Tattershall Thorpe (England), from the seventh century AD, can serve as a counterpart. In the case of this alleged 'smith's grave' with dissolved bones, D.A. Hinton (2000, 101) stated that 'at 1.7 m the grave was a little short for a normal adult'. M. Ježek (2015, 131) has argued that it is actually the grave of a non-adult member of the local elite. In any case, the mound from Galtalækur is one of four Icelandic Viking Age burials containing two touchstones (cf. Hansen 2009, 74; 2011, figs. 2-4; see p. 73). One of them is 29.8 cm long (i.e. too long for a SEM analysis) and weighs 775 g. We have recorded streaks of lead on the second (shorter) specimen.

Many prehistoric and early medieval graves containing fishing gear are known from Europe, and we can choose just illustrative examples. An individual buried in the eleventh century AD at Sowinki (Greater Poland), was furnished with two harpoons, six fish-hooks, a balance, 18 weights, two touchstones, etc. (Ježek *et al.* 2013, 181); his age could be anthropologically determined only approximately as *juvenis/adultus* (see p. 85 for other children's burials with touchstones from this site). A Viking boy's grave at Balnakeil near Durness, Scotland, contains adult weapons, needle cluster, pumice stone, iron fishhook and thread and other objects (Graham-Campbell & Batey 1998, 140-142). In the case of interpretation of the bronze mount from this grave as a finial from (missing) stone artefact (Batey & Paterson 2013, 645-646), we are rather sceptical. Nevertheless, in the same manner as gaming pieces, or hunting dogs and/or falconry (remains of dogs and birds in burials), fishing equipment in graves is one of the *longue durée* indicators of elite status, regardless of whether the evidence reflects pastimes or hunting rights (see Ježek 2015, 129).[39]

Three burials at Birka contain a forging hammer: grave 644 (with two touchstones, a fragment of balance scale and other items, in the chamber grave of a woman and a man); grave 750 (with three touchstones, two rasps, a drill, an axe, etc.); and chamber grave 872 (with two touchstones, weapons, etc.; Arwidsson 1989). When N. Ringstedt (1997, 148) used quantitative methods to identify the 'twenty highest ranking graves' from the 1,110 burials at Birka, he placed grave 750 at the top, grave 644 in third place and grave 872 in fifteenth place. No other graves at Birka produced metalworking tools;

39 However, singling out curiosities for sensational interpretation, such as a peacock bone in a Viking Age ship burial used to identify the deceased as a 'foreigner' from the south, or even for the 'foreign king' concept in early medieval Europe (Dobat 2015), is humorous even in light of written reports from the period. For example, the owner of a very modest estate expressed his fondness for his peacocks in his will dating to the 1120s in central Bohemia (CDB I, no. 124, p. 130), a considerable distance from trans-European connections.

however, forging tools have been found in many, both highly prestigious and less spectacular, burials from prehistoric and early medieval Europe (from Sweden, e.g. Vendel, Valsgärde, Gamla Uppsala), as well as in children's graves (Ježek 2015). Again, the reason for the occurrence of forging tools in burials can be linked to customs passed down since uses for metal were discovered, existing for the longest period in the Germanic societies of northern Europe (see above). On some occasions, the paths of touchstones and forging tools crossed in burials (especially prestigious ones), whereas sometimes they did not; the same is true for other symbols. It would be misleading to search for a functional connection between different tools in grave furnishings; in contrast with the world of the living, they are linked in graves exclusively by their function as symbols.

There are frequent deliberations in archaeological literature with regard to both prehistoric and early medieval, free, itinerant craftsmen and their role in spreading technological innovations, inspired by the ideas of V.G. Childe (recently, e.g. Ashby 2015, with refs.). This approach is in line with Marxist-Leninist theory on the division of work and the social order of prehistoric societies. However, not even Childe is the author of these thoughts; he merely attached his romantic notion of free craftsmen and merchants to the widespread nineteenth-century error based on the simple 'professional' interpretation of burials according to artefacts among their grave-goods. 'Itinerant gold/smiths' and 'armed merchants' appear frequently in literature dealing with burials furnished with weapons and other special objects and, at the same time, with tools for determining the value of metal. Likewise, there is much speculation as to whether weapons and/or jewellery in the graves of 'merchants' or 'goldsmiths' were articles of trade. Archaeologists in various parts of Europe are affected by the prospect of foreign merchants or craftsmen buried in extraordinarily furnished graves or graves in extraordinary locations (for early medieval examples from England, Germany and Scandinavia, see Ježek 2015, 130-131, with refs; for illustrative example from the opposite part of Europe, Romania, see a Roman period burial containing a 'whetstone' and other objects: Egri 2014, 237). Sometimes the presence of a single unusual item is enough, e.g. lamps in a La Tène cremation burial also furnished with an iron hammer, or perhaps a ceramic mould used to manufacture a pendant (Rustoiu & Berecki 2014, 250-252).

In any case, free 'itinerant craftsmen' have disappeared from the scene of prehistoric and early medieval Europe (Gibson 1996; Neipert 2006). With them, their graves, as well as the graves of 'armed merchants', have disappeared, leaving behind elite burials (Ježek 2013b, 719-720; 2015, with refs.). The occurrence of metalworking tools and tools for determining the value of metal in graves has no link to the activities of the buried individuals. As with axes without holes for handles (Ottinger 1974), or miniature equestrian spurs, with which the legs of children could not possibly have reached the flanks of a horse (Klápště 2009, 533-534), it is seemingly possible to regard the tools for determining the value of metal placed in children's graves as symbols of unattained social standing as perceived by the family of the deceased (as did erroneously Ježek 2013b, 720). Nevertheless, unlike the mentioned axes and spurs (which were perhaps made specifically for the burial?), tools for determining the value of metal were real tools, even with streaks of precious metal in the case of touchstones that had nothing to do with the destiny of children. Also many adult individuals encountered tools for determining the value of metal only after their passing. This simple fact has inevitable consequences, likewise assigning opinions about symbols of inherited professions or social standing based on the occurrence of various objects in children's graves to the ash-heap of the history of archaeology. Of greater interest is the issue of whether prehistoric and early medieval children's graves were furnished with actual toys…

A symbol for the dead of all ages

Extraordinary grave-goods often become the subject of reflections on the ostentation or even the *mise-en-scène* of burials of individuals with prominent social standing. However, it was not necessary to stage symbols, as they were a natural part of burials. Balances, weights or touchstones, which were often kept in a pouch hung from the waist, could hardly demonstrate anything to the community gathered at a funeral. The practice did not involve a message addressed to those in attendance at the burial (and it was certainly not thought that the objects were something the deceased would need in the afterlife). The same approach can be taken towards other grave-goods that went through a similar transformation, from being common utility tools, in the burial ritual. As is evident from children's graves furnished with weapons, riding gear, metalworking tools and those for determining the quality of metal, etc., the function of symbolic grave-goods was not conditioned by the use of these artefacts during the life of the deceased. Such is true for female graves, and there is no reason to interpret the furnishings of male graves in a different manner. In other words, the occurrence of a symbol in a burial holds no key to the social classification of a grave. The 'Black Earth' at Birka has given up thousands of typical stone artefacts; there was certainly no local shortage of touchstones. Touchstones, however, only occur in some graves at Birka, including both the most prestigious and the poorest (see below).

Leaving aside weapons, riding gear and jewellery, which help to clarify the testimony of social status of the deceased, many other objects acquired the function of symbols during the funeral ritual. These include the hemispherical (less frequently drop-shaped) glass artefacts most commonly designated as 'linen smoothers', 'smoothing stones' or 'slick-stones', which occur across a large part of medieval Europe (cf., e.g., Rogers 1997, 1775-1779; Schmaedecke 1998; Steppuhn 1999; Dekówna 2000; Bartels 2009; Galuška *et al.* 2012, 89-90; Myszka 2014; Hedenstierna-Jonson & Kjellström 2014, 196). Although the great majority come from trading centres, these artefacts are also known from rural sites. Hedeby, with 103 examples (see Schietzel 1998, 74-76), is an exception; the settlement layers (or Black Earth) at Birka, have provided just five fragments of these objects (Andersson 2003, 89). Conversely, unlike in (e.g.) Sweden, Britain and France, no Viking Age grave discovered at Hedeby contains one of these objects, despite (or perhaps because of) their frequent utilization at this site. At Birka, eight specimens were found in (six or) seven female graves and (uncertainly) in one male burial (grave 914: Arwidsson 1984). Although one of these female burials (grave 973, with a touchstone) belongs – only from her burial furnishing – to a 'better' social level (Hedenstierna-Jonson & Kjellström 2014, 196), none of them can be classified as prestigious (although they are not poor burials). The prevalence of the 'linen smoothers' in 'middle-class' female burials reveals a certain tendency. Nevertheless, the question remains as to whether the individuals buried with the 'linen smoothers' ever held these working tools in their hands.

The weights from nearly 80 burials at Birka are evenly divided between men and women. About 59 % of male burials and 41 % of female burials contain a touchstone (Ringstedt 1997, 78, 81, as 'whetstones'). Female burials furnished (also) with touchstones are not surprisingly a long-term phenomenon (see above). Early Bronze Age burials, such as Rollestone 23(1) and Barns Farm cist 2, England (Rogers 2013, 42-45), and the most prestigious burial in Late Bronze Age Cyprus, Kourion-Kaloriziki 40 (Fig. 3: C; Matthäus & Schumacher-Matthäus 2012, 76), may serve as examples. Touchstone candidates are known from female graves of various periods and parts of Europe, e.g. from the eastern Hallstatt environment (Pécs-Jakabhegy kurgan 37: Metzner-Nebelsick 2002, 398) and Viking Age Hebrides (Kneep/Cnip at Uig: Welander *et al.* 1987), as well as twelfth-century AD Pomerania (Barwino grave 3: Biermann 2008, 93). Vekerzug culture (sixth- to fourth-century BC) female burials furnished with touchstones sometimes also contain arrowheads (e.g. Chotín I-A gr. 167b and Szentes-Vekerzug gr. 30: see Burghardt 2012, 102-103). There are numerous female burials, particularly in Scythian contexts, equipped with arrowheads, lances, etc.; a female burial with a richly equipped horse provides an example (Petrenko 1961, 69). Considerations of burials of 'Amazons' (e.g. Fialko 1991; Gawlik 1998, 56; Guliaev 2003; all with refs.), including Mamay-Gora (Ukraine) as the largest barrow cemetery in the North Pontic area (Fialko 2010), are popular even today. Similar to this is the case of Viking Age 'warrior-women' (for 'examples', including prestige burials from Birka, Köpingsvik/Klinta, Oseberg, etc., see Gardeła 2013, with refs.). For example, 13 out of 41 anthropologically determined female burials contain weapons (including two shields) at Viking Age Kaupang, Norway, as is also the case with the local burial (Ka. 322) of a child furnished with a magnificent sword (Stylegar 2007, 83-84, 126).

One of the Birka chamber graves contains fine weaponry, a full set of gaming pieces and two horses (grave 581), i.e. a typical composition of the furnishing of high-elite burials. The grave belonged to a woman (Kjellström 2012, 76; Hedenstierna-Jonson & Kjellström 2014, 193).[40] Four spurs (along with four weights and a touchstone) form a part of the furnishing of an individual of high social standing buried at Birka (grave 943), reputed to be that of a woman

40 For female burials furnished with drinking horns at Birka and other Swedish sites, see Gräslund (2001, 92-97). Drinking horns recorded in two male burials in (e.g.) Latvia were accompanied by weapons, etc., and also by a 'whetstone' (Cibēni) or by iron slag (Rūsiši), both from the fifth-sixth century AD (Oras 2013, 69, tab. 1).

based on the other grave-goods. Nothing among these grave-goods indicates that the said woman 'actively participated in trade', 'was a trader or held a powerful position in one of the trading houses/families', and nothing justifies any questions as to whether she was 'an amber carver who travelled around and traded her products' or 'a member of a wealthy and important trading house that was involved in both craft production and trade' (Andersson Strand & Mannering 2014, 307, 312).[41]

H. Arbman (1943) classified 45 of the excavated Birka graves as children's burials. Six of them contained weights (graves 793, 807, 846, 974, 977, 1036), and two of these also (parts of) balances. 'Whetstones' were found in three graves regarded as children's burials due to the length of the grave pit: graves 635, 756, 1082 (in grave 635, the find was made in the pit fill). Although J. Staecker (2009) sexes several of the buried children, the more recent anthropological determination by Anna Kjellström tempers overly optimistic opinions; e.g. the human remains from graves 635, 756, 846 and 1082 do not provide any anthropological information. Five of the above-mentioned children's burials furnished with weights provide 'better' determinations: grave 807 of between 3 months and 2 years, and graves 793, 974, 977 and 1036 of between 5 and 10 years (A. Kjellström, pers. comm.). Some of the burials mentioned here were furnished only with common artefacts (knife, fibula), and others with larger assemblages, including silver articles or beads with gold or silver foil, just as other children's burials (not only) at Birka. Only a few of the children's graves at Birka contained weapons, including coffin burial 1036 and chamber graves 974 and 977 (with weapons, a horse, etc.). Whereas A.-S. Gräslund (1998, 285, 287) has pointed out the short length of the sword and absence of riding equipment in the exceptional burial 977 (also containing a weight, a fragment of a dirham, etc.), her conclusions involve ideas about the diversification of grave furnishings by age of the deceased and especially about the journey of the deceased to the underworld. This does not apply to examples of wooden rods or sceptres among 'royal/noble grave-goods' in children's graves from the Migration period (Gräslund 1998, 283, with refs.). Viking Age wooden staffs have been found in highly prestigious female burials at Oseberg and Fyrkat (for refs., including the find from a bog at Hemdrup, Denmark, see Price 2002, 200-202).

Thanks again to Anna Kjellström's rigorous work of determination, the inviting data presented by J. Staecker (2009) concerning the *juvenis* category are also awaiting corrections. In any case, inhumation graves 621, 644 and 804A belonged to young individuals (A. Kjellström, pers. comm.): coffin burial 804A (an individual 17-25 years old) contained a leather pouch with a touchstone, a weight, two fragments of a silver coin, etc.; chamber grave 644, furnished with weapons, (part of ?) a balance, weights and many other

41 A fully armed 'woman' – according to DNA-analysis – buried together with male Alemannian colleagues in Niederstotzingen, Baden-Württemberg, Germany (Brather 2009, 261-262, with refs.) has been determined to be male following review of the skeletal remains (Gärtner 2013; Gärtner *et al.* 2014).

objects, including gold and silver, contained the remains of a woman (?), 14-20 years old, and a man (?), aged 20-30 years. According to H. Arbman (1943, 222-225), this girl/woman was also furnished with a 'whetstone' and a weight, whereas the man with the balance and weights (and other objects); gaming pieces, a hammer, a 'whetstone' and other objects were deposited in the corner of the chamber. However, with a length of 26.5 cm, one of the stones from this burial is too long for the available SEM chamber (or, in other words, is a prestige specimen), and the second was unavailable during the research period because in use as an impressive example of the beauty of Birka 'whetstones' in a travelling exhibition around the world.

Graves of young individuals, including infants, furnished with touchstones and/or weights or balances, are known from many European sites. For example, a boy who died aged 6-8 years and a girl of 14-16 years were buried with the typical stone artefacts in the Vekerzug culture (Hallstatt period) cemetery at Csanytelek-Újhalastói (burial 16), Hungary (Burghardt 2012, 102, with refs.). Grave 85 at the seat of a local tenth-century AD Slavic ruler in Starigard/Oldenburg (Germany; Gabriel & Kempke 2011) can serve as another example: that of a child aged between 8 and 16 months in which was found, along with a gold-embroidered textile, etc., a touchstone with streaks of precious metals (Ježek 2013b, fig. 3, tab. 2).[42] A tenth-century burial (grave 110) from near the Desyatinnaya Church in Kiev contained a necklace, with two dirhams and a silver cross, on the chest of a child aged 6-8 years, with 157 astragali, a miniature iron axe, a fragment of a balance, two 'whetstones' and other objects (Karger 1958, 174-176, pl. XVI). From a range of other medieval children's burials containing a touchstone, including those from Viking Age Sweden (see Ježek 2013b, 720), we highlight the grave of a 2- to 3-year-old girl from a Merovingian period cemetery in Frankfurt am Main, Germany (von Freeden 2016, 96, fig. 7).

Of the touchstones on which it has so far been possible to analyse streaks of metal, those from two early medieval cemeteries in Poland can be selected as examples (for the additional case of Dziekanowice, see below). From the total of 32 inhumation burials at Pokrzywnica Wielka (Warmia-Masuria), dating to the first half of the twelfth century, of which one quarter are of non-adult individuals, five contain touchstones (Ježek 2013a, with refs.). Three of them are children: *infans I* grave 15 also contains a spear, bronze bowl and other artefacts; *infans II* grave 12 a knife, fire steel and spindle whorl; and the individual in grave 6, 'not older than 14-16 years' (Rauhut & Długopolska 1971, 343), weapons and other objects. The relative number of children's graves versus adult graves is substantially higher at Pokrzywnica Wielka than at Birka; Pokrzywnica Wielka, however, involved a cemetery of the local elite (with no identified settlement counterpart). Therefore, a better example is offered by the eleventh-century cemetery at Sowinki near Poznań (Greater Poland), with 150 excavated burials (Krzyszowski 1995) – again, with

42 In Starigard/Oldenburg, touchstones were also found in two other burials, including a richly furnished wooden sarcophagus in front of the altar of the local church, ascribed to an individual known from written sources as the *subregulus* of the Wagria (Ježek 2013b, 716, with refs. and the analytical results).

no discernable connection to any local settlement. Six touchstones occur in five burials here (Ježek *et al.* 2013). Two, and most probably even three, of the three anthropologically identified graves furnished with touchstones belong to *infans II* and *juvenis* individuals: two of them are clear elite burials. In contrast, many early medieval cemeteries, including those with richly furnished graves and those located near power centres, produced no tools for determining the quality of metal. No quantification procedures are helpful in this case.

Many graves have provided only parts of touchstones, or more precisely, fragments that cannot be reassembled into a whole (examples from Birka include both inhumation, e.g. grave 605B, and cremation burials, e.g. grave 995), whereas others contained broken touchstones that could be reconstructed. Fragments of touchstones are found relatively often among grave-goods; however, undamaged touchstones occur far more frequently. There is no evidence for potential speculation about the intentional destruction of utilitarian artefacts for burial purposes. As in the case of other symbols, which are often found incomplete in graves (parts of balances, for example), the symbolic essence of a touchstone was also preserved in its part, or in a broken specimen.[43] Nevertheless, for our research, fragmented touchstones are important for purely practical reasons, given that objects longer than 20 cm do not usually fit into the chamber of the available SEM. Several promising touchstone candidates from Birka graves, imposing symbols of the social standing of their owners, remain unanalysed because of their length (e.g. graves 644, 842, 1143; it does not mean that the buried individuals were owners of these tools). Fortunately, the artefact from grave 524, 29.2 cm long in total, was found broken into two parts. Only one face of the shorter fragment was observed in the SEM: streaks of tin, silver and silver with an accompaniment of copper were documented. Male grave 524 belongs to the most prestigious burials at Birka. The second, fine touchstone from this grave is one of the few specimens from Birka equipped with a silver ring (Fig. 28).

43 Naturally, this does not concern fragmented coins in Viking Age northern Europe, or in the bullion-economy zone, given that their parts served in everyday life; minting was a means for confirming the credibility of the precious metal.

Analysed touchstones from Birka burials

Scientifically speaking, it would perhaps be more correct in some cases to refer just to 'stone artefacts'. However, the results of the chemical microanalysis of more than one quarter of the typical stone artefacts from Birka burials (Fig. 28), and of hundreds of similar finds from other sites, allow illusory correctness to be set aside, and the artefacts are mostly referred to here as touchstones (or sometimes as 'whetstones' in quotation marks). Samples from Birka burials were selected for chemical microanalysis not on the basis of the social classification of the grave, age or gender aspects, but on the probability of being able to record metal streaks after study of the artefacts under a binocular microscope. Of course, even this seemingly impartial selection could (and probably did) focus unknowingly on touchstones from the graves of individuals with high social standing. Nevertheless, Tables 4 and 5 include a wide range of grave characteristics and demonstrate that the occurrence of touchstones in Birka burials is not limited by social aspects (as at Hedeby, for example; Ježek & Holub 2014, 200-201).

Among the c. 1,100 burials excavated at Birka, some of which contained the remains of two to four individuals, H. Arbman (1943) recorded 'whetstones' in a total of 154; two specimens were found in the graves of at least 11 individuals (burials of individuals with more specimens are also known from other sites; Ježek 2015). The furnishings of the graves containing these stone artefacts are highly diverse (also) at Birka. Some belong to prestige graves (524, 750, 1035), others to common burials. There are also graves with poor furnishings (e.g. fire flints, knives, shears, which are not listed in Tables 4 and 5 due to their high frequency). The burials are both cremation and inhumation, male and female. In addition, the graves of five people dressed in oriental caftans contain, among other items that often include special objects (Hedenstierna-Jonson & Holmquist Olausson 2006, 47), either a balance or weights, or a 'whetstone' – in some graves both (Jansson 1988, 594-595, fig. 14). Many prestige burials at Birka contain no tools for determining the value of metal. Certainly, the following discussion should ideally take into account – in addition to the 48 that yielded the analysed touchstones – over 100 further graves with similar

Grave	Cemetery	Gender	Militaria	Riding gear	Fibula/ae	Beads, valued stones, amber	Weights	Coin/s	Gaming piece/s	Other
69: C	1B	?		•			•			•
220: C	1D	?								
524: S	2A	M	•		•	•		•	•	•
540: S	2A	?								
746: S	1C	M		•	•					•
750: S	1C	F + M	•	•	•	•	•	•	•	•
823: S	1C	F		•	•	•	•			•
824B: S	1C	F								•
872: S	1C	M	•	•						•
995: C	1A	?								
1035: C	1B	F + M	•		•	•			•	•

Table 4. Birka burials with two 'whetstones' among the grave-goods of a single buried individual. In bold are graves from which one or two touchstones were confirmed during our SEM analyses (the stones from the other listed graves were not examined). C – cremation burial; S – inhumation burial; F – female; M – male. 'Other' includes combs, tweezers, keys, bronze vessels, etc. (after Arbman 1943); fire flints, shears, knives, ceramic vessels, etc., are omitted. Thanks to H. Arbman's detailed information in his description of the burials, our table differs from the data in his summary Tabelle. In his column of 'whetstones', Arbman included a number of stone artefacts found in the fill of graves (e.g. 362, 842, 968, probably 1125B) or stones 'belonging' to two individuals (one each) in a burial (e.g. 45, 644); elsewhere he listed two fragments of a single stone artefact (e.g. 11A). Sometimes the link between typical stone artefacts and the human remains is vague (1144). Prestige graves 750 and 1035 contain three touchstones; in both cases they are the joint burial of a man and a woman.

finds. However, although we do not doubt the classification of stone artefacts from the latter burials, they have not been analysed.

From our own perspective, the furnishings of burials containing (at least) two touchstones at Birka are summarised in Table 4. Of the listed examples, eight stone artefacts from five graves have been analysed (highlighted in bold in Table 4). A further 43 touchstones investigated using the SEM are from graves in which they were the only specimen (Table 5). Of the 'twenty highest ranking graves' from the Birka burials identified, using quantitative methods, by N. Ringstedt (1997, 148), two appear in Table 4 (750 and 872) and one in Table 5 (660). It is not surprising that streaks of precious and other non-ferrous metals were preserved on the touchstones from graves 660 and 750 (the stones from grave 872 were not analysed). It can be assumed that streaks of precious metals are also preserved on similar (unanalysed) stone artefacts found in other graves among the 'top twenty' (graves 542, 544, 581, 644, 735, 739, 854, 943, and others).

In Tables 4 and 5 together, the number of Birka graves containing only touchstones (11 %) is similar to the number of prestige graves containing touchstones together with other furnishings (c. 16 %). However, once again, these percentages are inevitably influenced by our selection, even if not 'socially' informed. The remaining burials show indicators of the social standing of the deceased that point essentially towards one or other pole. Despite the fact that the tables contain just under one-third of the (burial) finds under discussion,

Grave	Cemetery	Gender	Militaria	Riding gear	Fibula/ ae and/or parts of costume	Beads, valued stones, amber	Weights	Coin/s	Gaming piece/s	Other
47: C	1E	F		•	•	•				
56: S	1B	M		•	•	•	•			
60	1B	F			•		•			•
81 a: C	1B	?								
86 b: S	1B			•		•	•	•		•
145: C	1B	?			•		•			•
376A: C	4A	?					•			
414: C	4A	?		•			•			
432: C	4A	?		•						•
475: S	2A	?	•					•		•
495: S	2B	M	•		•			•		•
496: S	2B	M	•	•	•		•	•		•
557: S	2A	F			•	•		•		•
561: S	2A	M	•		•					•
573: S	2A	F + M	•		•	•				•
605B: S	2A	M	•		•	•				
624: S	2A	M	•		•	•			•	•
660: S	2A	F	•		•	•	•			•
667: C	5	?								•
674: S	5	?								•
708: S	1C	M	•	•	•		•			•
711A: S	1C	?								
715: S	1C	M			•		•			
752B: S	1B	M	•	•	•		•	•		•
768: C	1C	?		•			•			•
776: S	1C	?				•	•			
777: S	1C	F			•	•	•	•		•
795: C	1C	?				•				
804A: S	1C	M			•		•	•		
831: S	1C	F		•	•					•
913: C	1B	M			•	•	•			•
949: S	1A	M	•		•	•				
950: S	1A	F			•	•	•			
955: S	1A	M	•	•	•					•
964: S	1A	F			•	•	•	•		•
973: S	1A	F		•	•	•	•			•
991A: S	1A	M	•	•	•		•	•		
1014: S	1A	F			•					•
1020: C	1D	?								•
1043: S	1D	?								
1059: C	1A	M		•	•					•
1076: S	1B	M	•		•					
1082: S	1A	M	•							

Table 5. Birka graves containing one touchstone from the 51 analysed specimens. C – cremation burial; S – inhumation burial; F – female; M – male. Clearly elite burials are highlighted in bold. List of furnishings according to Arbman 1943. 'Other' includes combs, buckets, needles, awls, needle boxes, glass, keys, tweezers, etc. Fire flints, shears, knives, ceramic vessels, etc., are omitted. The touchstone from grave 60 was found in the mounded earth of the barrow (Arbman 1943, 23-24); the rest were part of grave-goods. Grave 1014 is listed according to Arbman's correction (1943, 426): the stone artefact is included with the finds from grave 1016, although not in H. Stolpe's records; the situation is reversed in the case of grave 1014.

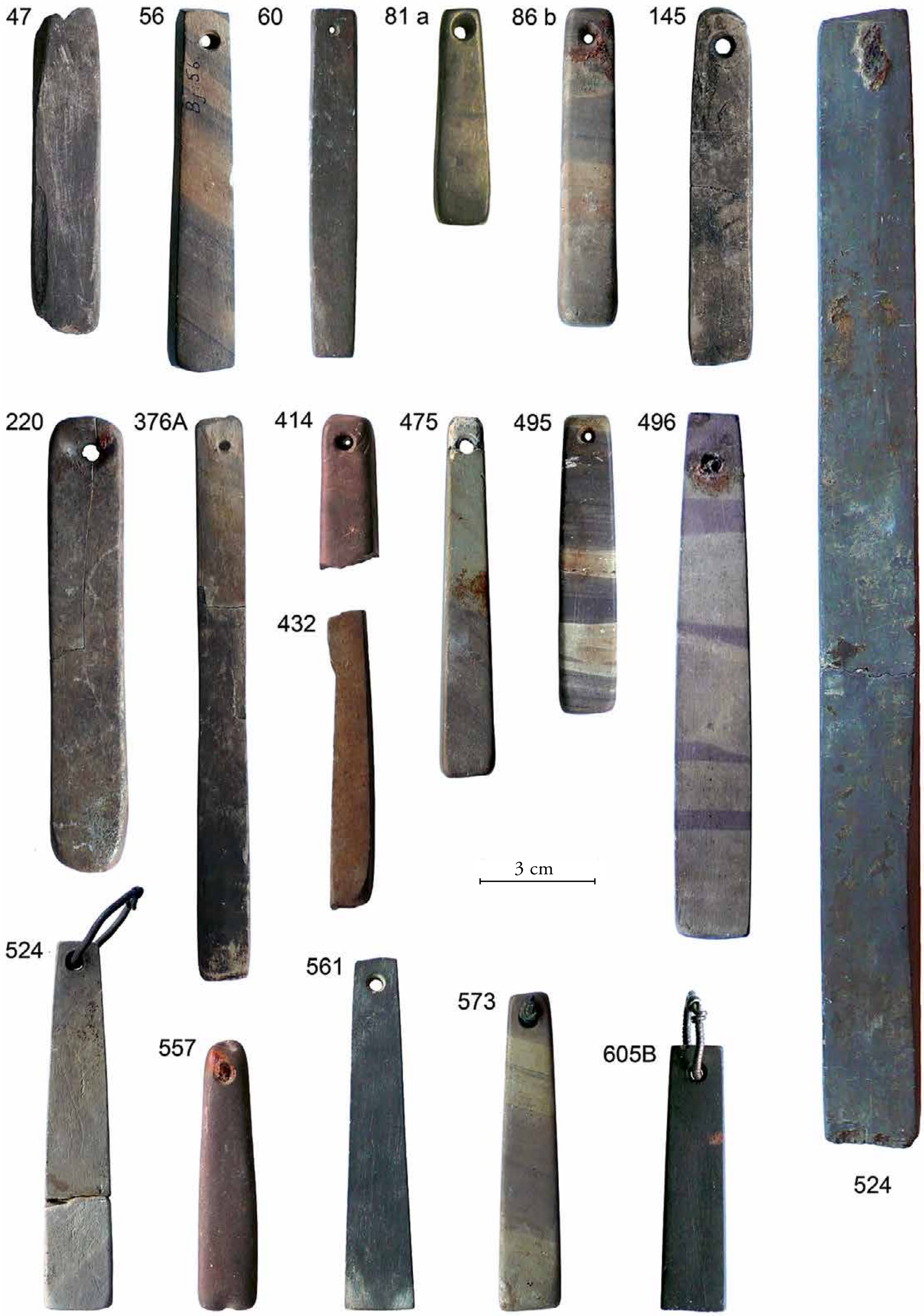


Fig. 28 (this and following pages). Analysed touchstones from selected Birka burials, with grave numbers. For the analysis results, see Table 12 and Figs. 46 and 47. (Photos: M. Ježek; fig. F. Laval; courtesy of the Swedish History Museum).

Fig. 28 (continued). Analysed touchstones from selected Birka burials, with grave numbers. For the analysis results, see Table 12 and Figs. 46 and 47. (Photos: M. Ježek; fig. F. Laval; courtesy of the Swedish History Museum).

Fig. 28 (continued). Analysed touchstones from selected Birka burials, with grave numbers. For the analysis results, see Table 12 and Figs. 46 and 47. (Photos: M. Ježek; fig. F. Laval; courtesy of the Swedish History Museum).

it is apparent that any attempts to categorise social standing of the buried individuals would be unproductive. Touchstones have also been recorded in cemetery 5 (Grindsbacka), linked to a village near Birka because of the rather poor furnishings of its graves, some of which contain no grave-goods at all (for examples of Viking Age rural burials furnished with 'whetstones', including child burials, from a part of southern Sweden, see Svanberg 2003). Theoretically, of greater importance could be whether traces of precious metal are preserved on stone artefacts from ordinary or even 'poor' graves. In this regard, there is no difference between touchstones from prestige and ordinary burials at Birka (see below). Drawing conclusions about the social standing of deceased on the presence or absence of traces of precious metals on the touchstones from their graves would be erroneous. It is appropriate to point out that at Birka some of the touchstones, both from graves without other noteworthy furnishings and from prestige graves, were worked into exquisite forms from banded silt, a rather rare material (see Johansen *et al.* 2003, 155; Bychkova *et al.* 2008; Hansen 2009, 76). From our point of view, however, the raw material of touchstones is less important than other findings (see below).

Fifty of the 51 stone artefacts from Birka burials chosen for chemical microanalysis are from the furnishings of graves, and one from the mounded earth of a barrow with four burials (grave 60). Despite the scepticism resulting from earlier experiences with the analysis of similar stones from cremation burials (cf. Ježek 2013b, 723), several promising specimens formed part of the assemblage marked for chemical microanalysis; indeed, approximately one quarter of the stone artefacts listed in Tables 4 and 5 come from cremation burials. Traces of non-ferrous metals are preserved on all these stones. However, traces of fire were found on just a few of them (e.g. grave 913), raising the question as to whether the others were ever in a funeral pyre. We will take two examples from the many cremation graves at Birka. In grave 11A, a fragment of a 'whetstone' was lying on a layer of burnt material (Arbman 1943, 3). Of the three touchstones from the female and male grave 1035, one was burnt, but not the other two (Arbman 1943, 432). Both unburnt and burnt items have been recorded in prehistoric cremation burials (for 'pyre goods' and 'grave-goods', McKinley 2013; for the Early Bronze Age examples, Rogers 2013, 46). Touchstones were both inserted into the actual urns and placed outside them (for examples from the Late Bronze and Early Iron Ages, see Burghardt 2012, 118, with refs.).

The supplementary addition of artefacts to the remains of the deceased is directly related to the presence of touchstones in the fill of graves or in the mounded earth of barrows at Birka, as well as at other early medieval sites (e.g. Kouřim, Czech Republic: Ježek & Zavřel 2010, 612). Despite the fact that it does not directly involve the burial furnishings of the deceased, and it is not possible to rule out the random deposition in the soil of a lost or discarded touchstone, or its fragment (improbable in an early medieval funeral area), a connection to symbolic behaviour is obvious. The same is true for countless coins from the fill of early medieval graves in row cemeteries (e.g. only for Moravia, Czech Republic: Marethová 2008, tab. 2: 47, 53, 55, 62, 103, 107, 159, 169, 179).

Conspicuous, at first glance, among the touchstones from Birka burials is the fragment from grave 605B. Whereas the other touchstones from local burials are made of various raw materials with a range of colours, including banded silt, this perfectly smoothed regular artefact is deep black silicite with a greenish tint, clearly a touchstone even using the traditional approach (Graham-Campbell 1980, no. 171), with a silver ring in the hole at its preserved end. This artefact is literally covered with streaks of non-ferrous metals. But while this touchstone probably belonged to a true expert in testing the quality of metals, it cannot be used to designate the social or even professional status of the buried individual. It is possible that this person never actually worked with the object during his lifetime; after all, only part of the broken tool was found in the grave. The grave also contained a spear tip, a bronze fibula, a knife and a rock crystal bead. The furnishings of a woman buried in the same chamber (grave 605A) are likewise not particularly spectacular, despite the presence of a gilt-bronze brooch (Arbman 1943, 198).

What makes the touchstone from grave 605B remarkable is neither its colour, raw material, high frequency of the streaks of silver, nor the silver ring (as is the case with touchstones from, e.g., Vendel burial IX and Birka graves 524 and 573). Remarkable is the streak of a metal composed of zinc (46 %), copper

(33 %) and silver (21 %),[44] which could be a credible imitation of high-quality silver created intentionally by melting silver in brass rich in zinc (see pp. 101-102 for the analogy from Helgö, Sweden). Equally noteworthy are the streaks of nickel and streaks of iron with a small amount of nickel (see pp. 109-112). Also, due to the extraordinary status of this touchstone among the specimens from Birka burials, there is no reason to consider post-excavation contamination, expecially so when the streaks of nickel have been recorded on other touchstones from prehistoric and early medieval Europe (see p. 110).

Although the colour black is undoubtedly practical for touchstones, their colour varies and includes light grey, ochreous, beige, sandy, creamish, etc. (see Oddy 1983, 58; Ježek 2013a; 2013b, 714, 717; 2014; 2015, fig. 1; Ježek *et al.* 2013; in press; Ježek & Zavřel 2011, fig. 7; 2013, figs. 3 and 4). One of many additional examples is the elegant, light beige object from prestige grave 524 at Birka, equipped with a silver suspension ring. The faces of this touchstone are covered with streaks of silver. It is also pointless to differentiate touchstones by raw material; for example, although the touchstones in the assemblage made of banded silt (19 specimens), typically perfectly worked into elegant forms, often have streaks of silver, some do not, unlike streaks of other non-ferrous metals (graves 475, 752B, 823, 913, 955). The same is true for touchstones made of less spectacular raw materials. In contrast, in the assemblage from Birka burials, streaks of gold are recorded only rarely on banded silt; gold occurs most frequently on common slate. However, information of this type is irrelevant; the randomly preserved traces of streaks recorded on the stones reveal little about which metals the touchstones had encountered in the past.

From a social perspective, the occurrence of touchstones made of banded silt in Viking Age graves is of greater interest. Their tendency to appear in the higher social environment, including prestige graves, is apparent (see also Bychkova *et al.* 2008, 313, for Gnëzdovo, western Russia). But other touchstones found in these graves are made of common materials, and specimens with low aesthetic appeal also occur. The survivors evidently did not concern themselves greatly with the raw material, quality, or even value of the touchstone placed in a grave. According to K. Sundbergh and G. Arwidsson (1989, 103: as 'whetstones') the majority (c. 75 %) of the touchstones from Birka burials are made of slate, and c. 23 % from banded silt. The 669 finds from the Black Earth included in the authors' analysis are again dominated by slate, with only a small quantity of banded silt (Sundbergh & Arwidsson 1989, 107). They also mention briefly the question of possible touchstones; based on the literature of the time, they could only conclude that 'the stones found in Birka were unsuitable for testing metal'. However, they did recognise the distinct difference between the carefully worked finds from burials and the more varied finds from the Black Earth at Birka (Sundbergh & Arwidsson

44 The data given in wt.% and calculated at 100 % appear also in the text below.

1989, 108). In fact, the colour of touchstones has no significance other than, in some cases, enhancing the luxurious nature of the actual artefact. A raw material that was as impressive as banded silt in the northern part of Europe was red schist in eastern Europe (see, e.g., Ježek 2013a, fig. 1; Ježek & Zavřel 2011, fig. 8: 1).

The majority of the touchstones from Birka selected for chemical microanalysis are perforated at one end for suspension. Some touchstones only have depressions from incomplete attempts at perforation, in some cases on both sides (e.g. graves 60 and 1082). The touchstone from grave 667 exhibits similar efforts, together with a hole made after the stone had broken at the location of the original hole (for a Slavic parallel, see Ježek *et al.* 2013; for Iron Age examples, see Burghardt 2012, 27). Testifying to the fact that even touchstones without a completed hole were used for their intended purpose are streaks of precious metals on their surface. Finally, many touchstones have no hole or traces of attempts to create a hole; the 'handle' sometimes has notches (e.g. Birka grave 777), but many specimens are without even these marks. The numerous finds of touchstones without holes for suspension (on a belt; see Fig. 4) suggest that they were carried in a pouch. Moreover, Birka grave 804A, for example, contains a perforated touchstone found in a pouch with other artefacts, including a weight. Any attempt at a typology would be counterproductive.

Touchstones in inhumation burials are found in various positions in relation to the skeletal remains, from the skull to the feet (see Ježek 2013a, 150-151, for several sites in Poland; Ježek & Holub 2014, 201, for Hedeby). In adult male burials they are most often located near the waist, especially those with a hole for suspension at one end, a location that corresponds to period reality. However, touchstones appear in various parts of graves (in the corners, etc.), both those with and without suspension holes. Their position in graves was not therefore limited by earthly reality, with the symbol remaining a symbol in any location, regardless of whether it was hung from the belt of the deceased, placed in a corner of the grave or tossed into the fill. The lack of a connection between ritual behaviour and earthly reality is best documented by the graves of infants furnished with tools for determining the value of metal; the same is true of infants' burials containing keys (for Birka, see Ulfhielm 1989, 129), knives, weapons, jewellery, etc.

Metals on touchstones from Birka and elsewhere

Almost none of the 51 stone artefacts selected from Birka burials (Fig. 28) were observed on all sides via SEM (Table 12; Figs. 46 and 47). Not all of them have the ‘classic’ four faces; in fact, in addition to thin and flat (two-sided) artefacts, three- and five-sided touchstones also occur (both made of banded silt). Due to time constraints, chemical microanalyses were often only conducted on a single face. As on the studied parts of the artefacts, traces of metals will surely also have survived on the faces that were not investigated. Although surprises can never be ruled out, the analysis of these additional sides would probably have resulted in an increase in quantity of the same data as has already been obtained. As is likewise the case with touchstones from Vendel and Tuna in Alsike (Swedish Uppland: Ježek 2014; 2016), the frequency of the preserved streaks on several touchstones from Birka is exceptional on a European scale. However, it is not possible to establish whether this phenomenon is a reflection (most probably) of the intensity of metal testing, or of the methods used for cleaning off previous streaks in the Early Middle Ages, or (less probably) of the influence of the chemical composition of the local soil, or whether it is the result of post-excavation care (objects removed from the ground at the above sites in Swedish Uppland during the late nineteenth century are all deposited in the same museum).

The summary below has no quantitative objective. Setting aside the numerous circumstances influencing the preservation of metal traces on touchstones, this was probably because, when observing various streaks on a single touchstone, recurrent or highly similar results of chemical microanalyses were not recorded. On the other hand, the traces that were recorded could come from the repeated testing of the same metal artefacts, whereas others could be the remnants of a single streak preserved in fragmentary form. As a result of the non-homogeneity of the tested metals, spot analyses conducted today on various parts of the same streak sometimes produce different results. Certain elements contained in the streak need not show up in the spot analysis, and therefore it is necessary to analyse it at various points. In the case of unusual results, the spot analyses were repeated on various parts of the streak; however, they are not repeated in the individual sections of Table 12. In brief, any type of mathematical, let alone statistical, method for evaluating the data as presented would be misguided. Moreover, chemical issues also play an important role (see pp. 117-121). Some metals do not form compounds in alloys. For example, if silver dominates an alloy of silver and copper, crystals of silver grow first, followed by an allotriomorphic mix of Ag and Cu with a eutectic composition. Lead present in alloys has an even greater influence on the eutectic substance. The overview provided below must therefore be taken as a report on results obtained by SEM, not a detailed report on the products of early medieval metallurgy.

Silver often occurs among the analysed streaks on Birka touchstones (on 33 specimens observed in SEM, i.e. 65 % of our assemblage), either in 'pure' form or with a small accompaniment of other metal, usually gold or copper, and rarely tin or zinc. In the case of tin its occurrence is not regarded as relevant as to whether this involved, for example, bronze added as an adulterant into coinage metal, since the chemical composition of many streaks is consistent with high quality coins. In a small number of cases, the ratios of individual metal components are approximately balanced. One streak belongs to a metal composed of silver and copper with an addition of gold (grave 605B), whereas another streak displays similar amounts of gold, copper and silver (grave 495). In another case the concentration of silver and lead is virtually balanced, with the metal also containing copper (grave 795).

The presence of a trace amount of chlorine in cases involving silver is presumed to be the result of the effect of the reaction of the silver streaks with airborne chlorides, with NaCl from human sweat, or hydrogen sulphide resulting from the decomposition of organic material, with hydrochloric acid concentrated in the digestive juices of higher animals, or the effects of micro-organisms. Silver and metals containing silver are often accompanied by sulphur, a phenomenon interpreted as the result of the natural reaction occurring when silver comes into contact with an organic material (the tarnishing or 'blackening' of silver). Silver reacts with sulphur from the air to produce sulphides and sulphates (e.g. acanthite Ag_2S), and the creation of sulphides is particularly intensive in the presence of hydrogen sulphide (H_2S), which is produced during the decomposition of proteins.

In certain cases at Birka, iodine accompanies silver with a copper content (graves 86 b, 220, 495, 496, 605B, 795, 831, 1035 – the longest specimen), in other cases 'pure' silver (graves 145, 495, 524, 557, 795, 831) and sometimes 'pure' copper (376A). A conclusive explanation for the presence of iodine has not yet been found. A proposal seeking to clarify the same results on touchstones from Tuna in Alsike, Sweden, likewise exclusively in combination with silver and/or copper in ores containing iodine (Ježek 2014, 424), is not credible. Halides could not survive the smelting process even in trace amounts; the iodine potentially contained in the ores would evaporate during metallurgical processing. The results do not involve the remnants of testing minerals such as iodargyrite AgI, miersite (Ag,Cu)I, or marshite CuI; the atomic weights of iodine are too low in the relevant analyses. According to Milan Holub (pers. comm.), a possible source for the iodine in the documented streaks of silver, copper and their alloys is seaweed – or an ash from it. This ash could have served for cleaning tarnished non-ferrous metals and could also have lent a welcome patina to silver artefacts (silver iodide turns bright yellow when exposed to light). However, the presence of iodine was also recorded in the chemical microanalysis of ninth-century wire, again in a metal dominated by silver and copper, although only in one of four analyses conducted on various areas of an artefact discovered at one of the Great Moravian centres (Czech Republic, Galuška 2013, fig. 130).

In addition to numerous traces of other metals, one touchstone (of banded silt from grave 56) also bears streaks of silver with a relatively high proportion of **mercury** and a small amount of copper and iodine.[45] The stable phase of the Ag – Cu – Hg system already melts at 400-500 °C. Mercury distils at higher temperatures, whereas crystals of the Ag – Cu system do not fully melt until temperatures of 950-1100 °C are reached. The mercury could not have survived the intentional production of the metal of which a streak is preserved on the touchstone. The same is true for iodine. Our attention turns to the extraordinary deposits in Swedish Uppland that were being exploited as early as the Middle Ages (Falun, Sala, Garpenberg: for refs., see Ježek 2016). Approximately 100 ppm Hg and 200 ppm Ag is reported in the sphalerite concentrate in Sala. The contents of Ag in galena at the location are variable; galena contains a variety of inclusions and exsolutions of silver minerals including tetrahedrite, which often contains silver and mercury (freibergite, schwatzite). In addition to other ores and minerals, paraschachnerite Ag_3Hg_2, schachnerite $Ag_{1.1}Hg_{0.9}$, amalgam Ag – Hg, kongsbergite AgHg, Hg-tetraedrite $CuHg_{12}Sb_3S_{13}$, eugenite $Ag_{11}Hg_2$, etc., also occur in the Sala mine (Zakrzewski & Burke 1987, with refs.); for the occurrence of mercury in the silver context, see also Table 1 (prestige Iron Age barbarian burial). In any case, the presence of iodine in the metal under discussion on the touchstone from grave 56 indicates that the streak is not a result of recent contamination.

Streaks of **gold** were recorded on 17 selected stone artefacts from Birka burials (i.e. 33 % of the assemblage observed in SEM). Gold most frequently occurs in 'pure' form or with an accompaniment of both silver and copper; less frequent is gold with a content of silver and gold with a content of copper. The vast majority of gold streaks documented on touchstones from the analysed assemblage are in excess of 20 carats. These do not include at least two streaks with an exceptional character extending beyond the Birka assemblage. A streak from a metal composed of gold with nickel and a trace amount of zinc was documented on the above-mentioned stone from grave 660, whereas a streak of a metal with an approximately 50/50 composition of gold and tin, with a content of copper, is preserved on the stone from elite grave 624. A minor amount of chlorine appears in one streak of gold (grave 715), as in a similar case from Vendel (Ježek 2016, tab. 2). The most probable explanation can be found in the decay of organic materials, which also releases chlorides – among other compounds. There are, however, many other possible explanations, ranging from gold cementation to gold refinement.

45 This situation, different from the evidence of the amalgamation of brass recorded at Hedeby, necessitates the retraction of premature footnote 34 in Ježek & Holub (2014, 200), with my apologies.

Lead is generally the most common metal found on early medieval touchstones from the north-eastern part of Europe, or at least in Sweden and Poland. It occurs also on c. 80 % of the touchstones in the investigated assemblage from Birka. Of the dozens of documented lead streaks, approximately the same number are of 'pure' lead and lead containing copper (in rare cases also zinc: brass?). Lead with a content of tin appears in a small number of cases, in others also of copper. The small number of cases of metals composed of approximately the same amount of lead and copper have been mentioned above; just as infrequent are metals with the same amount of lead and tin. Also previously mentioned was a streak of a metal with a roughly identical content of lead and silver and with a content of copper (grave 795). Lead also occurs as an accompaniment to both tin and copper (in a small number of cases together with silver), and in a rare instance as an admixture (?) in brass with a dominant component of zinc (grave 561). In several cases, lead is accompanied by chlorine (for similar results from both Tuna in Alsike and Vendel, see Ježek 2014, tabs. 1 and 2; 2016, tabs. 1-3). Lead reacts strongly with certain organic acids occurring during the decomposition of organic material and also readily reacts with chloride ions under certain conditions.

Streaks of **tin** have been recorded less often on touchstones from Birka. Although 'pure' tin is most common, in some cases it is accompanied by copper. Tin with a content of lead has been recorded in only a small number of cases, in some instances with trace amounts of copper, exceptionally also with zinc (or brass). Of greater interest are streaks on the stone from the above-mentioned grave 624: tin repeatedly dominates in the streaks of a metal composed of gold and copper with a minor amount of zinc (lead is present in one case); in another case, mentioned above, an analysis of the same touchstone revealed approximately the same representation of tin and gold with a content of copper. In rare cases, tin also appears as an accompaniment of silver or copper (or brass), in several cases combined. Tin creates organic compounds that can bind sulphur from hydrogen sulphide from rotting and decaying proteins. If the tin is close to chloride ions, it quickly corrodes; the chlorine probably comes from halite (e.g. in human sweat).

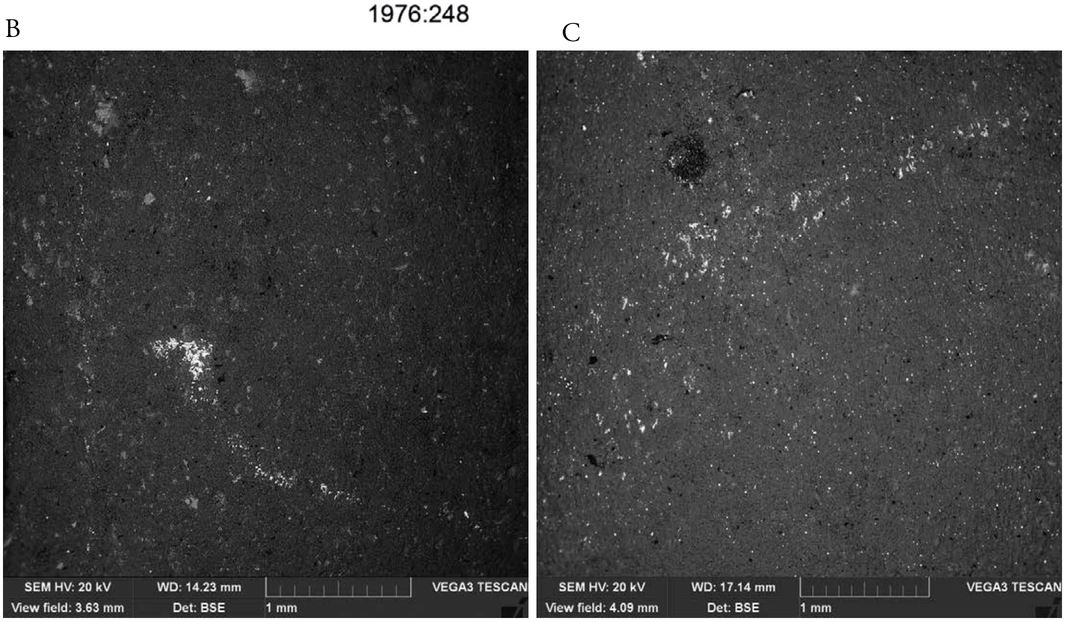
There are dozens of **copper** streaks in the studied assemblage. Copper appears in 'pure' form, as well as with various concentrations of lead and zinc, in rare cases with tin and silver. These also include streaks of copper with a content of zinc and tin (graves 752, 949), of zinc and nickel (grave 750 – the slate specimen), of silver and lead (795), of lead and zinc (949), etc. Far more often than as the dominant or only metal, copper occurs in the analysed assemblage (often in trace amounts) as an accompaniment of lead, silver, tin, gold or of metals composed of some of them.

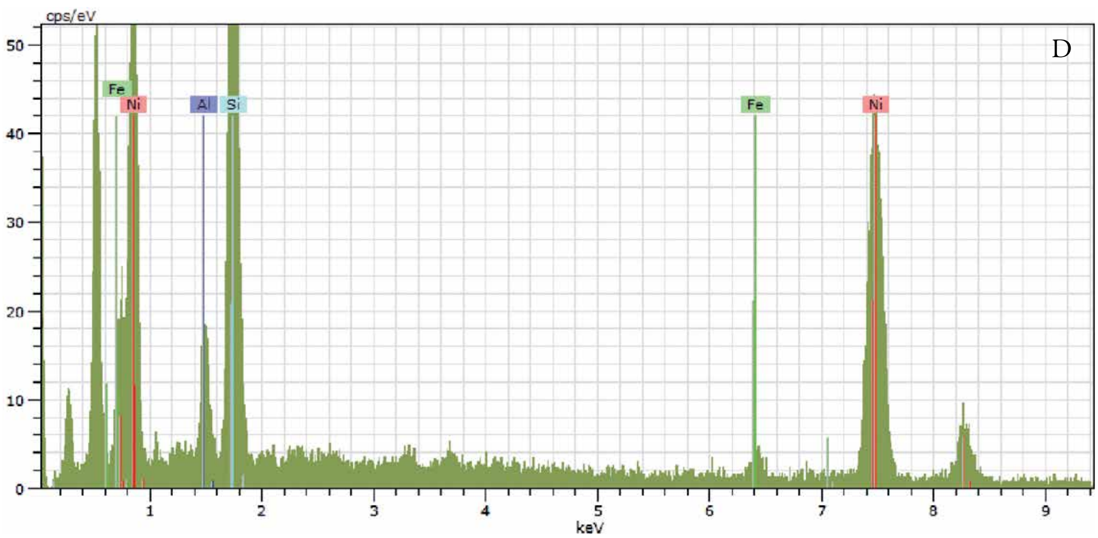
In several cases copper is accompanied by chlorine, in one case (grave 60) by chlorine and sulphur. The presence of chlorine in the streaks of copper or metals containing copper can be explained by corrosive processes accompanied by the formation of mixed oxy-hydroxy-chloride $Cu_2Cl(OH)_3$. Like silver, copper reacts with sulphur to produce sulphides and sulphates (e.g. verdigris), which can be expected in an environment rich in hydrogen sulphide, i.e. especially in inhumation burials. However, a minor content of sulphur in the streaks of copper can be also explained by the imperfect separation of sulphur during the smelting of copper ore (Ježek 2014, 425). In cases accompanied by sulphur, it is sometimes difficult to establish whether documented streaks represent tests of intentional products or of the raw ore itself. They represent intentional alloys in cases where the share of copper is approximately the same as the share of lead (graves 573 and 605B, both touchstones with silver rings). This is also true for similar streaks without the presence of sulphur (graves 145, 955, 973), and probably for numerous compounds of copper and lead (or conversely) without sulphur, where one of the metals is subdominant or marginal.

Zinc appears relatively often as subdominant in various streaks, especially of lead and tin, as at Birka. Zinc (5 %) also occurs in a metal with a dominant share of gold (77 %) and nickel (18 %: the stone from grave 660; see p. 109). The ratio of zinc to copper is typically up to one-third (33 %) in the traces of brass on specimens from Birka. Although this figure is in line with current literature on archaeometallurgy, the number of documented streaks on touchstones from Birka is uncommonly high. More surprising is that Birka does not belong to the sites where streaks of brass with an even higher share of zinc – up to 40 % – were observed. Such results have been recorded on touchstones from other early medieval European sites (e.g. Ježek 2013b, tab. 3; Ježek & Zavřel 2013, 125, tab. 3; Ježek & Holub 2014, tab. 1; Ježek *et al.* 2010, 68, tab. 1; 2013, tab. 1); contemporary brass artefacts with a similar share of zinc are also known (for burial finds, e.g., Frána & Tomková 2005, 321, tab. 4; Děd 2012, 292). Zinc gives a golden hue to brass; as yet unanswered is whether the aim of such alloys was to imitate a precious metal or whether it was a random by-product of classic brass production technology that caught the attention of touchstone users with its colour. Mentioned above is a unique (not only at Birka) metal composed of zinc, copper and lead in which the share of zinc is one half (grave 561), and a metal composed of zinc, copper (or brass) and silver in which the share of zinc is again nearly one half (grave 605B; for another example, see Table 3). If this metal was intentionally produced – for example, by dissolving silver in brass rich in zinc – it could have successfully imitated high-quality silver. However, the presence of zinc in this and other metals need not necessarily be connected solely with handling brass.

An even higher concentration of zinc in a copper alloy has been recorded during the analysis of prehistoric and early medieval stone artefacts, although this is rare. On the specimens from the La Tène oppida of Staré Hradisko and Třísov, Czech Republic (Table 3), the proportion of zinc in the clearly intentional streaks reaches up to 60-82 %. A metal of this type is consistent with a two-component brass in the gamma phase, which is known for its hardness and brittleness. Although it has no use from a contemporary perspective, its distinctive golden colour could have been a good reason for its intentional production (at temperatures above 820 °C), and especially for testing (on a touchstone). A similar metal, together with silver, also left its trace on a

Fig. 29. Bruszczewo, Greater Poland: (A) selected (fragments of) touchstones from the tenth- to eleventh-century settlement context (Poznań Archaeological Museum); (B) inv. no. 1976:248, right (horizontal, including the cluster) a streak of copper, left (vertical) a streak of nickel; (C) inv. no. 1960:968, streak of zinc; (D) spectrum of the streak of nickel on the touchstone inv. no. 1976:248. For complete results, see Table 7.





touchstone[46] from burial A31 in cemetery 116 at Helgö, Uppland, Sweden. A further three (of 17) typical stone artefacts from Helgö selected for chemical microanalysis bear traces of 'pure' zinc (inv. nos. 26481 A39[47], 30249 F16 A25, 30710 F4 A37), sometimes accompanied by chlorine, as is also the case with the touchstones from Birka graves 47, 86 b, 220 and 573. The discussion of chemically identical and apparently intentional streaks preserved on touchstones from prestige boat graves at Vendel and Tuna in Alsike (both also Swedish Uppland) concluded that there is no reason to doubt their early medieval origin, or rather, that the appearance of chlorine supports an interpretation of this kind (Ježek 2014; 2016). Although seemingly a somewhat unwelcome topic in archaeometallurgical literature (with rare exceptions: see Rehren 1996; Rehren in Fellmann 1999; Rehren & Martinón-Torres 2009; Nováček 2004; with refs.), evidence for zinc processing in European classical antiquity and the Middle Ages includes a small rolled sheet from the Athenian Agora, an inscribed tablet from a Gallo-Roman sanctuary near Berne, Switzerland, fragments of a Romanesque liturgical vessel from Pipe Aston, England, etc. (see Ježek 2016).[48]

Even after analysing hundreds of touchstones from a large part of Europe, linear streaks of zinc on touchstones are rare, unlike grains (in dozens of micrometres: e.g. Tables 3, 7 and 10; Ježek & Zavřel 2013, 124-125). From the Slavic environment, distinct streaks of zinc were observed on one (fragment of) touchstone from the tenth- to eleventh-century settlement located near the fortress at Bruszczewo, in Greater Poland (Fig. 29; Table 7), and on a touchstone (again, a fragment missing the most important part) from the twelfth-thirteenth-century, ordinary, sunken house in the village of Dřetovice, Czech Republic (Fig. 30).[49] Sphalerite, as a mineralogical rarity, occurs in pelosiderite concretions in the vicinity of Dřetovice (for more about the local use of this unusual source of raw iron in the eleventh to thirteenth centuries AD, based on both contemporary documentary and archaeological sources, from the vicinity of the eponymous Knovíz, see Anderle *et al.* 2000, 54-63).

However, the majority of the observed linear, clearly intentional, streaks of zinc have so far been recorded on early medieval touchstones from Swedish Uppland (again, a matter of our logistic possibilities). Nevertheless, even here,

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46 Swedish History Museum, Stockholm, inv. no. 30249 F10 (A31).

47 Streaks of silver, copper, lead and tin with an admixture of lead and copper are preserved on this touchstone. The inv. nos. are those of the Swedish History Museum, Stockholm.

48 The remarkable early medieval hoard from Rostock-Dierkow, Germany, contains a touchstone (now lost) and five bars, three of which should be made of an 'alloy of copper and zinc […] with a significant share of zinc', whereas the other two bars 'were probably made of zinc' (Warnke 1992/93, 204; translated from German). In fact, three brass bars are composed of 73-78 % Cu and 20-26 % Zn, with a marginal presence of tin and lead; the other two bars are made of tin, with a marginal amount of copper. I thank Detlef Jantzen and Lorenz Bartel for enabling the analyses in the Landesamt für Kultur und Denkmalpflege Mecklenburg-Vorpommern in Schwerin, and Jan Mařík for the analysis using a portable XRF spectrometer. Incidentally, even the title of the cited paper is at fault: there is no reason to ruminate on the hoard of a goldsmith, jeweller, etc.

49 I thank Kateřina Opicová for the chance to study the object from Dřetovice, where two further medieval 'whetstones' and dozens of kilos of iron slag were also recorded in the 1950s (Opicová 2016, 50-54).

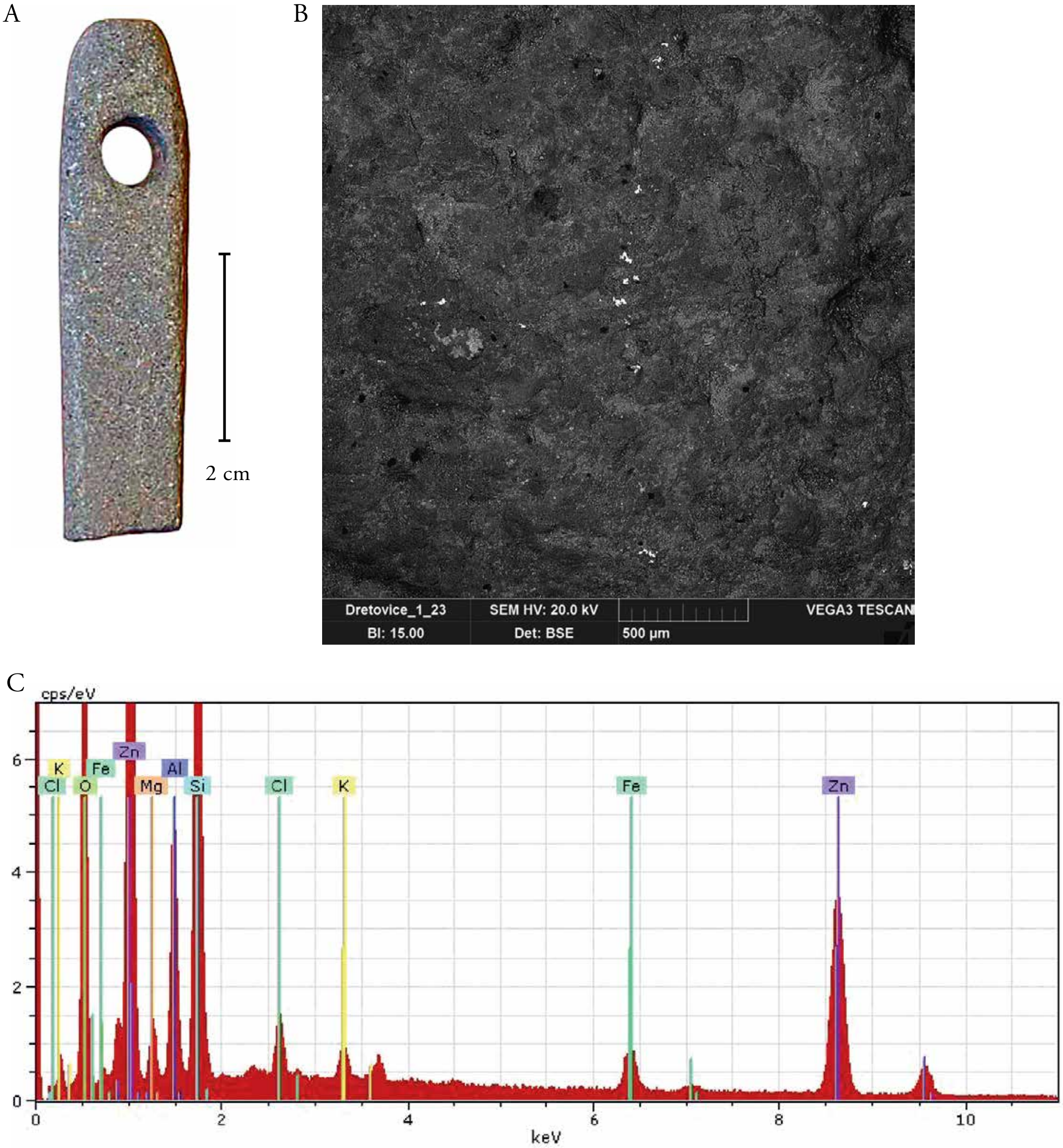
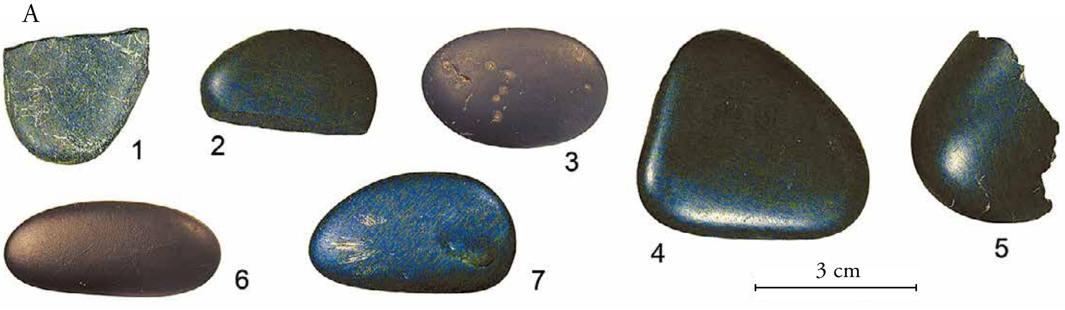


Fig. 30. Dřetovice, Czech Republic: (A) fragment of touchstone from a sunken house; (B) one of the streaks of zinc; and (C) its spectrum. (Photos: Š. Jonášová and K. Opicová).

the occurrence of streaks of zinc on touchstones is marginal in comparison with the number of streaks of other metals; zinc was by no means common.

Following the above results from Vendel, Tuna in Alsike, Birka and Helgö, the streak of a metal composed of zinc (38 %) and silver (28 %) with subdominant copper (6 %) and a relatively high amount of sulphur (28 %) recorded on another touchstone from Helgö (Swedish History Museum, inv. no. 26481 F2) is highly important for this issue. It is probably no coincidence that an artefact of similar composition (Fig. 31: B; 59 % silver, 35 % zinc and 5 % copper, with a marginal content of gold), has been identified among other remarkable objects (including chemical glassware, alembic, etc.) from the 'workshop of an



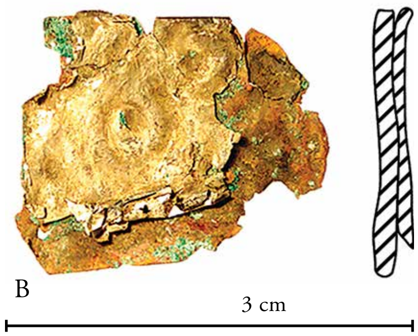


Fig. 31. Bilyar, Middle Volga region, Russia: the 'workshop of an alchemist, jeweller and glassmaker' from the thirteenth century AD. (A) Touchstones, no. 7 with visible streaks of gold; (B) an artefact with its upper plate made of 59 % silver, 35 % zinc and 5 % copper, with a marginal content of gold (after Valiulina 2016; courtesy of Svetlana Valiulina).

alchemist, jeweller and glassmaker' at Bilyar (Russia), the capital of the Volga Bulgars, at the turn of the thirteenth century AD. The particular proportions of the elements 'ensure the preservation of the best qualities of silver – the pure 'silver' colour, brightness and shine' of this thin plate (Valiulina 2016, 257, 259, tab. 2: 4, fig. 18: 3). Seven stone artefacts from this workshop classified as touchstones (Fig. 31: A), one at least with streaks of gold visible to the naked eye, are round and without holes (Valiulina 2016, 265-266, fig. 19: 8-14). Additional stones of the same shape, as well as rectangular stone artefacts, are regarded as 'whetstones' and 'grinding stones' (Valiulina 2016, 254, figs. 12: 1-3; 15: 3; 19: 15).

In the general European context, the number of linear, clearly intentional, streaks of zinc on touchstones is not the only curiosity from early medieval Swedish Uppland. Just as extraordinary is the evidence from this region for the medieval mining of ores with significant amounts, or even a predominance, of zinc; this is the earliest exploitation of such deposits in the northern part of Europe (for refs. and additional discussion, see Ježek 2016). The origins of mining in the Garpenberg district, where zinc forms a dominant part of metamorphosed, strata-bound, Zn-Pb-Cu-Ag sulphide deposits, remain dated only in general to the period before the thirteenth century. In the Sala mine, with sulphidic Zn-Pb-Ag-(Hg)-(Sb) mineralisation, the principal ores are massive sphalerite (ZnS) and galena (PbS). Local zinc ore contains, on average, 12 wt.% Zn, 2 wt.% Pb and 150-200 ppm Ag. Silver ore has been mined at the site at least since the Late Middle Ages (according to documentary sources). Another example of the long history of mining in Swedish Uppland is provided by the Falun district, with Cu-Zn-Au ores. Mining can be traced back there to at least the seventh century AD. In the cases mentioned above, sphalerite is the main Zn-bearing phase in the ore.

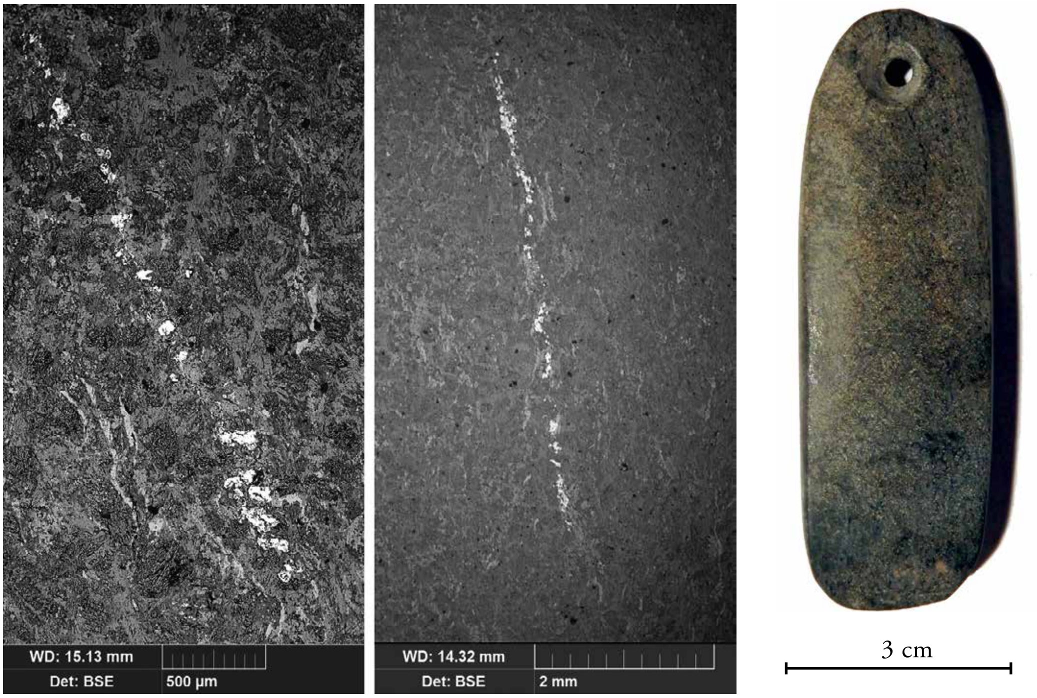


Fig. 32. Nižná Myšľa, Slovakia: touchstone made of serpentine from burial 474, c. 1700-1500 BC. Streaks of iron; for the streaks of non-ferrous metals, see Table 6. (Photos: Š. Jonášová and J. Zavřel).

It is therefore probable that nearly pure zinc was produced, perhaps accidentally, during the smelting of complex Cu-Pb-Zn ores with an admixture of Ag or Au. The metallic zinc might condense on the walls of the flues in the smelting furnaces. Sphalerite decomposes at c. 770-900 °C under the formation of ZnO. Metallic zinc is then obtained by the reduction of ZnO by live charcoal during its boiling and isolation of zinc fumes (Rehren in Fellmann 1999, 171).[50] Though galena and sphalerite behave differently during the weathering of the primary ores, zinc is carried away (mostly as sulphate). Zinc in a carbonate environment reacts with carbonates to produce smithsonite ($ZnCO_3$). As such, in the case of inhomogeneous smelting, zinc can be reduced from the roasted ore into metal that runs off together with the lead without mixing with it. Due to the higher smelting temperature of zinc and its lower specific weight, clumps of metal zinc could be (randomly?) created.

Again, the presence of zinc on the touchstones from the above-mentioned Birka burials does not mean that the buried individuals ever encountered zinc objects (and a touchstone, too). For that matter, one of the touchstones from Birka with streaks of zinc (and other metals, including silver) was found in a poorly furnished grave (220); this unattractive, even badly worked, touchstone is made of grey-beige schist This grave also contained an additional typical

50 Moreover, weathered portions of ores near the surface of these deposits could be rich in secondary minerals that decompose to ZnO at even lower temperatures than the sphalerite.

An. no.	Ag	As	Au	Cl	Cu	Fe	Ni	S	Sn	Fig.
1	80				5			15		
2	14		85	1						
3						100				32
4				25	74			1		
5		6		1	34		11		48	
6				5	31			1	63	
7						100				32
8				2	12			1	85	
9				3	97					

Table 6. Results of chemical microanalysis of the traces of metals preserved on the stone artefact from Early/Middle Bronze Age grave 474 at Nižná Myšľa, Slovakia (for the find-context, see Olexa & Nováček 2015, 78-79). The data given in weight percent (wt.%) and calculated at 100 % are semiquantitative. The geochemical background, i.e. elements deriving from the raw material of the stone, is excluded. Measurements: Š. Jonášová.

stone artefact (length: 18.1 cm) – not analysed because of being too long for the available SEM chamber.

Two stones in the analysed assemblage bear streaks with 72-75 % **antimony** and 15-18 % sulphur (cremation grave 376A and female grave 973, with numerous streaks). The atomic concentrations of Sb and S stoichiometrically correspond to Sb_2S_3. The chemical composition of the two streaks from Birka is identical with that of the streaks on touchstones from the early medieval fortresses and/or their suburbs at Ostrów Lednicki (inv. no. 8/71; see below) and Gniezno, Greater Poland (Ježek *et al.* 2010, tab. 2). Based only on the microanalysis as presented, it cannot be determined whether they are streaks from natural mineral antimonite (stibnite), weathering traces of metallic antimony in the form of its sulphide, or streaks from artificially prepared antimony sulphide (so-called antimony glass). Ancient metallic-antimony objects are known, particularly from graves of the third and second millennium BC in the Caucasus (Özbal *et al.* 2005, 198-199). Metallic antimony reacts freely with the hydrogen sulphide that forms during the decay of proteins in organic materials, and there should thus be a sufficient quantity of it in the environment of inhumantion graves to react with artefacts containing antimony upon the formation of Sb_2S_3. However, one of the two Birka cases derives from a cremation burial and, more importantly, all the other (aforementioned) parallels were found in settlement layers so that the 'mineral route' interpretation of the Sb_2S_3 streaks is probable. Due to the conspicuous appearance of antimonite with impressive crystals, and its similarity to lead, it is not regarded as significant that this mineral ('al-kuhl' in Arabic, from which the word 'alcohol' is derived) was used as eye make-up (made into a paste with fat), and later as a laxative.

Streaks of ('pure') **iron** were found on the touchstones from Birka graves 475, 524 (the longer specimen), 715 and 973. These could well be authentic; however, they could also result from contact with an archaeological tool during excavation (see Ježek & Holub 2014, 196, with examples of streaks of iron with an admixture of chromium). An illustrative reason in favour of such an interpretation is offered, for example, by one of the touchstones from the Bronze Age (c. 1700-1500 BC) cemetery at Nižná Myšľa, Slovakia (cf. Jaeger & Olexa 2014, with refs.). The serpentine artefact from male grave 474, also furnished with a decorated bronze dagger (Olexa & Nováček 2015, 78-79, pls. 155 and 156),[51] bears not only sporadic grains of silver and gold, but also streaks of copper, tin and their alloys – 'unwelcome' results for its interpretation as a Bronze Age touchstone – and also linear streaks of iron (Fig. 32; Table 6). However, iron objects appear in the third millennium BC in Anatolia and eastern Europe (cf. Tylecote 1992, 47), and their number grows during the second millennium BC, including in Slovakia. The occasional burials of this period containing iron objects refer to the high social position of the deceased (Bátora & Rassmann 2007, with refs.).[52] Given the number of graves and the finds of gold, amber, faience, boar's tusk armour, etc., the cemetery at Nižná Myšľa is one of the exceptional Bronze Age sites north of the Balkans. In any case, typical stone artefacts appear frequently in the assemblages of the (Middle Bronze Age) Füzesabony culture in Hungary (for settlement finds of 'whetstones', 'celts', etc., from the eponymous site, see Horváth *et al.* 2015).

Regardless of whether the streaks of iron on the touchstones from Birka are recent or from the Viking Age, their occurrence cannot serve as an argument for the use of these specimens as whetstones, given that streaks of non-ferrous metals are also preserved on the same stones, including (with one exception) precious metals. Suggestions (which I have often encountered) of possible multi-functional tools should definitely be consigned to where they belong – to the world of helplessness caused by the breakdown of petrified 'certainties'.

51 For the contemporary burial finds of typical stone artefacts from western Slovakia, see Benkovsky-Pivovarová & Chropovský 2015, 86.

52 We can only mention here the (most probably) Early Bronze Age finds from the polished-stone industry category – axes made of hematite and limonite, or limonitised hematite (Janák *et al.* 2004).

Nickel appearance

Milan Holub and Martin Ježek

When compared to analytical results from other archaeological sites, the occurrence of nickel in the relatively large assemblage of the touchstones from Birka selected for chemical microanalysis is paradoxically most interesting for its rarity. Nickel appears there in three streaks as a minor component of an alloy and once in pure form.

The streak documented on the touchstone from Birka grave 660 is composed of 77 % Au, 18 % Ni and 5 % Zn. This composition is typical for modern 'white gold', and the possibility of a sceptical interpretation remains open (contamination?). Grave 660 belongs to the '20 highest-ranking graves' at Birka (after Ringstedt 1997, 148), which moreover is furnished with an enigmatic iron rod (see p. 68). The streak preserved on the touchstone (made of grey schist) from grave 750 displays a metal composed of 65 % Cu, 23 % Zn and 12 % Ni. This chemical composition falls into the group of modern nickel brasses (58-66 % Cu, 11-26 % Ni, with the remaining part of Zn; trade-names such as nickel silver, paktong, alpacca, new silver, etc., are well known). Although it is naturally impossible to rule out modern contamination in the case of these touchstones (as is the case with some touchstones from other sites: see below), other streaks documented on them both cast no doubts as to their authenticity (see Table 12).

The only touchstone in the analysed assemblage from Birka on which streaks of 'pure' nickel were identified is from grave 605B. This is extraordinary (among the local burial finds of this kind) for its black colour, its silver ring for suspension and the quantity of streaks on its surface (see Table 12). This touchstone – in fact just a fragment, missing its most important part – also bears streaks of a metal composed of iron (c. 85 %) and nickel (c. 15 %), unique among the thousands of streaks observed so far on hundreds of European medieval touchstones. Although this chemical composition corresponds to meteoritic iron (cf. Leoni & Panseri 1961; Buchwald & Mosdal 1985; Johnson *et al.* 2013, with refs.), characterised by nickel contents in the range of 5-20 % (and even rarely of 60 %; cf. Scott 2013, 24-25; Tylecote 1992, 3), a similar amount of nickel in iron can also be caused by processes occurring during the oxidisation of the surface of iron forgings while being worked in the forge, or simply by an impurity in wrought iron (e.g. Photos 1989; Tylecote 1992, 3, 5; Bouzková *et al.* 2001; Hošek 2001; Macháček *et al.* 2007, 162-163; Scott 2013, 113). Hansson and Modin (1973) and Thålin (1973) have discussed the archaeological evidence for iron-nickel artefacts from Sweden.

Streaks of 'pure' nickel, along with traces of other non-ferrous metals, have been recorded on four additional touchstones from early medieval northern Europe, observed in the SEM: from the western mound at Gamla Uppsala (one of six specimens), two boat graves at Tuna in Alsike, Sweden (Ježek 2014), and grave 1 at Böklund, Germany (cf. Eisenschmidt 1994, 96), all belonging to an elite, or even aristocratic, environment. From the 'pre-medieval' Germanic environment, a streak of nickel is preserved on the touchstone from the 'royal' burial at Mušov, Czech Republic, dated to the second century AD (Ježek *et al.* in press). At the same time, it is important to remember that, although analysed touchstones from various sites are being taken into account, they represent only a very small part of the inventory of European finds, not to mention ancient reality, and are above all the result of our selection of specimens for chemical microanalysis, as well as of the willingness of various institutions to loan their collections to SEM laboratory.

On a wider European scale, a concentration of early medieval touchstones with traces of 'pure' nickel, including clear linear streaks, has been recorded from around Poznań in Greater Poland, from both (Slavic) fortresses and their suburbs (Ostrów Lednicki, Bruszczewo; Figs. 29, 41: c, 43: b; Tables 7 and 11) and from graves with elite connections (Dziekanowice, Sowinki: Ježek *et al.* 2013; see below). This cannot be said to be anomalous, given that the current state of our research is heavily influenced by logistical possibilities, although one of the largest meteorites (known as Morasko) to have fallen in Europe, of a ferrous-nickel composition, fell 5,000 years ago in the territory of modern Poznań. Several craters remain to this day of which the largest is c. 100 m in diameter. Two fragments of the meteorite were recently uncovered and analysed: one with a weight of 164 kg, the other of c. 261 kg (comprehensively, Muszyński *et al.* 2012, with refs.; cf. Stankowski *et al.* 2002). However, no plausible traces of iron with a low quantity of nickel are documented on the touchstones from this region.

Meteoritic iron was the raw material for the earliest known evidence of ironworking in the world, i.e. of iron beads from two prestige burials at el-Gerzeh, Lower Egypt (Johnson *et al.* 2013; Rehren *et al.* 2013). R.F. Tylecote (1992, 3) provides numerous examples of the use of meteoritic iron during the Bronze Age, and D.A. Scott conveniently summarises current archaeological knowledge in both ancient and modern contexts (Scott 2013, 83-92, with refs.).

In the case of touchstones, the presence of trace amounts of 'meteoritic markers', such as germanium, gallium, etc., in metal streaks cannot be discovered in environments strongly affected by their geochemical background (i.e. the raw material of the stone) without damage to the artefacts under study. Even worse, our analyses are far from perfect – and many questions arose only during their interpretation. Our incompetence is most clearly apparent in unusual cases which may be of key importance. Due to the fact that we were not expecting streaks of nickel in the early phase of our research (2012), we neglected the essential precision required in analysing them. The penalty for this lack of rigour is uncertainty in the acquired spectra, in which certain peaks remained unquantified. We therefore submit them for discussion. Two spectra obtained in the analysis of one of the streaks of nickel (Fig. 47: D 1) and of a compound of iron and nickel (Fig. 47: C 5) on the touchstone from Birka grave 605B show a marginally represented, unfortunately unidentified, element (just in front of the peak K K), probably cadmium. Cadmium occurs in both terrestrial ores and meteoritic iron (e.g. Schmitt *et al.* 1963; Rosman & De Laeter 1974). Another streak of nickel (Fig. 47: C 6) on the same touchstone did not reveal the presence of other relevant metal(s).

The above-mentioned spectrum of nickel (Fig. 47: D 1) has also another unidentified element (in front of the peak Ni K) in the potential position of cobalt. We attribute the occurrence of iron here to the touchstone material, as is the case in virtually all of the analysed streaks of various metals; however, it is impossible to rule out the presence of iron in the analysed streak of metal. Belated examination of the spectra of nickel streaks on two touchstones from Tuna in Alsike (Ježek 2014, fig. 4: 4, 5) also shows small unquantified peaks in the position of cobalt (naturally not listed in the relevant table 5, *ibidem*). Although cobalt commonly occurs in nickel deposits, it is also among the elements characteristic of iron meteorites.

Even after analysing several hundred stone artefacts from various parts of Europe, we are able to present only one additional specimen with traces of metal composed of iron and nickel. This comes from the La Tène period prestige grave 29 at Dürrnberg, Austria, on the Alpine hillside directly above an important salt mine (see Penninger 1972, 64, pl. 27: 7; cf. Ježek 2015, 128). In addition to other streaks, including those of silver, tin and lead, one of the observed grains with a size of c. 60 micrometres was found to have a composition of iron (96 %) and nickel (4 %), another iron (87 %), nickel (10 %) and trace amounts of copper, titanium (and sulphur, all 1 %). The size of these traces and their chemical composition do not suggest that they result from contact with an archaeologist's tool.[53]

During an analysis of 18 selected iron tools from the La Tène period oppidum of Staré Hradisko, Czech Republic, R. Pleiner (1982, 122-123) observed a low content of nickel in 80 % of the specimens. His findings were confirmed by Ustohal *et al.* (2001, 51). Both authors mention the occurrence of nickel in local iron ores (in the region of Drahany Highlands/Drahanská vrchovina, central Moravia). Two samples were recently analysed from the large assemblage of iron slag from Staré Hradisko. This analysis by K. Stránský and Z. Winkler (2003, 159) concludes: 'The results of analyses of the isolated occurrence of iron metal grains in slag show a remarkably high content of nickel – 4.8 wt.%. Such high content of nickel is unusual in iron grains present in slag stemming directly from iron ore processing.'

Obtaining 'pure' nickel from both meteoritic and telluric (terrestrial) iron would have been an insoluble problem for ancient metallurgists. Iron has a melting point of 1538 °C, and nickel of 1455 °C, i.e. at the limits of period technological possibilities. These two metals solidify – crystallise from

53 Two results should be mentioned here, too: streaks of a metal with a composition of c. 74 % iron, 16 % chromium and 10 % nickel were observed on two stone artefacts from the important early medieval site of Gniezno, Greater Poland (Ježek *et al.* 2010, tab. 2). Although streaks of such metal have not been found elsewhere, we regard them as remnants of archaeological tools used during the excavation in the 1930s.

Inv. no.	An. no.	Ag	Cu	Ni	Pb	S	Zn	Fig.
1958:1972	1	100						
	2		69		15	16		
	3				100			
1960:968	4						100	29: C
1976:248	5		83			17		29: B
	6	100						
	7			100				29: B, D

Table 7. Bruszczewo, Greater Poland: chemical composition of the streaks observed on selected (fragments of) touchstones (Fig. 29) from the settlement dated to the tenth-eleventh century AD (see Brzostowicz 2002, 80-82); inv. nos. after the Poznań Archaeological Museum. The data given in weight percent (wt.%) and calculated at 100 % are semiquantitative. The geochemical background, i.e. elements deriving from the raw material of the stone, is excluded (cf. Fig. 29: D). Measurements: V. Böhmová.

melting – in the form of a solid solution. At a temperature of 450-900 °C the solid solution transforms into a crystalline Fe-Ni phase (known also from meteorites). These transformations in Fe-Ni alloys are very slow (Kachi *et al.* 1962), and therefore the Widmanstätten pattern is a basic criterion for differentiating meteoritic and telluric Fe-Ni compounds (for archaeology, see Photos 1989). In attempting to interpret the occurrence of nickel in streaks on touchstones it is necessary to differentiate carefully the streaks of nickel from streaks of iron with a low content of nickel.

The small amount of nickel in iron artefacts could come from the smelting of iron ores containing nickel, especially laterite ores, or from multiple banding, forging and welding of iron semi-products. During smelting in small shaft furnaces without a forced stream of air, the ore was reduced to iron sponge that was subsequently forged to obtain raw, high-carbon iron. The iron is gamma phase (austenite), which in the C – Fe system coexists with the melted metal until it becomes solid (1154 °C). If nickel is present in the iron, iron (ferrite) lamellae quickly oxidise during the forging and heating of the forged piece; in contrast, austenite and kamacite lamellae are enriched with nickel (see Hošek 2001, with refs.).

The occurrence of nickel in streaks of metals composed mostly of copper and with an admixture of zinc discovered during previous work on early medieval touchstones, from Poland and Sweden, provided an impetus to consider the consequences of processing the so-called nickel-laterites (Ježek *et al.* 2010, 68; 2013, 184; Ježek 2014, 426). As already mentioned, we also observed clear streaks of nickel, along with streaks of metals composed of copper and zinc, sometimes also with nickel or lead, on three of the five stone artefacts analysed from the La Tène settlement at Bořitov, central Moravia, Czech Republic (Fig. 14: A; two other observed artefacts bear streaks of precious metals). Bořitov lies c. 25 km from the La Tène oppidum of Staré Hradisko, where processing of iron and non-ferrous metals took place, including the minting of coins (Čižmář 2002). Although a total of 229 'whetstones' were recorded at this oppidum during excavations in the 1930s and 1960s,[54] the shape of only a few of them raises suspicion from our point of view. Analyses of five selected specimens (Fig. 14: B) revealed streaks of various copper and zinc compounds on their surfaces, streaks of a metal composed of tin, copper and lead, streak of a metal composed of zinc, copper and nickel, and isolated streaks of copper, nickel and iron.

The occurrence of nickel streaks on both La Tène and early medieval examples thus shows an apparent link to copper ores, whether it involves a significant concentration of nickel in streaks of copper (often also with the presence of zinc), or streaks of nickel on touchstones that bear also streaks of copper. For the La Tène period, both examples are notably from sites with evidence for processing non-ferrous metals (see Table 3 for selected stone artefacts from two La Tène oppida in Bohemia). Indeed, until the discovery of nickel as a chemical element in 1751 (A.F. Cronstedt), and even as late as the first half of the nineteenth century, some specialists considered nickel to be a special form of copper.[55]

The basic condition for the pyrometallurgical production of pure metals is the use of pure ore concentrates. In the case of the production of copper from sulphide ores, this was not possible until the introduction of froth flotation at the end of the nineteenth century. In the words of L. Ercker (1574, Book III), the crude coppers obtainable before then were 'ferrous, leaded or otherwise impure'. If copper was produced using Ni-Cu sulphide ores composed mainly of pyrrhotite (FeS), pyrite (FeS_2), chalcopyrite ($CuFeS_2$), cubanite ($CuFe_2S_3$) and pentlandite $(Fe,Ni)_9S_8$, nickel remained after smelting in both the slag and in the raw copper. Cu-Ni alloys with a heavy predominance of copper were already known in ancient times, and the Bactrian kings (e.g. Euthydemos II, c. 190-171 BC, Agathokles, c. 171-160 BC), minted small coins from this material. C.F. Cheng and C.M. Schwitter (1957) assumed the Chinese origin of this coin metal. M.C. Cowell (1989) analysed a large assemblage of coins from three Bactrian mints, two of which according to his findings struck coins from metal of a Cu-Ni alloy. The nickel content in the analysed assemblage fluctuated between 10 % and 20 %, mainly between 17 % and 20 %. Statistical processing of minor elements (Fe 0.X-2 %, As 0.X-2 %, Co 0.X %) indicates that the alloys used at individual mints have a consistent composition, but differ between the mints themselves. Cowell therefore assumed the local origin of the coin metal or, more precisely, the ore from which the metal was smelted. Cheng and Schwitter (1957) describe tools similar to small punches forged from copper-nickel from northern Syria in the Early Bronze Age. D.A. Scott and J. Podany (1990, 36) mention a Cu-Ni seal that probably comes from

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54 For their petrography and morphology, see Leichmann 1994. Based on mapping the potential sources of raw material, J. Leichmann (1994, 108), over and above local manufacture, also anticipates the large-scale import of finished artefacts or of the raw material itself. The closest suitable outcrops for the dominant raw mineral (quartz sandstone: 64 %) for these objects from Staré Hradisko are located in the vicinity of Bořitov.

55 The pendant from the Roman period child (!) burial from the Wielbark culture cemetery at Gródek nad Bugiem, Poland, has been presented as evidence of a nickel artefact in the Roman period (e.g. Kokowski 1995, 62, fig. 43; 1999, 83-84, fig. 103), the grave itself ranking among those that are rather richly furnished. However, we doubt any intentional 'nickel processing' in this case (see Ježek *et al.* in press, with additional refs.).

the same area, at the end of the first millennium BC, which was originally thought to be hematite.

Ternary alloys of the Cu-Ni-Zn type were also no problem for ancient metallurgists. One of the aims of the cementation of brass was to achieve a gold or silver colour for the alloy. Brass instead of copper was therefore added to the mixture with calamine, as it was necessary to increase the concentration of white metal (cf. Ercker 1574, Book III; Theophilus 1847, 307). Whether or not the Cu-Ni alloy was added intentionally to the mixture, it was enriched with zinc when heated. It is naturally also possible that both binary alloys (Cu-Ni and Cu-Zn) were melted together. The Baltic Shield has large and small deposits of Ni-Cu sulphide ores, especially in the Outokump area of central Finland. These primarily Cu-Zn sulphide ores, sometimes containing nickel and/or cobalt, could have been a source for the chance or intentional smelting of a Cu-Ni alloy. Boulders of these ores were moved by the continental glacier to the south and south-east, to the area of the Gulf of Finland (comprehensively Papunen 1987, with refs.).

Since the Eneolithic, a colourful palette of secondary copper ores has been processed. Only rarely do these copper ores occur in a pure state, being usually intergrown with limonite and other products resulting from the weathering of ores and gangues. Smelting of such mixed ores using charcoal results spontaneously in a dark and glassy iron slag dominated by fayalite (Kronz 2000; Holub & Malý 2012). At temperatures required to smelt copper (at least 1150-1200 °C), such slag covers the molten metal and prevents its oxidation (and the oxidation of some impurities, e.g. Ag and Sb). Due to the fact that sulphur is usually also present, matte (a mixed high-temperature sulphide of Fe, Cu, Zn, Ni and other metals) also forms in the melt. Raw, impure copper with various admixtures was obtained from processing copper ores beneath fayalite slag. In order to obtain relatively pure copper, the smelting product must be re-smelted and the impurities transferred over to the slag.

Nickel is a typical admixture in copper obtained from ore deposits bound to basic and ultrabasic igneous rocks. Copper ores bound to intermediate (mainly andesite) volcanics are rich in antimony and arsenic (Mittchell & Garson 1981; Smirnov 1982). Both these elements occur often in primary copper bars as late as the early modern period (see Ercker 1574, Book III). Primary copper bars obtained from ores rich in nickel or arsenic could have found their way together to a foundry batch (Tylecote 1992, 18-21; Scott & Podany 1990, 31). If arsenic and nickel are present at least in small volumes in molten copper or bronze, these two elements form stable arsenides – speisses (Lechtman 1996; Lechtman & Klein 1999; Subramanian & Laughlin 1988; Thornton *et al.* 2009). During melting they could have been separated (liquation) from the molten metal and become a source of nickel after roasting and intensive smelting. The method for preventing the formation of speiss due to smelting Ni-Co ores with high contents of As and Sb, and containing (required) silver, was described by Lazarus Ercker (1574, 20-22).

We suspect that the speisses, the intermediate products from the processing of non-ferrous metals formed by arsenides and antimonides of metals, metals with

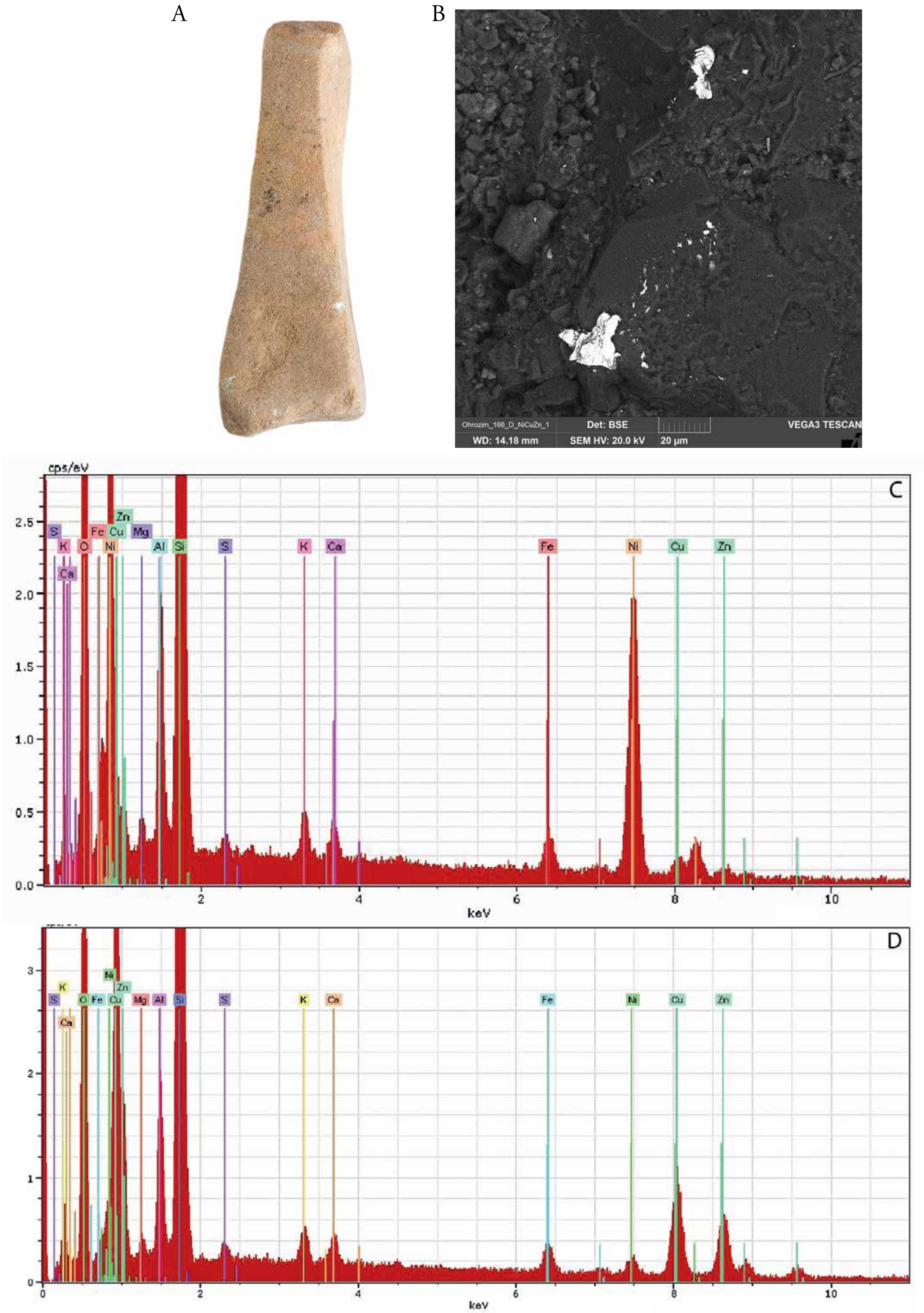


Fig. 33. Ohrozim, Czech Republic: one of the stone artefacts from the Late La Tène sunken hut (Moravian Land Museum, inv. no. 166/94). Fine-grained kaolinitic sandstone; length 10.9 cm. B: microphoto of the streak of a metal composed of nickel, copper and zinc. C and D: spectra from two results of chemical microanalysis of the same grain of metal (see Table 8). (Photos: Z. Kačerová and Z. Korbelová).

An. no.	Cl	Cu	Ni	S	Zn
1	+	7	85	2	6
2		53	5	2	40

Table 8. Ohrozim, Czech Republic: two results of chemical microanalysis of the same grain of metal preserved on the stone artefact from a Late La Tène sunken hut (see Fig. 33); Moravian Land Museum, inv. no. 166/94 (for its noteworthy find-context, see Čižmář 2015). The data given in weight percent (wt.%) and calculated at 100 % are semiquantitative. Element present below 1 % is marked by +. The geochemical background, i.e. elements deriving from the raw material of the stone, is excluded. Measurements: Z. Korbelová.

a high affinity to As and Sb (e.g. Ni, Co, Fe, Cu), but also with an admixture of precious metals, provide the most probable explanation for the streaks of nickel on touchstones. Nickel speisses crystallise from the melt at temperatures above 850 °C, i.e. just below the solidification temperature of 'standard' bronzes (see Singleton & Nash 1987; Subramanian & Laughlin 1988). Speisses have a lower specific weight (c. 5 g/cm^3) than molten copper or bronze, and form a separate layer above these metals during smelting or later recasting. During casting, speisses tend to deposit on the rims of the crucibles and moulds (see, e.g., Ercker 1574, 20-21; Varadzin & Zavřel 2015, 408). For example, medieval copper artefacts from Częstochowa, Poland, contain microscopic xenomorphic As-Co-Cu-Fe-Ni phase grains and rims (Konieczny *et al.* 2011). The authors of the analyses regard a phase with a predominance of As, Fe and Ni as a remnant of the metallurgical process. However, according to the chemical composition and published structures, it probably involves speisses that were not removed from the metal in a sufficiently long smelting of the batch (cf. Scott 1991, 25-30): the analytical results correspond to liquation of As-Ni speisses.

The unintentionally created nickel, as well as the local – most probably silvery – colouring of copper-nickel, would clearly cry out for a test of the suspect metal on a touchstone. But it was evidently not a major issue in Viking Age Birka, unlike, for example, in La Tène period central Europe. A better explanation will perhaps be found in the future for streaks of nickel on typical stone artefacts; however, it is thought that it will again result from a bond between copper and nickel. A good reason for such conjecture is provided by streaks documented on stone artefacts (the function of which remains unknown) from a Late La Tène sunken hut excavated at Ohrozim in central Moravia (Czech Republic; see Čižmář 2015, fig. 5: 13, 17, 18). Despite being both few in number and very small, streaks of gold and nickel occur most frequently on the stones. More noteworthy in the context of this work are streaks of a metal composed of copper, nickel and zinc. An eloquent example is provided by the results of two point-analyses of a single trace with the small diameter of c. 20 micrometres (Fig. 33; Table 8). Whereas such heterogeneity of metal is not very common, this example also demonstrates the limits of the use of a SEM for consideration of the representation of individual elements in streaks of metals preserved on touchstones. Alloys composed of copper, nickel and zinc form crystal phases and the chemical composition of even neighbouring crystals differs significantly.

On the limits of SEM analysis

Milan Holub

Why do long streaks of metal on the touchstone possibly display different compositions along their lengths? This phenomenon can be explained by phase heterogeneity of alloys. Only few metals are so pure that they are composed of crystals of a single solid, chemically and structurally defined phase – a compound or a solid solution. Commonly used metals contain two or more components and usually represent polyphase alloys. The relation between the number of components and the number of phases is governed by the Gibbs' phase rule which, however, unconditionally applies only to closed systems. No streak on an ancient touchstone can be considered a closed system.

Phase conditions of substances are generally illustrated by phase diagrams. Before using a specific diagram, one should make sure whether temperatures in the diagram are given in °C or °K (or, possibly, °F) and whether the composition of the mixture is given in atomic or weight percent. Diagrams using atomic percent directly visualize phase stoichiometry whereas those using weight percent are suitable for the preparation of alloys.

Simple is the situation in single-phase alloys of which the two components form a solid solution. This is the term for a solid phase of which the components crystallize in the same type of crystal lattice, have similar ionic radii and more-or-less identical other properties. It can be also said that the two components in the crystal can mutually substitute with no limitations, i.e., they are isomorphous. Classical examples of such alloys are binary Cu-Ni or Ag-Au alloys. A good example is the diagram of the two-component Ag – Au system, in which only a single solid phase exists: solid solution Ag+Au (Fig. 34). The two components in the alloy – in the solid phase – form a solid solution, which is stable even under normal conditions.

Let us consider a melt composed of 50 wt.% Ag and 50 wt.% Au (symbolic designation Ag50Au50 or Ag50Au), which is being cooled to the point that it starts to crystallize. As soon as the decreasing temperature reaches the point at which the vertical coordinate transects the liquidus line, crystallization of

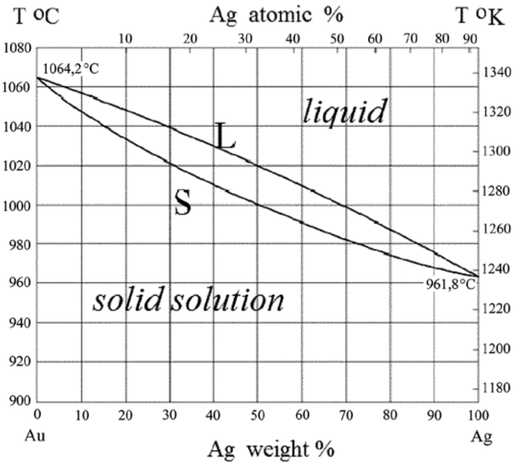


Fig. 34. Phase diagram of a binary Ag – Au system. L – liquidus line, S – solidus line (Barton 1980, adapted; Wikimedia 2017). 'The solidus is the temperature below which the substance is stable in the solid state. The liquidus is the temperature above which the substance is stable in a liquid state. In the gap between the solidus and liquidus the substance consists of a mixture of crystals and liquid.' (Ashby 2009).

solid phase starts. Below this temperature, solid phase crystals start to grow, commonly referred to as phase alpha. The composition of the originating solid solution is, however, different from 50 : 50. It can be determined by drawing a horizontal line from the point 50 : 50 on the liquidus towards the solidus (which marks the upper boundary of the solid phase area). Then, a vertical line is drawn from the point where the horizontal line transected the solidus to indicate the composition of the crystallizing solid phase at the onset of crystallization on the horizontal axis of the diagram. In this case, for example, the originating crystals contain approximately 68 wt.% Au. After further temperature decrease along the liquidus line, the crystallization continues. The melt becomes depleted in Au, and layers progressively richer in Ag are exsolved on the crystal surfaces. After the temperature drops to the melting/solidification point for Ag, the final alloy crystallizes on the margins of the primary crystals and is composed almost exclusively of pure Ag. An alloy of solid solution formed at continuous cooling is usually composed of grains of approximately equal size – the texture is hypidiomorphic. In other cases, such as during accelerated cooling, the crystals formed at the onset of crystallization already are of larger size (porphyritic grains), being surrounded by smaller-size grains richer in Ag. The texture of such alloy is referred to as porphyritic.

Warming of the alloy, such as during its subsequent exposure to heat, is first accompanied by homogenization of its chemical composition within the crystals, and possibly even by recrystallization of the alloy. As soon as the heating temperatures exceed the melting point of Ag, an Ag-rich phase starts to exsolve at crystal boundaries. This phase fills the interstices upon cooling. In such case, analyses of a streak on a touchstone may reveal a variety of compositions ranging from pure Ag to Ag32Au68. The average composition of the tested alloy cannot be determined: although the arithmetic mean from several measurements can be precisely calculated, the result has a low informative value and is basically random.

Another simple case are alloys of which the two components represent simultaneously two separate phases, and solid solutions are formed to a limited

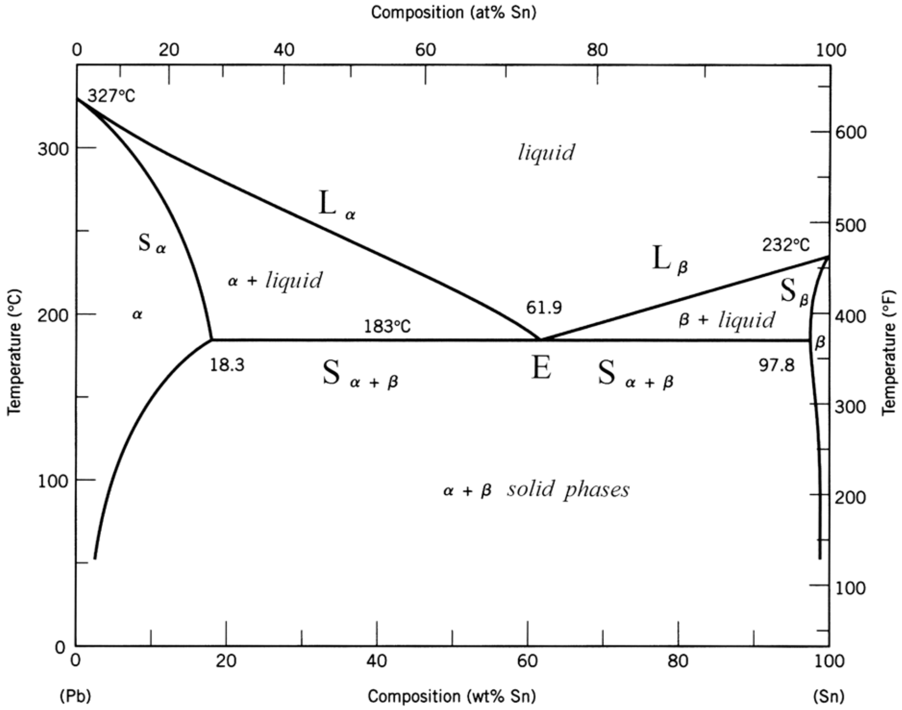


Fig. 35. Phase diagram of a binary Pb – Sn system. Both components form a solid solution to a limited extent – phases α and β. L_α, L_β – liquidus lines of the two phases, S_α, S_β – solidus lines of the two phases, $S_{\alpha+\beta}$ – solidus line of eutectic mixture of the two phases. E – eutectic is the temperature at which the two solid phases and the melt coexist in an equilibrium (Ashby 2009, adapted).

extent only. Such alloys are exemplified by archaeometallurgically significant combinations Ag – Cu, Ag – Pb, Pb – Sn etc. The phase situation is sometimes complicated by liquation – the presence of immiscible liquids in the melt, e.g., in the two-component system of Cu – Pb.

Let us consider the course of crystallization of melt Pb40Sn – i.e. composed of 40 wt.% Pb and 60 wt.% Sn (Fig. 35). As soon as the temperature drops to the liquidus level, the alpha phase starts to crystallize. The composition of the crystals can be determined by drawing a horizontal line from the alpha liquidus to the alpha phase solidus (left) and by drawing a vertical line from this point down towards the axis with mixture composition. After a further temperature decrease, crystallization proceeds along the alpha phase liquidus as far as to the eutectic point representing a temperature at which both solid phases and the liquid phase exist in an equilibrium state. During the crystallization process, crystals of the alpha phase continue to grow and the melt becomes depleted in Pb; this depletion is, however, only weak due to the steep course of the alpha phase solidus. Crystals of the alpha phase formed at the eutectic temperature contain almost 20 wt.% Sn. When the temperature drops below the eutectic point, an even crystallization of both phases (α and β) occurs. Hereat, an equigranular texture of the matrix, develops with primary crystals of the alpha phase forming phenocrysts. The textural characteristics may be complicated by

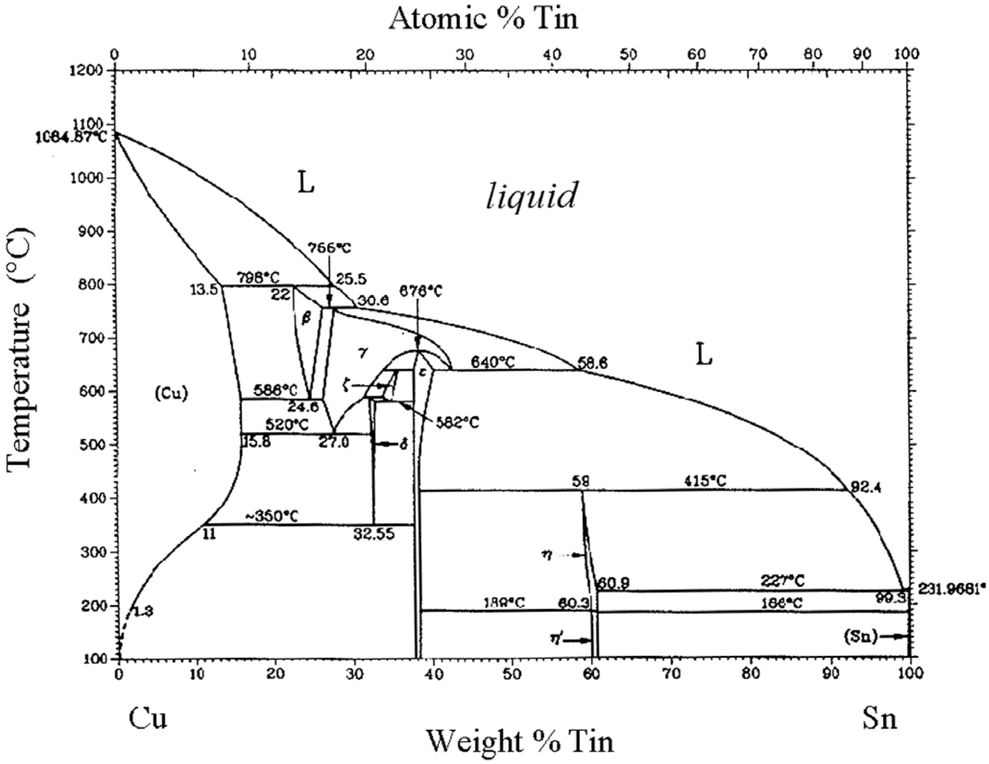


Fig. 36. Phase diagram of a binary Cu – Sn system. L – liquidus line (after Equilibrium Diagrams 1992, adapted).

contrasting crystallizing forces of the two phases and by the fact that both phases are solid solutions which may decompose into almost pure components upon cooling. Such phase changes can be usually best observed on the phenocrysts.

When the alloy is heated, homogenization of the decomposed solid solutions occurs first. After reaching the eutectic temperature, a melt becomes exsolved along the interstices, containing c. 61-62 wt.% Sn. As a result, the streak on a touchstone may reveal variable compositions from almost pure Pb to almost pure Sn depending on the grain size of the alloy and the size of the streak.

Varied is the realm of alloys. Most alloys of Cu with other metals contain stoichiometrically and structurally defined phases – compounds of components. Brass and especially bronze can serve as good examples. In Sn-bronze, two components – Cu and Sn – form a higher number of defined solid phases. The phase diagram (Fig. 36) is subdivided into several partial diagrams the vertical limits of which are represented by the above-mentioned defined solid phases. Individual phases are designated by Greek letters in the order of a successive crystallization. For an easier interpretation the diagram should be split into partial diagrams limited by stoichiometrically defined phases marked by vertical lines. The spaces between them are filled with a mixture of crystals the chemical compositions of which are governed by the Pb – Sn pattern described above. Where the diagrams are limited by curved lines, the spaces between them are also filled with solid solutions. Horizontal lines denote solid-state phase transitions, i.e. changes in internal crystal structure (changes in crystal lattice), or possibly also microscopically visible recrystallization.

The diagram explains the historical preference for 'standard' types of bronze with 8-10 % Sn. Upon solidification, these types form a solid solution – the alpha phase – not subjected to cooling-induced structural transformations. When cooled below c. 400 °C, they transform to a mixture of almost pure Cu and the structural descendant of the gamma phase; however, this change is not fast in fresh casting and forging products. Anyway, such change can be diagnosed in archaeological artefacts. These changes can be eliminated by structural homogenization by heating. The situation is different in bronze types richer in Sn, with 20-40 % Sn. Larger casts solidify from the margins and crystal axes are orientated perpendicular to cast margins. The melt inside the casts becomes slightly enriched in Sn, being subjected to a number of structural transformations affecting the qualities of the casts.

When the alloy is heated, exsolution of almost pure Sn occurs first, being followed by Sn-rich bronze – see the eutectic point in the Cu – Sn diagram. Due to the steep course of the liquidus at temperatures below 400 °C, the exsolved alloy fills again the interstices and open spaces created by melting. Lead was – and still is – added in amounts of 1-4 % (however, 0.X % would be sufficient) to improve casting properties of the alloy. Thermal processing of the cast thus implied, among others, changes in the alloy structure. Following the very low solubility of Pb in bronze, metallic Pb becomes dispersed in the interstices of the alloy. At the presence of Pb, the Pb-Sn eutectic becomes exsolved as the first component at c. 180 °C (see Fig. 35). Sn-rich bronze becomes exsolved again during continued temperature increase only after the exsolution of this eutectic liquid.

Considering the fact that Pb forms no stoichiometrically defined phases with either Cu or Sn, streaks made by objects composed of these metals may reveal almost pure Cu, Pb and Sn compositions or their various mixtures when subjected to SEM point analyses. This equally applies to alloys of precious metals. Results of the measurements therefore depend primarily on the grain size in the alloy, on the size of residual streaks and possibly also on the history of individual streaks during their millennium-long existence.

A lesson from the deep

There are at least dozens of early medieval sites in Europe on which hundreds of touchstones have been found (for examples, see Ježek 2013b). However, assemblages of analysed touchstones comparable in size to that from the Birka burials are only available from a couple of sites:[56] the castle on Ostrów Lednicki island in Lake Lednica, and a cemetery on the shore of this lake at Dziekanowice, Greater Poland (Fig. 37). The lake is situated mid-way between the two most important sites of the First Piasts' domain: Poznań, the secular capital (c. 30 km), and Gniezno, the ecclesiastical capital.

An imposing castle was built on the island in the second half of the tenth century with a church and baptistry; these could be reached over two wooden bridges, 450 m and 200 m in length, with a width of 4-4.5 m (Wilke 2014a). A palace with a chapel was later added to the island complex. These works are justifiably attributed to the Polish rulers of the period – the Piast dynasty. Settlements formed at the entrances to both bridges on the mainland shore of Lake Lednica. The castle was destroyed in the mid-eleventh century and rebuilt a short time after (Sankiewicz 2013, 26-27, with refs.). The settlement at the eastern bridge entrance was also rebuilt, although not to its original size; part of the former settlement area was covered with burials. This cemetery was used at least until the thirteenth century, when the island lost its function as a royal castle. As of 2014, a total of 1,585 inhumation graves (six of which were chamber graves), containing the remains of c. 1,650 individuals, has been documented at the site. Among these graves, 847 were furnished with some type of grave-good, most of which were very simple (Wrzesińska & Wrzesiński 2014, 201-202). A smaller cemetery was also located in the central part of the island. However, one of the most significant discoveries made at Lake Lednica came from an investigation of the lake bed.

Two tenth- or eleventh-century swords were found during the underwater investigation of the remains of the eastern bridge; their inscriptions claim that both originate from the 'Ulfberht' workshop in the Rhineland (Głosek & Kirpičnikov 2000); nearly 60 axes, 2 bow fragments and 3-4 arrow fragments, 7-10 spears or fragments (one tipped with silver inlay) and 6 pieces of riding

56 For additional examples of analytically confirmed touchstones from the Slavic part of early medieval Europe, see Ježek 2013a; 2013b; Ježek & Zavřel 2010; 2011; 2013; Ježek *et al.* 2010; 2013.

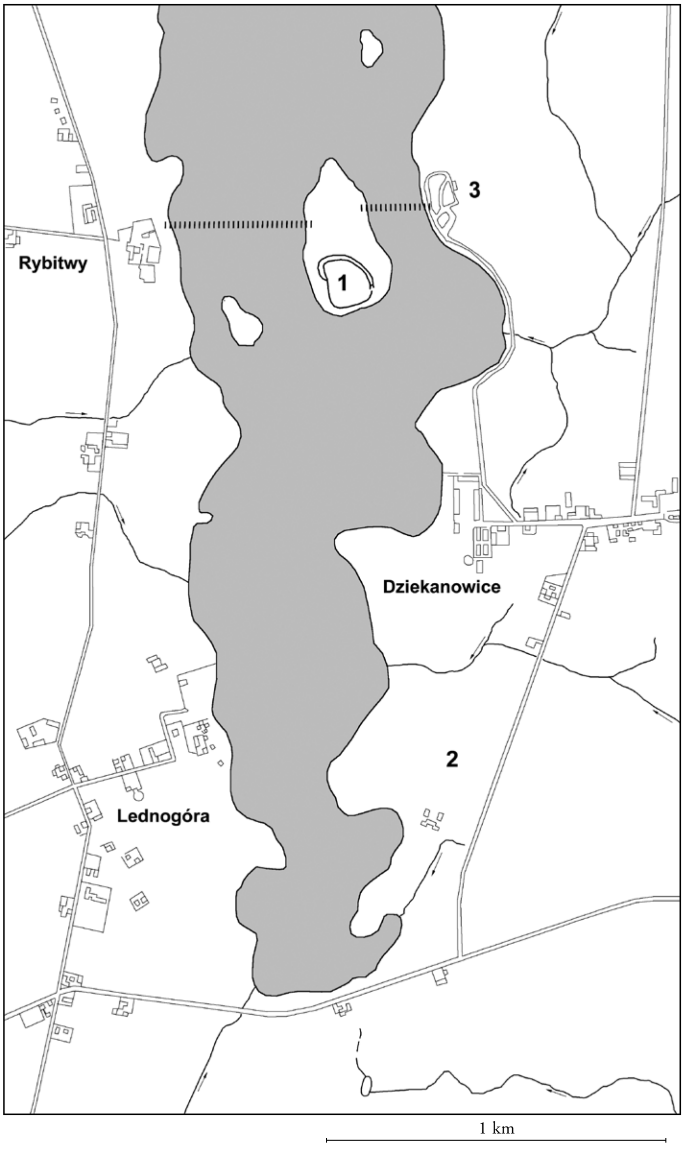


Fig. 37. Lednica Lake, Greater Poland: (1) early medieval castle on Ostrów Lednicki, with two bridges; (2) the cemetery near Dziekanowice; (3) eastern suburb. (Compiled by F. Laval, based on Wrzesińscy 1992, fig. 1, and Wilke 2014a, fig. 3).

equipment were also discovered. Supporters of the theory that these finds represent the remains of local battles suggest that some of the axes could have been dropped by workers during the construction of the bridge, but that most of the military artefacts ended up in the lake during assumed armed clashes (e.g. Tokarski 2000; Wilke 2006, 444). At the same time, G. Wilke (2006, 447) justifiably rejects the notion that the axes were lost during the bridge construction. Moreover, four of the axes date to the Late Middle Ages. Several early medieval axes were found at the entrance to the bridge on the island itself (Sankiewicz & Wyrwa (eds.) 2013), and the question remains as to whether they would have remained as unnoticed remnants of fighting during the subsequent centuries of the island's use. The bottom of the lake along the line of the eastern bridge also produced over 90 pieces of agricultural implement, as well as over 150 other artefacts, including eight 'whetstones' (Szulta 2000)[57] and one small iron 'Silesian type' bowl, linked to elite environments (Rzeźnik 2006, with refs.). Other finds include 24 spindle whorls, 4 weaving swords and other items for textile production, dozens of kitchen items, keys (Grupa 2000), a helmet, etc. (the list is quite extensive: see Kurnatowska (ed.) 2000).

A different situation was discovered on the west side of the island. Axes and spears were also found along the line of the bridge, especially close to the shore of the island. However, more finds were scattered on the bottom of the lake, in a 25-70 m belt along the entire western shore of the island (for the axes, see Sankiewicz 2013, fig. 4). Four swords were found at a distance of 3-50 m from the shore. G. Wilke (2006, 446-448) therefore considers the possibility of battles on boats or rafts. Whereas the vast majority of the c. 80 swords and two battle hammers date to the period between the second half of the tenth and first half of the eleventh century, at least four swords are from the Late Middle Ages (Sankiewicz & Wyrwa (eds.) 2013), including the fourteenth century (Głosek 2014a, 77-78). M. Głosek (2014b) points to similar finds from lakes or rivers in Poland, and elsewhere, without comment. Of the 51 spear or javelin heads found to the west of the shore of the Lednica island, two are inlaid with silver, and one with silver and gold (Wilke 2014b). G. Wilke mentions a ritual hoard, containing c. 225 spears and many other weapons in Gudingsåkrarna fen at Vallstena, Gotland (see Müller-Wille 1999; Thunmark-Nylén 2006, 460-464), but this does not alter his conviction that the finds represent the remains of a battle on Lake Lednica. These three special spearheads were found at a distance of 10-30 m from the shore (Wilke 2006, 447). The inventory of military artefacts from the water west of the island is completed by four arrowheads (and one quarrel head) and a single piece of solid armour (Kola & Wilke (eds.) 2014). Two of the four stirrups found along the line of the bridge have silver and copper inlays; of the three spurs discovered, one is inlaid with silver, and another is plated with copper. The rest of the assemblage of riding equipment is composed of eight snaffles and only two horseshoes (Kaźmierczak 2014). If random losses are considered as an explanation for these artefacts, the representation of ostentatious riding equipment is striking. Their connection with military events is rather unlikely. The problem of nine ploughs, 14 sickles and additional agricultural equipment, a fully intact upper millstone (quern-stone), craft tools, vessels and other artefacts will be set aside. Nevertheless, the discovery of four small bowls of the Silesian type, a pair of pans from a balance and seven weights (Baran 2014, 180, 184-185), and especially of two 'whetstones' (Radka 2014, 162, pl. XX: 13, 15), in fact typical touchstones, should be emphasised.

The small number of arrowheads (eight at the most) and armour (two items) found is apparent (see Wilke 2006, 448, who even attempts to explain

57 Among the river finds in north-eastern Germany (Slavic in the Early Middle Ages), J. Anders (2013, 79) has recorded over 100 'whetstones', found mostly during earthworks with heavy machinery, i.e. without any chance for their dating. The stone artefacts, sometimes featuring a hole, are mostly 7-13 cm in length; the largest specimen is 31 cm long. The same rivers have also produced other finds, including numerous weapons.

the absence of metal parts of shields), as is the fact that the vast majority of weapons found beneath the central part of the eastern bridge were located 4-10 m from its sides (Wilke 2006, 446), even if the romantic notion of hand-to-hand combat for every metre of the bridge (see Wilke 2014b, fig. 15) is abandoned. After all, the bridge could easily have been cut off in the face of imminent battle. Potential defenders would certainly not have been surprised by the sight of an attacking army on the opposite shore. Burnt fragments of the submerged parts of both bridges testify to fires at the site, which G. Wilke (2006, 444) tries to connect with traces of fire on the axe-handles. However, it is not clear why defenders (or perhaps the raiders) would have burnt the bridge only after the attack; or did the axe-handles begin to burn while still in the hands of the raiders or defenders?

In summary, according to existing interpretations, the finds from the bottom of Lake Lednica can be divided into two main groups: (a) artefacts that found their way into the lake by chance, or as waste; and (b) militaria, including special objects, which fell into the water during assumed battles (Wilke 2006). However, in the light of other sites with evidence of demonstrably symbolic activity manifested in underwater finds of both valuable and common artefacts (see above), it would be negligent not to raise a similar question in this case. After all, it is difficult to imagine a more suitable setting for events that were neither random nor even private, than the lake surrounding the castle of the rulers of Poland. These manifestations definitely need not have been related to military events. The finds from the bottom of Lake Lednica do not make the site exceptional in the wider European context, especially when the anticipated raids – connected in this case to the military campaign of the Bohemian prince in 1039, concerning which the defenders of Ostrów Lednicki must have had fresh news and enough time to take defensive action – are not mentioned in any written sources (which document in detail the Bohemian campaign as it culminated with the theft of the relics of St. Adalbert in Gniezno).

Lednica Lake is clearly not the only lake in early medieval Poland over which the fog of symbolic/ritual activities hangs. From those which have been investigated by underwater archaeologists (Chudziak *et al.* 2011), we can select, for illustrative purpose, three lake bottoms near fortresses built on peninsulas. Miejske Lake (Pszczew, Woj. Lubuskie) produced three swords, one with the inscription 'Vlfberth', a dagger, an axe, a spur, a 'Silesian type' bowl and other artefacts. Seven axes, a lance and a bronze bowl were found in Steklin Lake (Niedźwiedź, Woj. Kujawsko-Pomorskie), while 18 axes, three spears and other artefacts were retrieved from Zarańskie Lake (Żółte, West Pomeranian Voivodeship). Finds regarded as 'whetstones were the most numerously represented category of stone artefact discovered at Żółte. A total of 31 items of this type were recorded', including elegant oblong specimens with a hole in one end (Chudziak & Kaźmierczak (eds.) 2014, 178, fig. 6.64, 6.65): 'Most of the whetstones […] were discovered in underwater contexts associated with the construction and use of shoreline timber structures dated to the 11th century'. Did carpenters sharpen their axes during their work several times a day on whetstones mere centimeters in length? In any case, balances, 27 weights and a 'Silesian type' bowl from this lake (Chudziak & Kaźmierczak (eds.) 2014, 273-278, fig. 6.140-142) also form typical components of the inventory of such sites. On the basis of additional finds that have been made at the last mentioned site, there is no doubt about its ritual role in the eleventh and/or twelfth centuries; the Scandinavian-insular style of decoration of numerous wooden finds is hardly surprising (Chudziak & Kaźmierczak 2013; Chudziak & Kaźmierczak (eds.) 2014, 449-450).

The environment of the Elbe Slavs has also yielded weapons from the bottom of rivers, lakes and wells, although most of the finds of military gear have been made during the recent dredging of river beds. While a few doubt their intentional deposition (cf. Ulrich 2008), references to clearly ritual (Viking and other) hoards in waters or wetlands typically only serve as an obligatory reminder of the scope of interpretative possibilities. Fortunately, in her work on river finds in 'Germania Slavica', J. Anders (2013) has taken this topic seriously. The early medieval weapons, including special weapons, extracted from rivers and lakes in north-eastern Germany number in the hundreds, and she aptly sums up the interpretative possibilities offered by these and other finds (Anders 2013, 130-147, with numerous refs.). A balance pan was found along the path of the bridge to the island fortress at Plauer See (Mecklenburg-Vorpommern: Bleile 2008, 94-97). Archaeologists in Bavaria (Scholz 2007), Croatia, Hungary, Slovakia (Husár 2016), Slovenia and elsewhere face a similar problem, with the Ljubljanica River having produced over 10,000 finds ranging from the Bronze Age to the Middle Ages, including numerous weapons (Gaspari 2003; 2004; Turk *et al.* (eds.) 2009).

Of the many famous as well as lesser known sites which have provided evidence of ritual or votive behaviour of ancient Europeans, let us choose the most famous one. Hundreds of weapons from La Tène (Switzerland) represent only a part of the finds from the bottom of the river flowing into the Neuenburgersee Lake; women's jewellery is practically absent here. Current interpretations consider also the idea of the original position of these finds on a bridge across the river; the hanging of trophies is suggested (illustrated in Müller & Lüscher 2004, 146). A less numerous but similar spectrum of finds was recovered using dredger blades at the nearby, somewhat younger, site of Corneaux. Examples of Polish lakes, the bottom of which have yielded weapons at considerable distances from the preserved remains of medieval bridges, show that (interpretative) pathways leading across bridges cannot be relied upon even in the case of the eponymous La Tène site or other sites with this chronological classification. In any case, practices of the Iron Age had been long forgotten in early medieval central Europe (including Switzerland), unlike in the Baltic areas (including Greater Poland).

Finds of early medieval weapons, agricultural tools, etc., from northern European lakes, the names of which alone often indicate their ancient ritual role (e.g. Lund 2008, 58-62, for Scania), are not the only reason for our concerns over the accuracy of existing interpretations of the results of the underwater excavation in Lake Lednica. Inland bodies of water in countries on the Baltic Sea, including wells, springs, etc., have also produced numerous bronze and brass bowls from the tenth to thirteenth centuries. While such finds have also occurred in other countries, including Italy, England and Finland, the highest numbers come from Germany and Denmark (Müller 2006, 215-222; Biermann 2006, 391, for the area of the Elbe River Slavs). Two bowls found at the bottom of Lake Lednica (Górecki 2000, 394-395) are an exception in south-west Poland, as is also the case with two bowls from two male graves in the nearby cemetery at Dziekanowice (Wrzesińska & Wrzesiński 2000; 2002; for c. 30 grave finds from – mostly the northern part of – Poland, see Janowski & Kurasiński 2003). These bowls intended for hand-washing had already had, when in use, a privileged place in the environment of the north-west Slavic elite and are therefore a sensitive symbol in the archaeological record. In the territory of western Slavs (with virtually the same language and material culture during the tenth to thirteenth centuries) living south of the Krkonoše (Riesengebirge) Mountains, not a single bronze/brass bowl has been found in water or in a grave. As is the case with western Slavs living north of these mountains, i.e. outside the territory of the Holy Rome Empire, the northern part of Europe has also produced numerous burial finds of these bowls, including (e.g.) 12 graves at Birka, 7 at Hedeby, 17 at Grötlingbo (Gotland), 10 at Wetrovo and 13 at Ircekapinis[58] (both near Kaliningrad; Müller 2006, with refs.). Hoards containing dozens of bowls (up to 65) in Estonia clearly belong in a ritual context (Müller 2006, 326-328). The concentration of Viking Age jewellery on Hiddensee Island (Armbruster & Eilbracht 2010) and, for example, the hundreds of weapons from Gudingsåkrarna fen on Gotland (Thunmark-Nylén 2006, 460-464), indicate that islands were also favoured for ritual acts (see, comprehensively, Müller-Wille 1999; Bradley 2016).

The large assemblages of weapons and other military gear from the south Scandinavian marshes of the third and fourth centuries AD, including Illerup Ådal, Vimose on Funen, Nydam Mose (Denmark) or Thorsberger Moor (Germany), are of a different type. If the general opinion is correct that the booty was 'drowned' after a battle, then the causes of such acts were not votive in nature, and it would be possible also to polemicise about expanded formulations regarding sacrificed (or, better, discarded?) objects. Several typical stone artefacts, and even identified touchstones, appear among them (Bemmann & Bemmann 1998, 213; Blankenfeldt 2015, 184-190, with additional examples, 411, pls. 41, 42; von Carnap-Bornheim & Ilkjær 1996, 376-377; Ilkjær 2002, 118-120; Rau 2010, 411-416,[59] with additional examples). Of course, these stone artefacts in fact found their way into the lakes unintentionally, strictly speaking, as part of the contents of a bag or as separate belt appendages thrown into the water as a whole.

58 Where 15 graves furnished with a balance and/or weights and at least seven graves with 'whetstones' were discovered (Steuer 1997, 362, 376, 381, 382). Many such graves have been excavated in the Baltic region (see Steuer 1997).

59 With reference to the differing level of the layers containing a typical stone artefact and a sharpening iron at Nydam Mose, the author challenges his own opinion regarding the 'undeniable connection' between these finds (Rau 2010, fig. 176).

The assemblage of over 500 artefacts from the period between the third and fifth centuries AD, from Lake Nidajno in Masuria, Poland, is composed exclusively of military gear and parts of belts, some with silver, gold and/or enamel elements, including a sword plated with finely decorated gold forging, and the silver and gold figurine of a vulture interpreted as an emblem of a war band or kinship group (Nowakiewicz & Rzeszotarska-Nowakiewicz 2012). Lake Käringsjön (south-western Sweden) is an example of a similar ritual site from the same period (Carlie 1998). Later, the number and size of north-European wetland deposits decrease, but they do not disappear (see Zachrisson 2004). Skedemosse on Öland, with sacrifices dating from the fifth to tenth centuries, may serve as an example (Hagberg 1967). Touchstone candidates occur in the metal hoards from East Baltic regions of the first millennium AD (e.g. Oras 2015, 280, 328).

Fortunately, it is not our aim to resolve the vexed issue of the reason for the occurrence of the medieval weapons and other items on the bottom of Lake Lednica. By the time the late medieval axes from the assemblage fell to the bottom of the lake, the bridges were probably long gone. The alleged 'whetstones' from the bottom of Lake Lednica were not examined in a SEM. A total of 24 specimens were chosen for chemical microanalysis from the dozens of typical stone artefacts found at the castle, dating from the period between the second half of the tenth century and the thirteenth century. A detailed study of the find-contexts would probably facilitate a more precise dating, and linking artefacts to specific contexts could significantly expand existing knowledge of the castle's social composition. However, existing publications are of no assistance in this respect – and it is beyond our power to delve into the field documentation from several dozen excavation seasons or years. Moreover, the result would probably only involve some of the finds of this type and therefore its testimony would be fragmentary at best (see Ježek *et al.* 2010). In any case, I have given up on such an attempt, though not by choice.

Thanks to permission from the Museum of the First Piasts on Lednica Lake, I was able to analyse selected touchstones from Ostrów Lednicki and Dziekanowice in 2012. While returning the finds from a laboratory, I entered the results available at the time into the computer at the museum, as we had agreed on a joint publication with the authors of the cemetery excavation. But it was not until 2015, when I accidently came across an article on the Internet on the analysed artefacts from the cemetery in Dziekanowice, that I was able to view my own microphotographs, spectra, etc., and even their comments (Wrzesińska & Wrzesiński 2014). This article contains numerous mistakes and gaps, but nevertheless it presents an (incomplete) description of the graves in which the analysed artefacts were found, and the contexts of most of the grave finds can in part be summarised here (Table 9).[60]

60 Errors by Wrzesińska & Wrzesiński (2014) complicate efforts to produce a summary. For example, grave 27/2008 should contain an iron weight, based on the caption of the relevant figure (28); however, no weight is depicted there, nor mentioned in the list of burials. The same situation may apply to other finds presented from Dziekanowice.

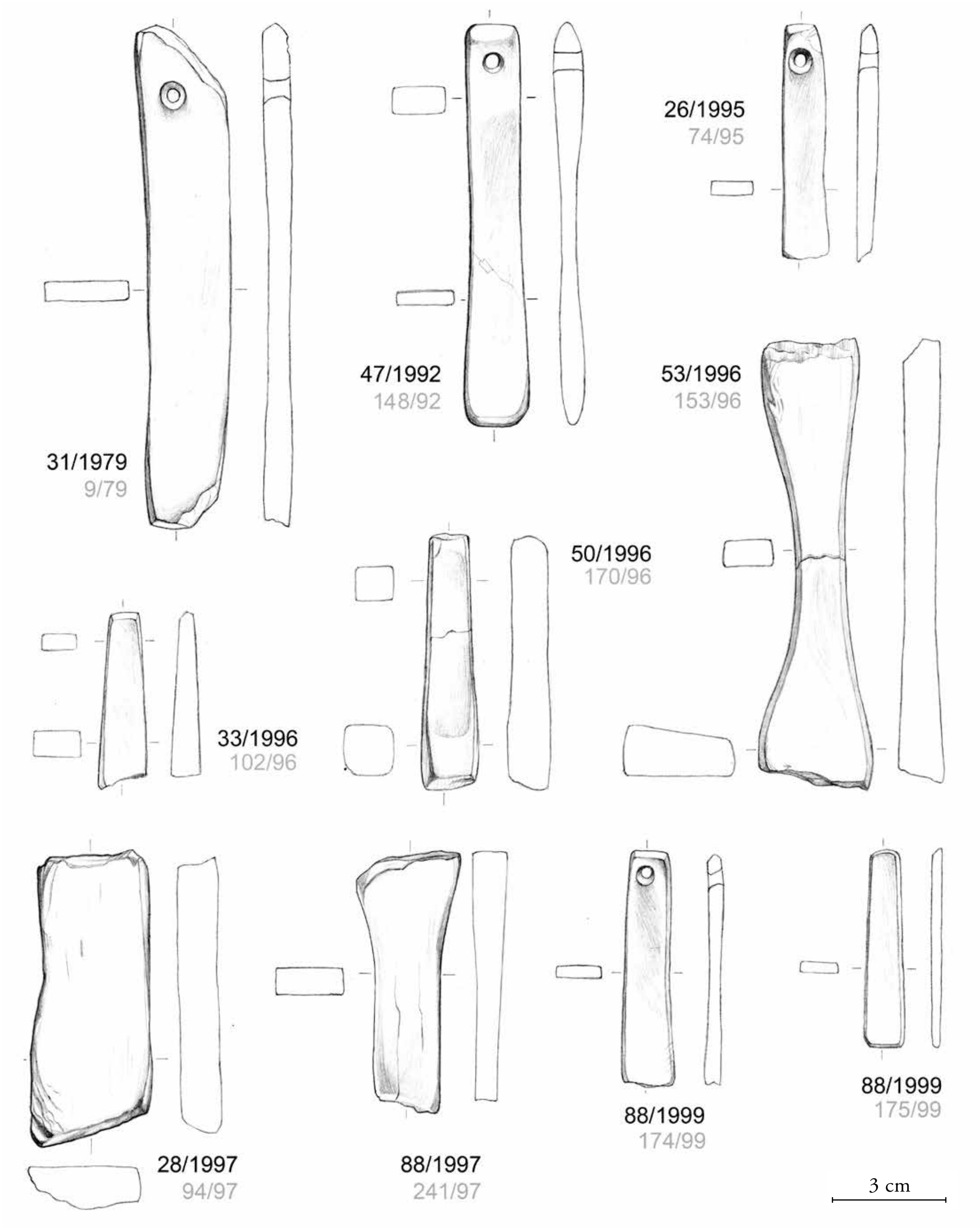


Fig. 38 (this and following pages). Dziekanowice, Greater Poland: analysed touchstones from the cemetery, with burial nos. in black, and inv. nos. in grey (after the Museum of the First Piasts on Lednica Lake; drawn by L. Raslová).

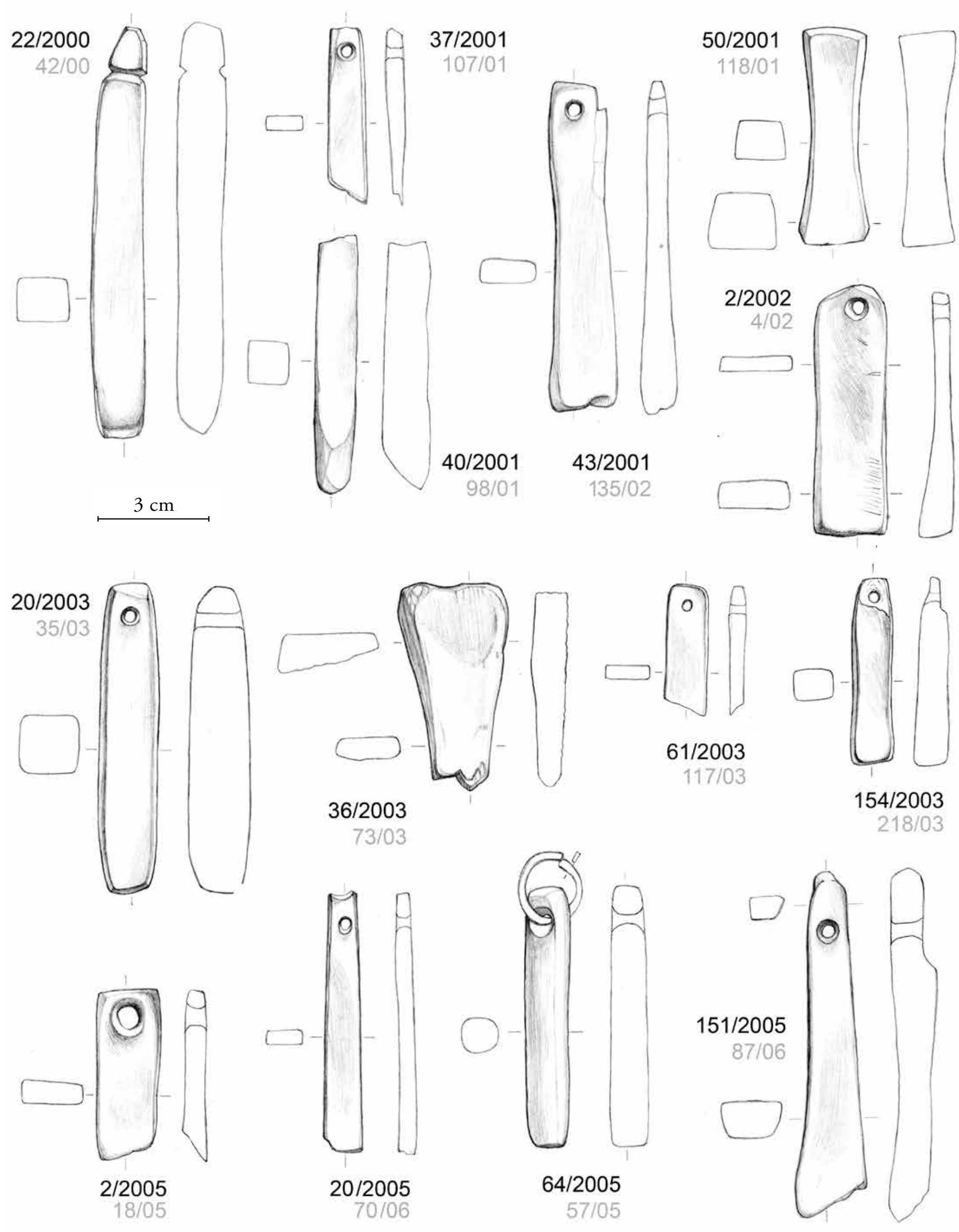


Fig. 38 (continued). Dziekanowice, Greater Poland: analysed touchstones from the cemetery, with burial nos. in black, and inv. nos. in grey (after the Museum of the First Piasts on Lednica Lake; drawn by L. Raslová).

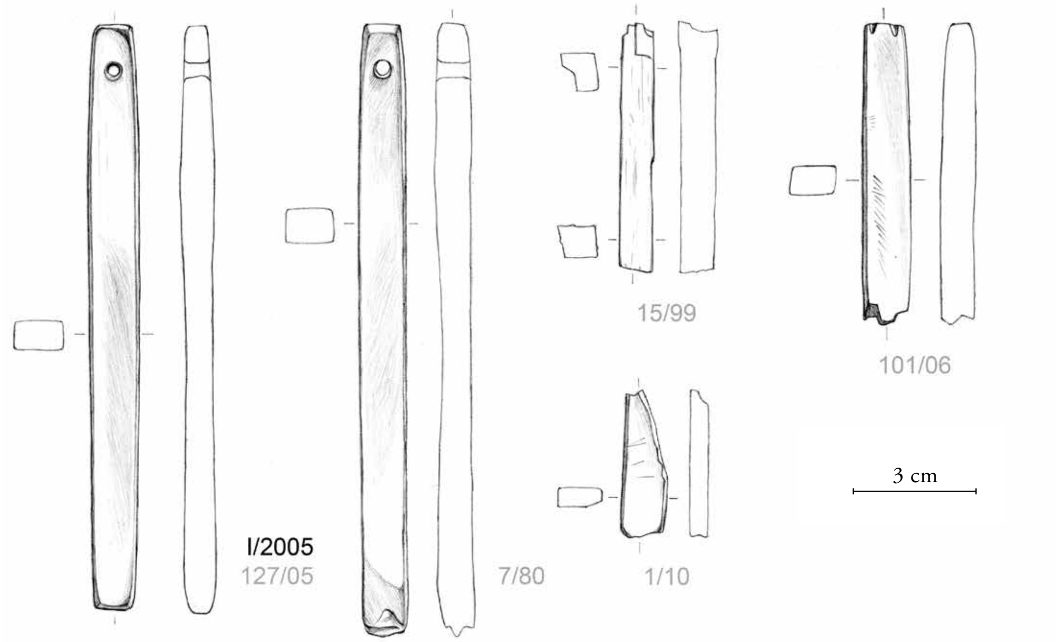


Fig. 38 (continued). Dziekanowice, Greater Poland: analysed touchstones from the cemetery, with burial nos. in black, and inv. nos. in grey (after the Museum of the First Piasts on Lednica Lake). The find-contexts of inv. nos. 7/80, 15/99, 101/06 and 1/10 are unknown to the author; at least some were found in graves. (Drawn by L. Raslová).

Approximately 30 inhumation burials (2 % of the total number of excavated graves), ranging in date from the later part of the eleventh century to the thirteenth century, were furnished with touchstones (in several cases their fragments); one grave (88/1999) contains two specimens. Working with an incomplete inventory (Wrzesińska & Wrzesiński 2014), from which several finds are missing (e.g. inv. nos. 15/99, 101/06, 1/10), a total of five graves contain the burials of women with ages ranging from *juvenis* to *maturus*; one contains the remains of a small child (*infans I*), whereas 21 graves belong to adult men (Wrzesińska & Wrzesiński 2014, 203, 205).[61] At least two of these graves were also furnished with weights, which were found in several dozen other local graves, too (see Wrzesińska & Wrzesiński 2006 for this stage of the excavation). Only one of the six local chamber graves contains a touchstone (and two knives).

Unlike the analytical results from the study of touchstones from Birka (as well as from Vendel and Tuna in Alsike: see Ježek 2014; 2016), the results of the analysis of touchstones from Ostrów Lednicki and Dziekanowice can be

61 One of the graves in the cemetery at Dziekanowice contains a miniature brass axe, 6.5 cm long: *infans I* (Wrzesiński 2013, 36). About 100 parallel or highly similar miniatures (type I after Makarov 1992) are known from early medieval northern and eastern Europe, including Birka and Sigtuna (nine specimens; see also Holmqvist 1980, 62, for Helgö). However, only in five cases, exclusively in present-day Russia, is the find-site listed as a grave; two of these are children's burials (Nikolskoje III and Sarkel – Byelaya Vezha), one is a female burial (Vyzhumskij III mogilnik) and two are male ...

Grave	Gender/age (in years)	Silver coin/s, or fragment/s	Jewellery	Weight	Knife	Other
31/1979	F/maturus				•	
31/1992	M/(30-35)	•?			•	Bronze, iron
47/1992	M/maturus				•	Iron
26/1995	M/maturus				•	Bone awl
33/1996	M/maturus				•	Bone comb
50/1996	M/maturus				•	
53/1996	M/maturus				•	
28/1997	M/maturus (35-40)				•	Iron
88/1997	M/maturus					Bucket
88/1999	M/maturus II (50-55)					Bronze
22/2000	F/juvenis – adultus (20-25)				•	Iron
33/2001	M/adultus (25-30)				•	
37/2001	M/senilis (60-)	2			•	Iron
40/2001	M/senilis (60-)				•	Iron
43/2001	M/maturus (40-50)				•	
50/2001	M/adultus (25-30)				•	Bone (pipe?)
2/2002	M/adultus (c. 25)				•	
20/2003	F/adultus (c. 25)		2 silver temple rings, carneol bead	•	•	Bronze
36/2003	M/adultus I (22-25)	•			•	Iron, bone
61/2003	Infans I (4-5)				•	
154/2003	M/adultus (25-30)				•	
2/2005	M/adultus (25-30)	2			•	
20/2005	M/adultus (22-25)			•	•	
64/2005	M/adultus – maturus (30-40)					
151/2005	F/juvenis (c. 18)				•	Bronze
I/2005	F/adultus (c. 30)		Gilded silver		2	
27/2008	M/adultus (30-35)			•?	•	

Table 9. Dziekanowice, Greater Poland: incomplete list of burials furnished with a touchstone, after Wrzesińska & Wrzesiński 2014. Grave 88/1999 contains two specimens; grave I/2005 is a chamber grave. F: female, M: male. Metal finds under 'Other' are mostly unclassifiable fragments, except for a bronze mount from a leather sheath and a sharpening iron.

summarised in only two tables (10 and 11), as is also the case with other sites, including Viking locations (e.g. Ježek & Holub 2014). None of the selected

... burials, one of which is an individual aged 17-19 (Nikolskoje III), the second without a recorded age (Gorodishche: Kucypera *et al.* 2010, 133-145, with refs.). When known, the find-context in other cases is an occupation layer. In the case of Makarov's distinct type II (to which the find from Sigtuna also belongs), it is possible among the 30 finds recorded in the summary by Kucypera *et al.* (2010, 146-152) to identify four from graves (again, all in Russia): three from children's burials (Nikolskoje III, Mitjajevo) and one from a female burial (Kolchino). Two additional finds come from uncertain burial situations. Again, similar finds are not known from the Holy Rome Empire, including its Slavic parts. However, the story of miniature axes begins much earlier (see e.g. Whittaker 2014, 103; Woodward & Hunter 2015, 73, 118, 124).

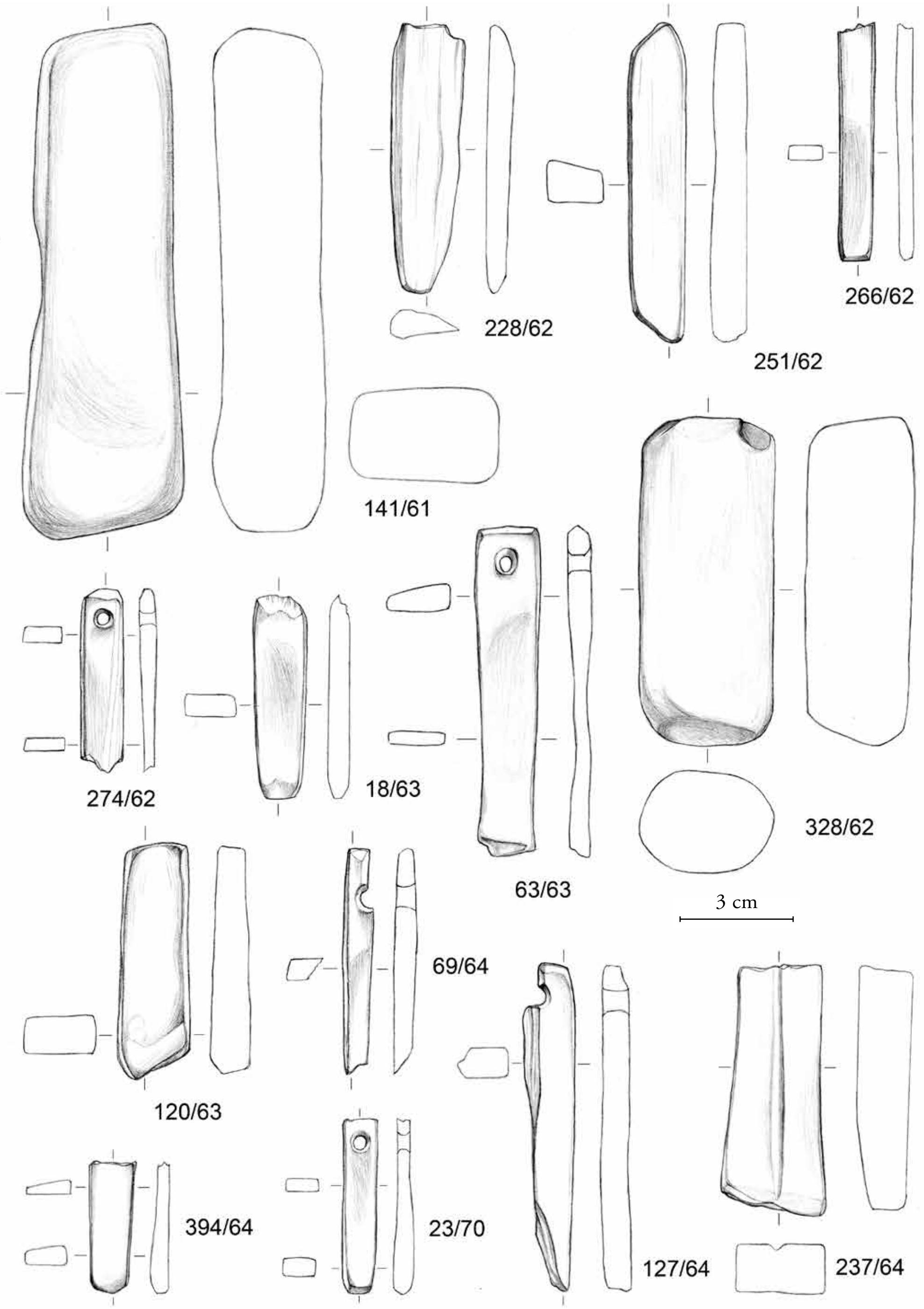
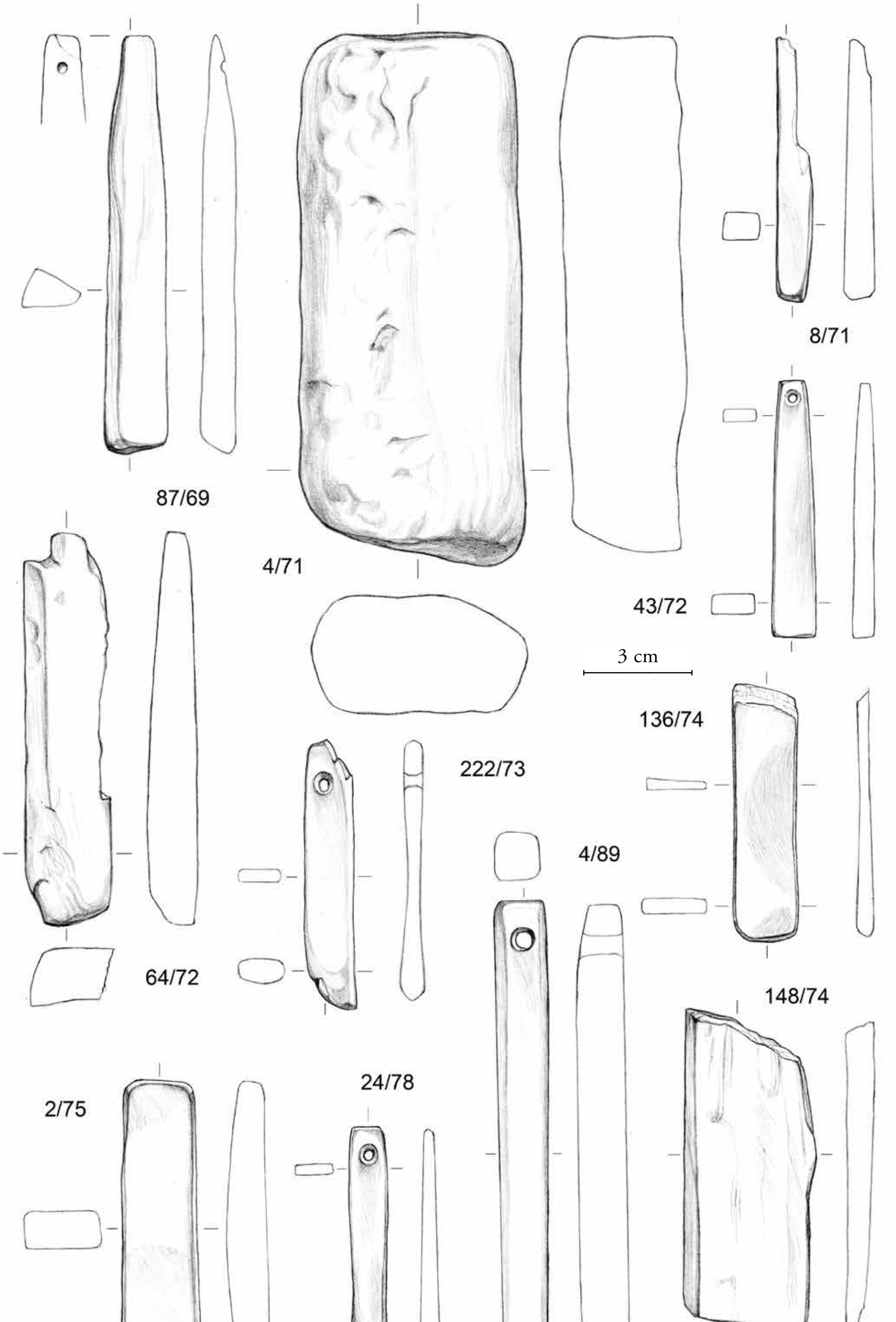


Fig. 39 (this and following page). Analysed touchstones from the lake island of Ostrów Lednicki and (inv. no. 266/62) the settlement at Dziekanowice, Greater Poland (inv. nos. after the Museum of the First Piasts on Lednica Lake; drawn by L. Raslová).


87/69
4/71
8/71
43/72
3 cm
136/74
222/73
4/89
64/72
148/74
2/75
24/78

specimens from Dziekanowice (Fig. 38) and Ostrów Lednicki (Fig. 39) were observed on all four sides, and thus the results essentially represent random findings that do not permit the use of any statistical methods. Nevertheless, just like the clear difference in the frequency of metal streaks on touchstones from the cemeteries at Birka and Dziekanowice, there is a distinct difference in the 'richness' of grave furnishings between the burials under discussion from these two sites. It is worth emphasising that only one-ninth of the graves furnished with touchstones at Dziekanowice do not contain a knife; the fondness of archaeologists for the idea of a functional connection between knives and the typical stone artefact among grave-goods is thus easily understandable.

None of the graves furnished with touchstones from Dziekanowice contains a weapon, and the occurrence of jewellery is very rare. As at Birka and elsewhere, neither the occurrence of touchstones nor the presence of streaks of precious metals on their surface shows any connection with the 'wealth' or 'poverty' of other grave-goods. At Dziekanowice, streaks of precious metal regularly appear on touchstones from graves furnished only with a knife, without it meaning that any of these artefacts necessarily belonged to the deceased. The touchstones at Dziekanowice were found most often near the waist, mostly on the left side of the deceased; in two cases a touchstone was found near the skull, and in one case near the deceased's chest (see Wrzesińska & Wrzesiński 2014). Again, the position of the touchstone in a burial is not significant (see p. 95); likewise, whether the touchstone was part of the deceased's equipment or clothing, or whether the touchstone was placed in the open grave after the deposition of the body, or was added along with the fill, are also factors of no consequence. The same is true for weights found in graves at Dziekanowice. Up until 2006, a total of 24 had been found in 23 graves (out of the 1,150 graves excavated until then) of both women and men, of various ages, and in one grave of an *infans I* which was also furnished with a silver coin (Wrzesińska & Wrzesiński 2006, 348). Whereas the majority occurred in the area of the waist (originally in a pouch), they were also found by the deceased's feet and skull, and in one case in the palm. In several cases it is thought that the touchstones were tossed into the grave fill. Some of the graves containing weights have no other artefacts, others have standard or average grave-goods. One exception is the remains of an axe in the grave of young man, c. 18 years of age; jewellery finds are rare (Wrzesińska & Wrzesiński 2006, tab. 2).

More than half of the touchstones from Ostrów Lednicki and Dziekanowice are made of rock of a phyllitic nature (determined by Jan Zavřel). Raw material of a gneiss nature is less common, quartzite, sandstone and/or arkose are even more infrequent. Fluvial pebbles are rare, marlstone, quartz and radiolarite are sporadic. A touchstone made of fossilised bone is a curiosity on a European scale (inv. no. 15/99).[62]

Although the cemetery at Dziekanowice and the island castle on Ostrów Lednicki are essentially one site from a geographical perspective, a fact that could tempt one to make a joint evaluation of the chemical microanalyses of metal streaks from local touchstones, it is best to treat them separately. The

62 A grave find, omitted from the list in Wrzesińska & Wrzesiński (2014).

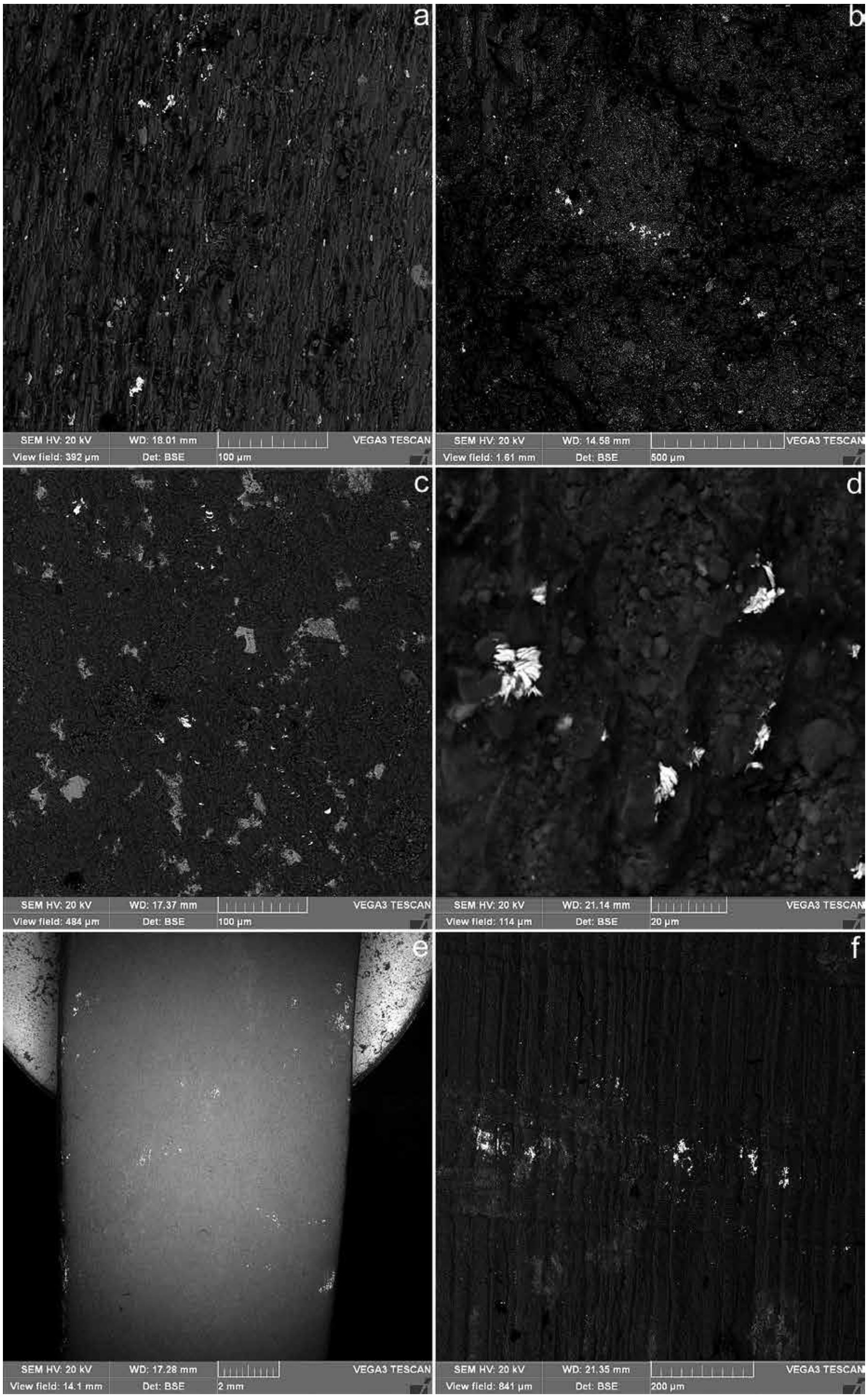


Fig. 40. Selected microphotographs of metal traces on the touchstones from the cemetery at Dziekanowice; the (analysis) nos. correspond to Table 10: **a** *silver with a content of copper (an. no. 6);* **b** *copper (39);* **c** *nickel (56);* **d** *nickel (30);* **e** *lead (22);* **f** *silver on the touchstone made of fossilised bone (72). (Photos: V. Böhmová).*

Grave	Inv. no.	An. no.	Ag	Au	Cl	Cu	Fe	Ni	Pb	S	Sn	Zn	Fig.
31/1979	9/79	1	86			5				9			
		2	8	69		23							
		3				19			74			7	
47/1992	148/92	4	7	59		34							
		5	85							15			
		6	69			12				17		2	40: a
		7	80			17						3	
		8		65		35							
26/1995	74/95	9	85			14						2	
33/1996	102/96	10	100										
		11							100				
		12				61						39	
50/1996	170/96	13							100				
53/1996	153/96	14							100				
28/1997	94/97	15	88							12			
		16									100		
88/1997	241/97	17									100		
88/1999	174/99	18	87							13			
		19	95								5		
		20	76		15					9			
		21							100				
88/1999	175/99	22							100				40: e
22/2000	42/00	23				58						42	
		24	84		11					5			
		25							100				
		26	87		11					2			
37/2001	107/01	27	100										
		28		100									
		29							100				
		30						100					40: d
		31									100		
40/2001	98/01	32	86							14			
		33				100							
		34				63					24	13	
50/2001	118/01	35	75		15					10			
		36				90				10			
2/2002	4/02	37				52	39			9			
		38				89	11						
43/2001	135/02	39				100							40: b
20/2003	35/03	40	100										
		41					100						
		42							100				
36/2003	73/03	43							100				
61/2003	117/03	44	86							14			
		45							100				
154/2003	218/03	46	79		13					8			
		47							100				
		48				69						31	
		49				67						33	
2/2005	18/05	50				100							
		51							100				
64/2005	57/05	52	81		19								
		53	80		3	2				15			
		54	97			3							
		55	87							13			
		56						100					40: c; 42: A
		57							12		88		
		58							100				
		59	78		22								

Grave	Inv. no.	An. no.	Ag	Au	Cl	Cu	Fe	Ni	Pb	S	Sn	Zn	Fig.
I/2005	127/05	60							100				
		61										100	
20/2005	70/06	62				39		37				24	
151/2005	87/06	63				100							
		64			7						93		
?	7/80	65	76			7				17			
		66							65		35		
		67					100						
		68							100				
?	15/99	69	82							18			
		70				33						67	
		71							100				
		72	81		13					6			40: f
?	101/06	73				62						38	
?	1/10	74				6					94		

Table 10. Results of chemical microanalysis of selected touchstones from burials at Dziekanowice (Museum of the First Piasts on Lednica Lake). The data given in weight percent (wt.%) and calculated at 100 % are semiquantitative. The geochemical background, i.e. elements deriving from the raw material of the stone, is excluded. The bottom lines of the table present the results of analysis of touchstones from the area of the cemetery without known (to the author) attribution to a grave. Measurements: V. Böhmová. For complete results of analysis no. 56, see Fig. 42: A.

reason is in the differences in the frequency of the metals of which streaks were recorded on the analysed touchstones. Streaks of silver are far more common on touchstones from the graves than on those from the island, whereas in the case of lead the results are the opposite. The predominance of lead streaks is consistent with results from other early medieval (not only) Slavic settlements, including fortresses and their close vicinity/suburbs (e.g. for Parchim-Löddigsee, Mecklenburg-Vorpommern, Germany, see Ježek 2013b, tab. 5; for Gniezno, Greater Poland, Ježek *et al.* 2010, tab. 2).

A total of 25 stone artefacts from 24 (certain) graves at Dziekanowice were analysed, together with four additional specimens from the area of the cemetery (inv. nos. 7/80, 15/99, 101/06 and 1/10), probably also from graves (Fig. 38; Table 10). Streaks of silver, either 'pure' or with a content of copper, were recorded on 14 (certain) grave finds, together with tin in a small number of cases. Gold (on three stones) appears both 'pure' and with copper. Copper occurs most commonly 'pure' or as part of brass with a zinc content of up to 42 %. In one case copper dominates a metal that also contains tin and a small amount of zinc. An exception (and not only at this site) is provided by streaks of metal composed of approximately the same proportion of copper (39 %), nickel (37 %) and zinc (24 %). Streaks of lead were observed on 15 specimens, in one case with a content of copper and zinc. Streaks of tin are relatively rare, sporadically containing lead or copper. 'Pure' zinc was recorded once – on the touchstone from chamber grave I/2005, which is exceptional at this site for its length and elegance[63] (and on which no traces of precious metal were found).

63 There exists one parallel to this touchstone among the finds from the area of Dziekanowice cemetery: inv. no. 7/80, probably without attribution to a grave (see Fig. 38; Table 10).

Inv. no.	An. no.	Ag	Au	Cl	Cu	Ni	Pb	S	Sb	Sn	Zn	Fig.
141/61	1						100					41: f
228/62	2	89		11								
	3						100					
	4									100		
251/62	5		64		18	18						
	6		52		26	17					5	
	7	42	36		18			4				
	8						100					
	9					100						41: c
266/62	10	100										
	11				57					43		
	12						100					
274/62	13	15	60		25							41: a
	14						100					
328/62	15						100					
18/63	16	78		10				12				
	17	94			6							
	18						100					
	19										100	41: d; 43: A
63/63	20	85						15				
	21						100					
120/63	22						59			41		
	23						44			56		
	24						100					
69/64	25						100					
127/64	26						100					41: e
237/64	27				100							
	28					100						43: B
	29									100		
	30						4			96		
	31						100					
349/64	32						100					
87/69	33						100					
23/70	34						100					
4/71	35						100					
8/71	36	84			5			11				
	37				58						42	
	38	100										
	39							21	79			
	40						100					
43/72	41						38			62		
	42						100					
64/72	43						100					
222/73	44						100					
136/74	45						100					
148/74	46				18		78	4				
	47				83		17					
	48						63			32	5	
	49						100					
2/75	50				10	17				73		
	51						100					
24/78	52		62		23	10					5	41: b; 42: B
	53						100					
4/89	54	77		7				16				
	55						12			88		
	56						100					

Table 11. Results of chemical microanalysis of selected touchstones from the lake island Ostrów Lednicki, Greater Poland (Museum of the First Piasts on Lednica Lake); inv. no. **266/62** *comes from the settlement at Dziekanowice. The data given in weight percent (wt.%) and calculated at 100 % are semiquantitative. The geochemical background, i.e. elements deriving from the raw material of the stone, is excluded. Measurements: V. Böhmová. For complete results of analyses nos. 19, 28 and 52, see Figs. 42: B and 43.*

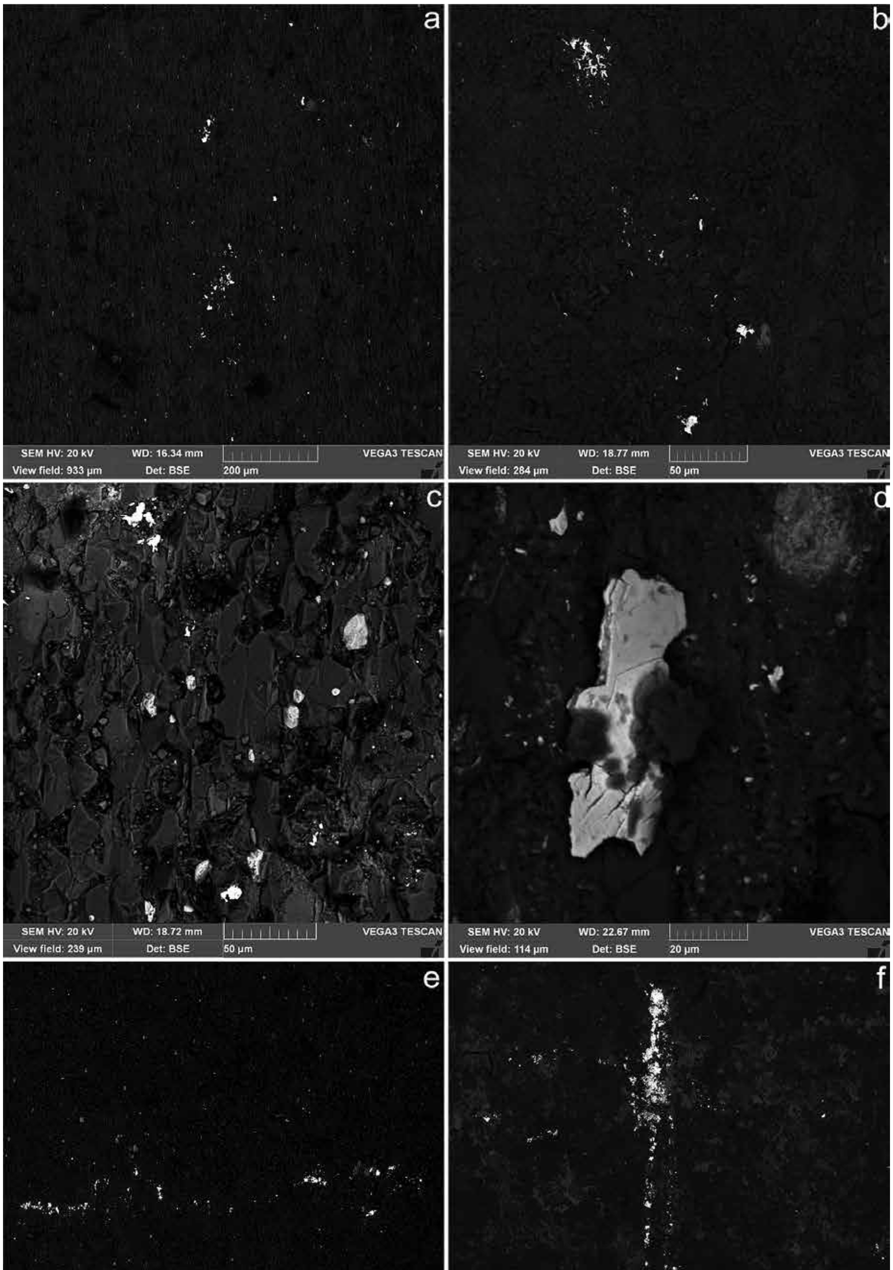


Fig. 41. Selected microphotographs of metal traces on the touchstones from the lake island of Ostrów Lednicki; the (analysis) nos. correspond to Table 11: **a** *gold with a content of copper and silver (an. no. 13);* **b** *gold with a content of copper (52);* **c** *nickel (9);* **d** *zinc (19);* **e** *lead (26);* **f** *lead (1). (Photos: V. Böhmová).*

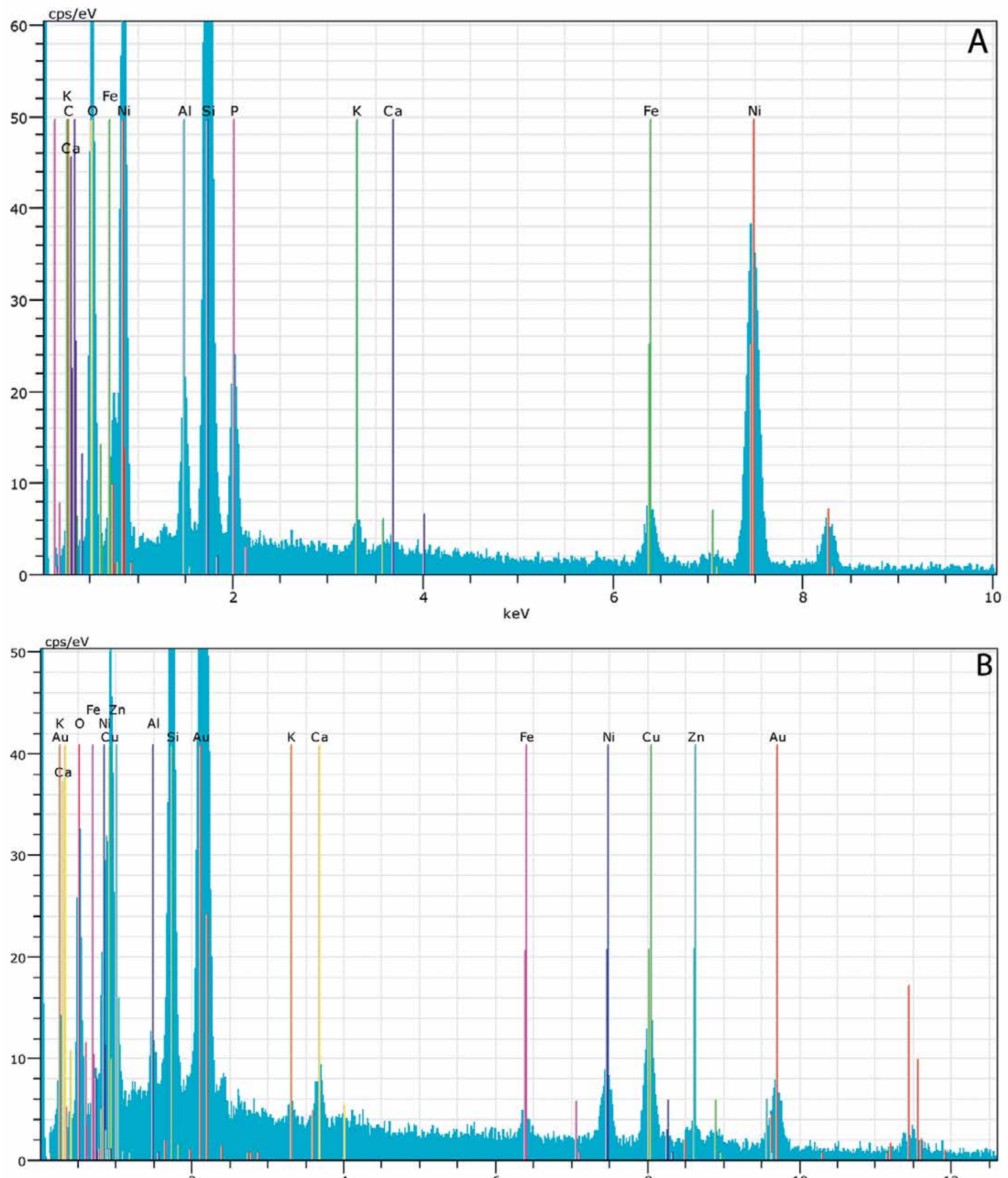


Fig. 42. Selected spectra of metal traces on touchstones from Dziekanowice and Ostrów Lednicki. A: Table 10: analysis no. 56; B: Table 11: an. no. 52.

Zinc also occurs in metals containing copper. Streaks of nickel were recorded on two touchstones (also bearing streaks of precious metals): in one case from burial 64/2005 without other grave-goods, in the other from burial 37/2001 also containing two coins. Streaks of iron, the origin of which is unknown (see p. 107), were observed on two touchstones, together with streaks of silver, lead, etc. The analysis of the artefact from grave 2/2002 showed copper with

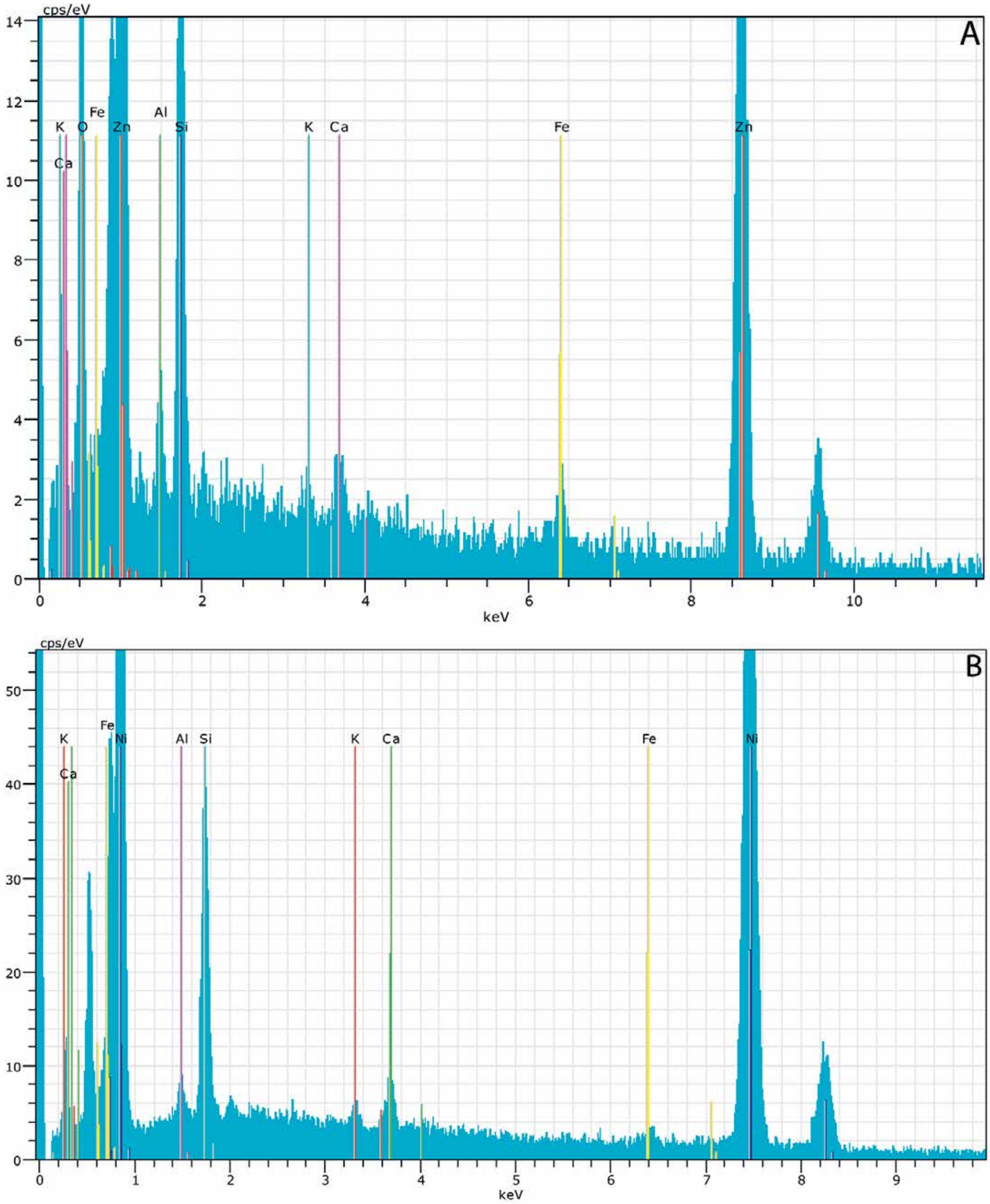


Fig. 43. Selected spectra of metal traces on touchstones from Ostrów Lednicki. A: Table 11: analysis no. 19; B: Table 11: an. no. 28.

a content of iron (Table 10: an. nos. 37 and 38). Theoretically, it can be a trace of matte, which should have a goldish colour in this case. But due to the absence of sulphur it is not clear whether the presence of iron is rather to be attributed to the geochemical background. However, the proportion of iron, otherwise obligatory element in the raw material of touchstones, seems to be too high in the case of the analysis no. 37 (Table 10).

Streaks of precious metals were recorded on seven of the 24 selected stone artefacts from the lake island (Ostrów Lednicki), and also on the only artefact from the settlement at Dziekanowice (inv. no. 266/62)[64] selected for microanalysis (Fig. 39; Table 11). Silver occurs most often in 'pure' form (six specimens), twice with a content of copper, and once in an alloy (?) of silver, gold and copper. On three touchstones, gold always appears as the dominant component of metals containing copper accompanied by either nickel or silver. 'Pure' copper was registered only once; elsewhere copper dominates a metal containing lead. Brass appears once (with a c. 42 % share of zinc), as does bronze. All the analysed specimens from the island bear streaks of lead. Streaks of a metal composed of lead and tin occur in a small number of cases; streaks of 'pure' tin appear twice. Two touchstones bear streaks of nickel. A streak of Sb_2S_3 (see p. 107) and a streak of zinc were each recorded in one case. Streaks of iron were not found in the analysed assemblage from Ostrów Lednicki.

64 My thanks for details of the find-context go to Paweł Sankiewicz.

Forgotten star witnesses, *or* Conclusion

From the Early Bronze Age up to the Early Middle Ages, tools for determining the value of metal were commonly placed in female and male graves, both cremation and inhumation. Although nothing is certain in the current stage of research, this custom seems to be limited to male burials for the Eneolithic. Later, these tools also appear in numerous children's graves. As these demonstrate, given that they are sometimes additionally furnished with forging tools, weapons, etc., many individuals only encountered these objects on the occasion of their own burial. At Birka, the proportion of graves furnished with balances and/or weights, and of graves furnished with touchstones is nearly identical (c. 13 % of the total number of excavated graves in both cases), with some of these graves containing both categories of tool. The burials are both some of the most prestigious and the poorest. Tools for determining the value of metal appear in children's, female and male burials. Gender or age aspects play no role in the Early Middle Ages. The symbolic behaviour of the bereaved had much deeper motivation.

We again emphasise that Viking Age Birka, anyhow exceptional, serves here 'just' as a convenient example. By way of illustration, Birka can be compared, for example, with a part of the Early Iron Age cemetery at Palaepaphos-Skales, Cyprus (Karageorghis 1983)[65], which is almost two millennia older. Ten tombs of a total of 51 excavated (i.e. 20 %) before 1983 include typical stone artefacts (Fig. 44), with lengths from 3.5 cm to over 16 cm (a fragment). These are predominantly made of schist and sandstone (Elliott 1983, 426), with three having a hole at one end. Two tombs yielded two specimens, and one of these two tombs (no. 89) produced several weights. Another tomb (no. 67, without a touchstone candidate) contains a balance (Karageorghis 1983, fig. CXXXI). All the local tombs with tools for determining the value of metal feature rich furnishings. Some have a large quantity of ceramic artefacts (up to 200 vessels) and golden and other objects (tombs 43, 75, 76, 89); constituting a notable

65 For another part of the cemetery, with at least nine touchstone candidates from 18 funeral features, see Karageorghis & Raptou 2016, or above, pp. 26-27. As noted above, the touchstone candidates kept in the Department of Antiquities in Lefkosia, Cyprus, were not available for investigation in a SEM.

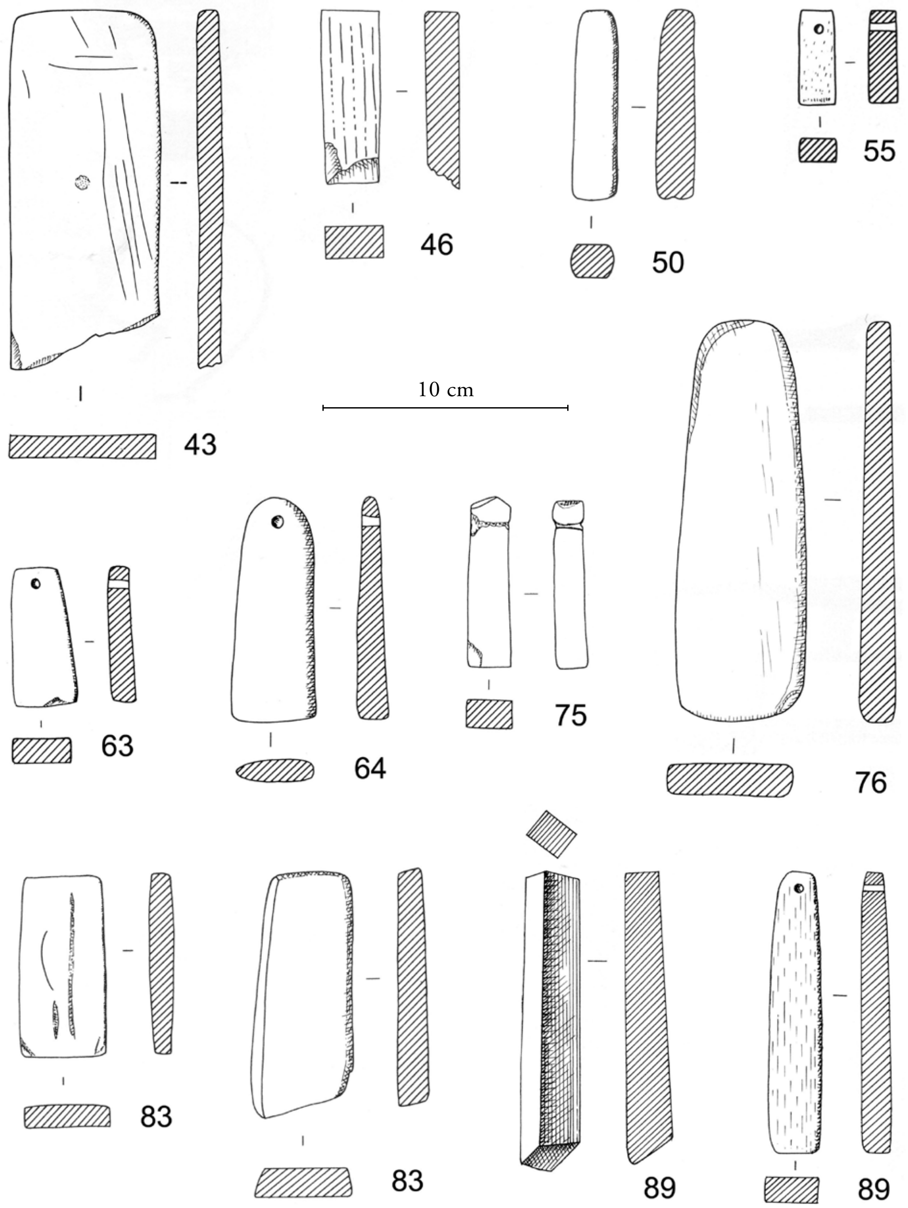


Fig. 44. Selected stone artefacts from Iron Age tombs (with tomb nos.) excavated at Palaepaphos-Skales, Cyprus (after Karageorghis 1983, figs. LI, LXIX, XCIV, C, CXIX, CXX, CXXXIX, CXLIII, CLXVII and CXCIII). Courtesy of Prof. Vassos Karageorghis (fig. L. Raslová).

element in other tombs with 'whetstones' are dozens of painted vessels (46, 50, 55, 63, 64, 83). Some of the local tombs, including those with touchstone candidates (43, 55, 64, 76, 89), also contain weapons. The majority of the tombs at Palaepaphos-Skales did not contain any tools for determining the value of metal.

Birka, like other European early medieval cemeteries, thus represents merely a funeral tradition that is repeated over thousands of years, along with all its variants. The cemeteries at Birka were, however, not – when compared to (e.g.) Palaepaphos-Skales – exclusively for the elite. But even the aristocratic cemetery at Vendel, for example, is not an ideal comparison for this Early Iron Age Cypriot site, which does not involve the burials of nobility. For this reason we reiterate that of the 14 boat graves at Vendel, five contained touchstones, i.e. 36 % (see Ježek 2016). Two things are clear, however: (1) in Viking Age burial customs, there is little 'Viking' involved;[66] and (2) every archaeological site and situation is unique and so attempts to generalise human behaviour through mathematical methods, without taking into account the specific features of individual sites, cannot be other than erroneous.

The *longue durée* congruence in burial patterns is all the more noteworthy given the fact that Viking Age Scandinavia (and other parts of the early medieval bullion-economy zone) differs significantly from other periods and regions in the frequency of the use of tools for determining the value of metal. The best evidence for this is provided by the thousands of touchstones (or touchstone candidates) from settlement contexts at Birka and Hedeby. The cause of the massive concentration of these tools, as well as of weights and balances, in early medieval northern Europe, can be found in the interplay between the accessibility of silver resulting from Viking activities in central Asia and the method of handling the precious metal in the bullion economy. From this perspective – despite the vast number of early medieval Scandinavian graves equipped in this way – these tools are in fact reflected rather marginally even in Viking burial customs.

Our selection of stone artefacts from the Birka burials for chemical microanalysis was based on the anticipated possibility of preserved metal streaks, an assessment made after the artefacts had been observed under a binocular microscope, not according to the social or other classification of the graves. Unanalysed touchstones from local prestige burials undoubtedly bear streaks of non-ferrous metals and probably often streaks of precious metals. An apparent 'handicap' in our choice (which could have produced significantly more impressive results if the focus had been on prestige burials) is compensated for by other results. Even simple graves contain touchstones, including some with remarkable streaks. Some of the objects were added later during the placement of ashes from cremated remains and burnt furnishings in the grave. Touchstones also occur in the grave fill or in the barrow, i.e. not only in the direct furnishing of the deceased – or of the actual body.

The range of metals that left traces on touchstones from Birka burials nearly equals, and even supplements, the results obtained from other European sites, and not just those dating from the Middle Ages. Noteworthy are streaks of zinc and the remnants of testing various minerals. Regional metamorphic submarine exhalative deposits in central Sweden are particularly rich in ores

66 Incidentally, it is (also) in Sweden where finds of 'Late Neolithic' and Early Bronze Age touchstone candidates from burials total at least dozens.

often not found, or even exploited, elsewhere in early medieval Europe (see Ježek 2016, with refs.). Streaks of a metal composed of silver and mercury (with minor content of copper and iodine: grave 56) and streaks of Sb_2S_3 (probably antimonite) suggest that many streaks derive from tests of ores and minerals. Another evidence for testing minerals is the streak of cinnabar on the touchstone from the Roman period 'royal' burial at Mušov, Czech Republic (Ježek *et al.* in press). In reality, we are often unable to determine in cases of precious and other non-ferrous metals whether the streaks originate from testing metalworkers' products or from testing ores. In any case, streaks on touchstones cannot be directly linked to activities conducted at a site, including Birka.

From a different point of view, there is an evident frequency of lead streaks on early medieval touchstones from both Viking and Slavic environments. The streaks of lead probably cannot be explained by the uncertainty of touchstone users over an easily distinguishable metal, but rather as attempts to determine its qualities. The frequency of lead on touchstones from early medieval northern and central European sites opens up at least two interpretational possibilities, both emphasising the importance of this metal for ancient Europeans – either for making jewellery and working with non-ferrous metals in general, or for trade with raw materials. In the second case, a response to demand from the Mediterranean cannot be ruled out. Following the decline of the Roman Empire, the lead mines in Hispania, Britannia, etc., ceased to be a regular source of this important metal (even if the shafts were not destroyed in the post-Roman period, as was the case, for example, with the Rio Tinto mine in Spain). At the same time, the importance of lead continued to grow in the Early Middle Ages across Europe, e.g. for church buildings, coin minting, jewellery production, etc.

Although the level of ancient knowledge should not be underestimated, the presence of streaks of certain metals or minerals does not mean that early medieval metallurgists knew which metal, ore or mineral they were working with, i.e. that they understood its 'chemical composition'. And this was certainly valid for the majority of touchstone users, i.e. for regular participants in exchange, who encountered both common and peculiar metals, including intentionally created imitations. For that matter, only one touchstone from the analysed assemblage from Birka is regarded as the tool of a true specialist: the artefact from grave 605B. But not even this object can be tied to the activities of the deceased individual whose grave was furnished with this artefact (in fact, only its fragment). Excluding the superb touchstones from the graves of rulers, these tools, as is also the case with other objects used as a symbol during burial ceremonies, cannot be connected directly with the person buried in the grave in question. Symbols used as grave-goods need not be the deceased individual's personal belongings, and current popular speculation as to how the survivors wanted to (re)present the buried person is also misleading (see, e.g., Morris 1992, 8-24, with refs.). Touchstones or weights concealed in a pouch are eloquent testimony of the fact that the composition of grave-goods was mostly the private concern of the survivors and not a subject of the communication of burial participants or even ostentatious (re)presentation.

As is true to this day, the survivors had a single objective: to give the deceased a proper burial in the local – or even, in some cases, regional – community. The survivors' wishes for the deceased to remain in peace where they had gone and not return with their demands could have been a primary motivation. The choice of means (including the decision about cremation or inhumation), and the symbols used in the farewell ritual, depended on a wide range of traditional possibilities. Only some of the survivors chose tools used to determine the value of metal, artefacts that had been used in the burial ritual from time immemorial. The meaning of symbols in the burial rite cannot be derived directly from the function of the artefacts in living culture, and to ponder the motivation of the survivors who placed them in graves is to enter the realm of archetypes accompanying human society from its very beginning. Unlike archaeologists, ancient European survivors were not concerned as to whether their behaviour had a rational explanation. It is futile to search for specific reasons as to why a certain artefact was placed in a grave, as the survivors themselves were either unaware of this reason or construed it in connection with the traditions of their own society. Depending on local cultural circumstances, the original long-forgotten meanings of symbols were replaced by others in connection with local faith and myths; however, the phenomenon itself, or rather, its formal expression, has been maintained (for that matter, what does the sign † mean today: salvation or death?). Naturally, this does not mean that grave furnishings cannot tell archaeologists anything about the social rank or gender of the deceased or, especially, about the spiritual world of ancient societies.

In Europe, the end to furnishing graves in general and the introduction of coins are both related to the establishment of state structures. The influence of Christianity on the dis/appearance of grave inventories is beyond the scope of our possibilities, and our aim is not to explain the role of Christianity in European state formation, since transalpine Europe in the Middle Ages went through these processes hand in hand. What is important is that grave furnishings disappear in hierarchically organized (or state-forming) societies of Europe much earlier than in areas resisting the efforts of missionaries, regardless of whether this concerned a population classified as Germanic, Baltic, Finno-Ugric or Slavic (etc.). An exploration of the influence of the hierarchical organization of a society on the composition of grave furnishings in Europe could perhaps answer a much more important question: objects used for determining the value of metal also disappear from grave-goods in certain periods in regions that Christianity did not reach (Mesopotamia, the Altai Mts., China, etc.). The change in burial customs depends on social change rather than religious matters. Significantly, for example, one of just two burials excavated in the Basilica of San Gervasio in Centallo-Fossano (Italy) from the seventh century contained forging tools (Micheletto & Pejrani Baricco 1997, 334-335). Sheet gold was part of the furnishings of elite burials in (Great) Moravian church cemeteries from the ninth century, including one case directly from a church (Galuška 2013, 175, 179).

Ritual practices valid across Europe for millennia went undisturbed until the exercise of Christianity. This history is all the more remarkable because Church sources from the period contain no ban on placing goods in graves or any sanctions for doing so, and the Church itself ostentatiously continued the ancient traditions when burying its dignitaries. The medieval luxury of bishop burials peaked between the eleventh and thirteenth centuries. And while it declined after the mid-thirteenth century (only until humanistic piety took hold), the earlier splendour was often replaced by imitation, including wood and wax (Sanke 2012, 533-556), which, even more eloquently, continued to fulfil the role of symbols. Not even the study of eschatological treatises from the period helped M. Sanke in his efforts to explain the reasons behind the spectacular burials of bishops in the Middle Ages. For that matter, the Christian clergy did not interfere with the continued practice of traditional ('pagan', if you prefer) customs by its followers, and not only those of the highest rank. Evidence ranges from miniatures in the form of diseased or healed limbs, or even livestock, as known from numerous excavations of medieval churches and even hung around Catholic and Orthodox churches to this day,[67] to scissors in late medieval and early modern Christian graves (Fehring 1979, 569-570) and coins buried with the deceased, including in recent, traditionally Catholic, rural environments.

As the story of touchstones demonstrates, an approach applied in the first half of the nineteenth century, which can in retrospect be designated as a Morganist-Engelsist one, permeated archaeology to its very core as early as the nascent stage of it becoming an established discipline. It is a classical example of the sociomorphic model (E. Topisch). Playing a significant role here was also the 'discovery' of ancient Egyptian culture by Europeans at the beginning of the nineteenth century. The overwhelming effects brought on by the remains of Egyptian civilisation could do nothing else than manifest themselves in the interpretation of archaeological finds from other parts of the Old World. However, their ancient spiritual, and thus also social, contexts differed totally. European archaeology was dealt another fatal blow by the Marxist-Leninist work of V.G. Childe in the second quarter of the twentieth century, when naive nineteenth-century thoughts grew into grandiloquent theories connecting entire continents. Despite the fact that, for at least a century now, there has been general consensus among scholars studying prehistory and the Early Middle Ages that symbolic and ritual aspects played a significant role in ancient societies, this patently true premise is often ignored, or sheepishly mentioned, in work with concrete archaeological material. And despite the difficulties involved in proving this theory (aptly Hines 1989), it does not await just a sad fate at the periphery of 'scientific' interest, assuming, of course, that archaeology does not wish to become ever more isolated.

Nevertheless, not even the revelation of critical error in the traditional approach (e.g. Rowlands 1971; Budd & Taylor 1995; Gibson 1996; Gilman

67 The issue of prehistoric and medieval votive offerings far exceeds the aim of this work (for Birka, see Gräslund 2007).

Fig. 45. One of the touchstones with streaks of gold found in the assemblage of medical and pharmaceutical equipment from cesspits in the house of a physician in seventeenth-century Plzeň (Pilsen), Czech Republic (Dudková & Orna 2009; Ježek & Zavřel 2010, 614-616). The West Bohemian Museum in Plzeň, inv. no. HA 21034 (photo: J. Orna).

1996; Neipert 2006) has led to the proper interpretation of burials furnished with metal-touching tools. The result so far is the prevailing concept of free craftsmen who enjoyed enormous social prestige (see Ježek 2015). Although an interpretation of this type causes insoluble discrepancies (e.g. the contradiction between historical sources and archaeological deliberations as to the social in/dependence of ancient craftsmen, or the disproportion between the number of anticipated smiths and the related furnishing of graves), archaeology does manage constantly to find new reasons for the petrification of its ideologically (or period) conditioned paradigm.

The same approach can be taken towards countless European Bronze Age (and later) hoards. For example, in Moravia, metalworking tools (hammers, anvils, casting moulds, etc.), are present in 10 % of the Middle and Late Bronze Age metal hoards (Salaš 2005, 60; 2014). (Not only) Moravian Bronze Age hoards also contain castings, including defective casts; for Cypriot finds of hoards containing metallurgists' tools, see Matthäus & Schumacher-Matthäus (1986, 162-163). In the light of sites showing evidence of human sacrifices and the concurrently repeated deposits of metal hoards (i.e. Cezavy–Blučina: 18 hoards; Velim–Skalka: 7 hoards; both Czech Republic), there remains no doubt as to ritual motivation (Salaš 2005, 230; see also Kurz 1995, 33, 110-112; both with additional examples and refs.). On the contrary, there is justifiable doubt as to the legitimacy of the (usual) linking of these deposits to the needs (exclusively) of metalworkers. Metallurgical workshops in Bronze Age shrines, or in their close vicinity, are recorded on east Mediterranean islands (e.g. Enkomi and Kition, Cyprus; Phylakopi, Melos: for refs., see, e.g., Matthäus & Schumacher-Matthäus 1986, 169-172; Ježek 2015, 132; and, in particular, Orfanou 2015, 33-62, 291-299, with numerous additional examples and refs.). The construction of the temple to the goddess Demeter near Gela, Sicily, in the sixth century BC, was preceded by the deposition of at least 30 bronze hoards over four centuries (Hänsel 1997, 19). An example of the connection of a sanctuary with a metallurgical workshop is offered by the Roman period Swiss site of Cham-Hagendorn (Schucany & Winet 2014). Also found is the evidence of Bronze Age and early medieval metalworking in fortified aristocratic residences and chieftain's halls (for examples and refs., see Ježek 2015, 132; cf. Moorey 1994, 226, for the Mesopotamian environment).

At least five of the nine investigated chapels from the period of the Conversion of Iceland were built on the place of a forge (Hed Jakobsson 2003, 31-32); the same situation has been documented in southern Sweden (Heimer 2010).

When archaeological finds are not interpreted against the background of period behavioural factors, they by themselves do not in fact reveal much in this connection. An understanding of them depends on a willingness to abandon stereotypes ingrained during the 200-year history of archaeology, as the seeming logic of these widely held beliefs is in fact merely faith shared within an outdated, but still current, paradigm. In this case, it is the faith of nineteenth- and twentieth-century archaeologists in the belief that ancient European societies must have believed in an afterlife, or rather, in a form of posthumous existence in which the deceased performed activities similar to those conducted during their lifetime. Using tortuous constructions, archaeology manages to talk its way out of messy situations such as the occurrence of 'whetstones' in infant's graves – often without knives, never mind. This discrepancy is even more apparent in the numerous cases of children's graves with weights or balances. For that matter, instances of children's graves with weapons and/or other adult-related objects clearly demonstrate that such grave-goods acquired symbolic meaning only on the burial occasion. After all, similar behavioural patterns have been recognized even in the case of a chipped stone industry in Early Bronze Age burials (Únětice culture: Kaňáková & Parma 2015); another example is the occurrence of wristguards in Bell Beaker (Late Eneolithic and Early Bronze Age) female burials (Turek 2004b, 212-213). Nothing new: the issue of the symbolic meaning of burial furnishings does not start with tools for determining the value of metal.

The occurrence of touchstones, weights and balances in burials does not mean that the deceased were involved in exchange. Traces of metals on a touchstone found among grave-goods does not mean that the individual concerned had come into contact with these metals. And the occurrence of such tools in settlement contexts does not mean that long-distance trade played a significant role in, or even dominated, the economy of the given location. In the northern part of early medieval Europe, tools used to determine the value of metal were a standard part of a life in which exchange was operated on both local and super-regional levels. Although there is no reason to doubt the importance of long-distance trade in the case of Birka, there is also no point in overestimating its role. This is also true for other early medieval centres connected in archaeological literature with long-distance trade, especially for centres that could not be reached by ships sailing from one shore to another of the same sea, i.e. for inland sites. An analysis of the spatial distribution of touchstones in settlement layers offers better insights into the production – or even social structure – of such sites, although it is a thankless task to have to work always with just the selection of touchstone candidates for SEM analysis, as also with finds from archaeological trenches that typically cover only a small part of a site (cf. Ježek *et al.* 2010). However, this is an issue for future generations of archaeologists at Birka, Helgö, Sigtuna, Kaupang, Hedeby, Ribe, Sebbersund, Trelleborg, Dorestad, Ralswiek, Usedom, Wolin, Szczecin, Truso, Wiskiauten, Staraja Ladoga and many other sites – from Iceland to central Asia (or even further afield) – regardless of whether medieval or prehistoric in date. A fragment of a balance and a 'whetstone' from a Norse settlement site on the eastern shore of Arctic Canada (Sutherland 2008, fig. 44.1.2) illustrate the importance of these tools in determining the value of metals far from centres typically linked to super-regional trade (for a crucible with traces of bronze from Arctic Canada, see Sutherland *et al.* 2015).

Just as important are the hundreds of touchstone candidates, including 'classical' black specimens, from nineteenth- and early-twentieth-century Alaska, the Great Plains, Japan, India, Indonesia, Malaysia, etc., recorded in American and European collections as 'whetstones' (e.g. Penn Museum,[68] Metropolitan Museum of Art, British Museum,[69] Pitt Rivers Museum: for the latter, see Barton 2013, 521, mentioning also touchstones from Malaysia).[70] It would be too simple to say that the early ethnographers were not interested in the function of the said artefacts in a living culture, and that they classified the acquired artefacts using exclusively their own judgements. In fact, these collections contain many donations and sale-room acquisitions without any 'field records', often with a century of delay following the separation of the objects from their functional contexts. It could also be that such artefacts from North America might originally have been robbed from graves of the indigenous population.[71] The classification of the artefacts was usually made by twentieth-century museum curators. Nevertheless, archaeology often turns to such collections, and such deduced 'identifications', in the belief that they can help with the classification of archaeological finds. Without a more critical approach, ethnographic acquisitions of this kind cannot be of much assistance – as archaeology is again and again discovering in its own cases, as documented by the history of archaeological research.

The reader will certainly recall that the earliest burial finds of touchstone candidates mentioned in this book come from the sites of Maikop and Klady in the northern foothills of the Caucasus. Casting moulds and chisels, as well as typical stone artefacts, appear relatively frequently in prestigious burials of the Yamnaya and Catacomb-grave cultures (Novosvobodnaya, Baturinskoe, Inozemtsevo, etc.; e.g. Korobkova & Skharovskaya 1983; Bátora 2002; Kaiser 2003, 162-169; 2005; with additional examples and refs.) and gradually

68 E.g. nos. 32-7-1765, 69-16-15, 69-16-482, 45-15-871A, 97-564-161.

69 E.g. nos. Af1913,1013.97, Af1913,1013.98, Af1922,0413.121, Af1922,0713.1, Am.8215, Am.8217, Am.8218, Am1855,1126.213, Am1855,1126.599, Am1890,0908.177, Am,St.749.

70 As noted above, it was not possible to investigate any objects in Penn Museum and the British Museum; the store of the Pitt Rivers Museum, Oxford, was undergoing reconstruction during 2016 and 2017.

71 Given the unavailability of objects from Alaska and the Great Plains, this work does not address this issue, one that has surely been adequately covered by American researchers. Worth mentioning is a paragraph in the memoirs of a traveller, trader, Inuit chief and supreme justice of New Siberia, Jan Welzl. He recalls on his journey to Dawson City in Yukon, at the turn of the twentieth century, an '[…] old Indian cemetery, where commemorative items often accompanied the dead. Prospectors opened the graves and stole these artefacts and then sold them to museums in the United States. This practice was then strictly forbidden […], of course in Canada, where the ban was taken seriously. The Americans took a more lenient view toward such items' (after Welzl 1989, 119, from Czech translated by D.J. Gaul).

increase in Early Bronze Age burials in south-eastern and central Europe. Casting moulds are even included in the 'Yamnaya Package' (Harrison & Heyd 2007, fig. 46; see figs. 43 and 50 for the directions of Yamnaya culture migration).[72] The distribution of metal-touching tools in grave inventories conspicuously recalls the well-argued conclusions, supported by other sources, of D.W. Anthony (2007) on the origin of Indo-Europeans (not to mention works by G. Kossina and M. Gimbutas; see Heyd 2017). Anthony's definitive book includes illustrations of the inventory of the richest graves from the Early Bronze Age steppes of central Asia and south-eastern Europe, also containing oblong 'stone pestles' with a circular cross-section (Anthony 2007, figs. 13.9 and 16.8). A 'polished black stone pestle' and a 'whetstone' from a Maikop-culture prestige kurgan at Evdik can serve as an early example; however, 'stone pestles also frequently appeared in Sintashta and Petrovka graves' of the Bactria-Margiana Archaeological Complex (the turn of the second millennium BC), etc. (Anthony 2007, 297, 431, with refs.). While metal-touching tools, including touchstone candidates, also occur in Eneolithic graves across Europe (e.g. Bertemes & Šebela 1998; Bertemes *et al.* 2000; Brandherm 2010; Freudenberg 2010; Drenth *et al.* 2013; all with additional refs.), the 'ethnic' affiliation of these populations, not to mention the spread and adoption of cultural habits, remains unanswered. In any case, the hypothesis concerning the connection between the custom of depositing metal-touching tools in graves and the spiritual roots of the Indo-European world is in complete conflict with efforts to explain the behaviour of early medieval Europeans on the basis of recent parallels from Africa (see p. 57). As a result, the possibilities of ethnoarchaeology in the study of European or Near Eastern post-Neolithic society appear at best to be highly limited.

Finally, we can compare the above-mentioned Assyrian reliefs and stelae depicting the finials of typical stone artefacts in the same position as daggers (Fig. 13), with the Scythian (Cimmerian, Sarmatian, etc.) stelae showing men equipped with weapons and a touchstone (Fig. 4). Although both the standard of the work and the arrangement of the tools on the body differ, the motif is the same. It is the symbolic rendering of an unusual being (regardless of whether human or supernatural), whose power is expressed by the depiction of key objects. Because of the wide distribution of touchstones across social levels in early medieval Europe, it is understandable that tools used to determine the value of metal have lost their 'iconographic' value. Later, with widespread coin exchange, touchstones fell into virtual oblivion, with the exceptions of prospecting, advanced metallurgy, and particularly the goldsmith's profession (for another example, see Fig. 45). The quality of currency was guaranteed by the imprint of local authorities. However, the word itself – *touchstone* – still remains in the vocabularies of European nations and is often used in a figurative sense. But not many today would link this word with the beginnings of European culture.

72 The authors interpret the relevant graves in the traditional manner as 'craftsmen's graves' (Harrison & Heyd 2007, 196, fig. 47).

The petrographic qualities of analysed touchstones from Birka burials, and their description

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During one day of contact with the respective stone artefacts from the collections of the Swedish History Museum in Stockholm (before their chemical microanalyses), the attention of the petrographer was focussed on the possible presence of metal streaks on their surfaces and the selection of suitable specimens for the initial SEM analysis. Because of the earlier petrographic analysis of these finds from Birka (Sundbergh & Arwidsson 1989), the identification of individual types of rock was only noted in passing.

A significant number (37 %) of the 51 stone artefacts from burials at Birka, macroscopically selected for further analysis in a SEM, belonged to types described in earlier works as multi-coloured schist (silt), or banded silt. This distinctively coloured rock has irregularly alternating strips, bands, stripes or thin layers of whitish, light and dark grey, greenish-grey, violet, reddish-brown and reddish-violet hues (touchstones from graves 56, 86 b, 475, 495, 496, 524, 573, 660, 708, 750, 752B, 823, 913, 949, 950, 955, 973, 991A, 1076). Some of these stones have been smoothed by water or glacial transport and therefore derive from alluvial, glacial or marine deposits (e.g. from graves 86 b, 708, 823, 991A).

Stone artefacts of the characteristic shape made of banded crystalline silt constitute only c. 5 % of the total assemblage from Birka, including finds from settlement layers (Sundbergh & Arwidsson 1989, 103); according to these authors, this material comes from south and/or central Sweden. M. Elfwendahl and P. Kresten (1993) offer a fine introduction to the raw materials of typical medieval stone artefacts from the territory of Sweden.

In addition to Birka, oblong polished and smoothed stone artefacts made of banded silt also occur at other archaeological sites in northern Europe from

Iceland to western Russia, albeit in far smaller numbers. Blanks from this stone have been documented at two sites – Hedeby and Borg (Resi 1990, 89; Johansen *et al.* 2003). The material of the previously petrographically assessed artefacts from Borg is similar to rock from outcrops between Laksefjord and Tanafjord in northern Norway (c. 500 km from Borg), but similar rock is also known from Sweden, near Torneträsk (Johansen *et al.* 2003, 155). Detailed analyses that would confirm the origin of the primary materials are mostly lacking. Banded material from Gnëzdovo (western Russia) appears to be the only exception (a petrographic section under a polarising microscope). This rock was classified as quartz-chlorite-sericite-tourmaline schist with ore mineral inclusions (Bychkova *et al.* 2010), with its particular association of minerals suggesting that it could be banded metamorphic rock – banded hornfels. Some of the banded rocks mentioned above probably also belong to this genetic type of metamorphic rock.

Further artefacts from Birka chosen for chemical microanalysis, the results of which constitute this publication, were manufactured from less distinctive materials. Both light and dark grey schists and metasiltstones are represented (in graves 47, 145, 220, 376A, 561, 667, 711A, 715, 750 – shorter specimen, 795, 1020, 1082), with the lighter types (e.g. in graves 145, 667, 711A, 1020, 1082) probably coming from around Eidsborg (Telemark), Norway. Brownish-grey and pale reddish-brown schists (graves 414, 423, 557, 624, 768, 776, 1059), and grey schists (graves 60, 81 a, 524 – longer specimen, 605, 674, 804A, 831, 964, 1014, 1035), also occur in the area. Of less frequent occurrence in the analysed assemblage are metasiltstones to fine-grained quartzites of unknown origin; however, their actual representation (influenced here by our selection for SEM analysis) is undoubtedly much higher at Birka. And other raw-materials also occur there.

The surfaces of many stones in the analysed assemblage are rounded by water or glacial transport – regardless of the rock type (graves 81 a, 86 b, 220, 414, 557, 674, 708, 776, 823, 831, 913, 964, 991A, 1014, 1035). Stones prepared by natural forces and with suitable shapes, colours and physical qualities, from alluvial, glacial and marine sediments, clearly competed with the demanding extraction, and laborious shaping, of rock material.

The first number refers to the Birka grave. L length; CS cross-section; D diameter: in millimetres.

47 Fragment of a roughly and irregularly worked artefact that was also probably deformed by intensive grinding. Both ends are missing. Variable cross-section, from trapezoidal to hexagonal. One face straight, the surface of the others variously ground into flat and rounded parts. The surface is mostly smoothed yet uneven in places. Dark grey schist. Preserved L 84; CS 17 × 11.

56 This elegant artefact would have been of trapezoidal cross-section if one of the perfectly smoothed sides did not have a convex curve. From the end with a hole (conical on both sides, with D c. 3 mm at the narrowest point), it widens slightly toward the opposite end. Fine-grained banded silt with alternating beige and grey. L 93; CS 14-17 × 13.5-15.5.

60 Artefact of rectangular cross-section with convex faces tapering towards both ends. The smoothed surface is slightly rough; edges are sharp. One end has a depression c. 1.5 mm deep as the remnant of an abandoned attempt to create a hole. Grey sericite quartzite with a rusty tint. L 90; CS 10-12.5 × 7-9.

81 a Artefact of square cross-section with polished faces and rounded edges. Expands from the end with a hole (D 3.5) toward the opposite end. Dark grey to black quartzite. L 56; CS 11-14 × 9-14.

86 b Finely worked and regular artefact widening slightly from the end with a hole (D 1-2), which contains the remnants of a metal ring. The narrower end has a rectangular cross-section, the wider end a square cross-section. The faces are smoothed, with rounded edges. Banded silt, creamy beige alternating with shades of grey. L 82; CS 12-15 × 10-15.

145 Artefact glued together from three fragments. The cross-section changes: triangular at the end with a hole (D 3), which widens considerably in a conical manner, whereas the rounding of one edge creates a nearly rectangular cross-section at the opposite end. The other edges are sharp, the faces smoothed. Greyish-beige to light grey quartz-sericite schist. Blackened by smoke (cremation burial).

220 Flat artefact having wide faces with a smoothed yet slightly rough surface, rounded corners and edges. A hole (D 4) opens wide in a conical manner on both sides. Grey-beige sericite schist to metasiltstone. L 117; CS 19-20 × 7-10.

376A Flat artefact of rectangular cross-section with sharp edges widening slightly from the end with a hole (D 2). The faces are smoothed yet slightly grainy. Glued from two parts. Light grey schist, blackened by smoke in parts (cremation burial). L 145; CS 12.5-13.5 × 6-7.

414 Part of a perfectly smoothed artefact of square cross-section with rounded edges and corners. The narrower end with a hole (D 3) contains a remnant of a metal ring. Brownish-grey quartzite. Preserved L 40; CS 20-22 × 20-22.

432 Fragment of an artefact of (originally) rectangular cross-section that is irregular due to grinding, with one end and one side preserved. The surface is finely coarse. Ochre-grey quartzite? Preserved L 77; CS 11 × 10.

475 Regular artefact with straight smoothed faces and of nearly square cross-section, with elegantly bevelled edges at both ends. The narrower end has a hole (D 3). The banded silt alternates layers of greenish-grey and greyish-violet colour. L 92.5; CS 9-14 × 12.

495 Cubiform artefact of rectangular cross-section tapering toward the end with a hole (D 2); glued from two parts. The faces are perfectly smoothed and the corners are rounded. Banded silt, creamy grey alternating with shades of grey, metasediment. L 78; CS 13-15 × 12-13.

496 Perfectly worked artefact tapering in an elegant, convex curve toward the end with a hole (D 4) containing a remnant of a metal ring. The square cross-section flattens slightly toward the hole. Smooth faces, sharp edges. Banded silt, beige-grey alternating with violet-grey. L 135; CS 11-19 × 14-19.

524 Entirely regular artefact of square cross-section with straight, slightly rough walls and sharp edges widening from the end with a hole. The hole is conical on both sides, D c. 3 mm, with a preserved silver ring (D 26) made from wire with D c. 2.5. The artefact is glued from two parts. Banded silt, light grey-beige, slightly weathered. L 94.5; CS 11-17 × 11-17.

524 Artefact of irregular rectangular cross-section, broken into two full parts. Three faces are perfectly smoothed; one (the widest) is uneven, with only a small part smoothed. One end bears rough traces of cutting. Bluish-grey

metasiltstone. L 292; CS 25 × 11.5-18; weight 234 g.

557 Artefact with rounded sides of nearly oval cross-section widening from the rounded perforated end, with remnant of a metal ring, toward the opposite end, the middle of which is grooved. Smoothed, slightly coarse surface. Dark grey sericite quartzite with a reddish-brown tint. L 70; CS 12-15 × 7.

561 Perfectly smoothed and regular artefact with sharp edges and straight faces widening from the end with a hole (D 3). Blackish-grey schist. L 90.5; CS 11-18 × 7-8. (Cf. Oddy & Meyer 1986, 159.)

573 Perfectly worked and smoothed artefact of rectangular to square cross-section expanding from the perforated end toward the opposite end. Rounded edges and corners. Remains of a silver ring in the hole (recorded by H. Arbman as bronze). Banded silt of alternating greyish-violet and greyish-beige tones. L 82; CS 8.5-9.5 × 9.5-15.

605B Fragment of a regularly shaped artefact with perfectly smoothed faces and blunt edges, slightly widening from the perforated end which has a silver ring decorated with incisions every 1 mm. D of conical hole on each side c. 2.5; D of ring 19; D of wire 2. Greyish-black fine-grained quartzite(?) with a greenish tint. Preserved L 65; CS 13-16 × 7-8. (Cf. Graham-Campbell 1980, No. 171.)

624 Artefact of rectangular cross-section with polished faces tapering from the end with a hole (D 4.5). Grey quartzite? with a reddish-brown tint. L 112.5; CS 15-18 × 10-12.

660 Artefact of square cross-section at its widest point, which is otherwise irregular due to grinding at both ends. The narrower end with a hole (D 2) contains a remnant of wire. Three faces are perfectly smoothed, one is rough; the faces are straight, the edges sharp. Banded silt of alternating greyish-violet and greenish-grey colours. L 62; CS 18-20.5 × 2.

667 Flat artefact of rectangular cross-section widening distinctly toward the perforated end. The conical hole (D 1) on both sides is secondary; the original (narrower) end of the artefact is broken off at the original hole (D 3). A trace of an abandoned attempt (depression) to create a new hole, after the other hole broke, is also visible. The faces of the artefact are smoothed, with sharp edges. Greyish-beige to light grey quartz-sericite schist with an irregular darker secondary crust. Preserved L 78; CS 11-20 × 6.

674 Smooth, needle-shaped artefact of circular (at the end) to oval (in the middle) cross-section that tapers to a point from the end with a hole (D 3.5). Grey to brownish-grey quartzite? L 88; CS max. 10 × 8.5.

708 Perfectly formed artefact of square cross-section tapering toward the end with a hole conically formed on both sides. The faces are smooth, the corners rounded. Banded silt, beige-grey alternating with shades of grey (with a violet and green tint). L 70; CS 11-15 × 11-15.

711A Flat, roughly worked artefact with a hole (D 3-7) conically formed on both sides, at one end. Both wider sides of the artefact are smoothed, one of which is ground into a concave wave. Both ends are bevelled. Light grey schist. L 82; CS 13-15 × 7.

715 Cubiform artefact of rectangular cross-section, with smoothed faces and sharp edges. The hole at one end contains a remnant of an iron ring. The opposite end is irregular but probably not damaged. Grey schist to metasiltstone. L 6; CS 14-16 × 12.

750 Perfectly worked artefact of square cross-section tapering toward the end with a hole (D c. 4) conically formed on both sides and with a remnant of a metal ring. The faces are entirely smooth, the corners slightly rounded. Banded silt, the cream-coloured (beige), greenish-grey and violet-grey layers of which are at an angle to all its faces. L 70; CS 9-13 × 10-14.

750 Flat artefact of rectangular cross-section, missing one end and one side. The hole (D 3) at one end can be used to reconstruct the original width of the artefact to 20 mm. One wider side is smoothed and slightly concave from grinding; the other side is uneven. Grey schist. Preserved L 60; CS 16 × 5.

752B Perfectly smoothed artefact with a cross-section that changes from square to trapezoidal, with slightly rounded edges. In one of the lengthwise cross-sections, the artefact swells considerably from the perforated end with the corroded remnant of a metal ring. Banded silt with greenish-grey and grey alternating with a violet and brown tint. L 59: CS 10-16 × 10-14.

768 Small, flat artefact of rectangular cross-section with smooth faces and rounded edges. It tapers from the end with a hole (D 3) as a result of grinding. Grey sericite quartzite to metasiltstone with a reddish-brown tint. L 71; CS 10-11 × 4-5.

776 Artefact of mostly square cross-section with a hole (D 3-4) conically formed on both sides at one end, beginning to taper slightly at approximately one-third of its length toward the opposite rounded end, part of which is broken off. The fact that the perforated end has a slightly trapezoidal cross-section probably does not result from grinding. The faces are smoothed, the edges rather sharp, and one edge is partially ground. A fragment of a bronze ring has been preserved. Grey quartz schist. L 87; CS 13 × 13.

777 Artefact of square cross-section at the end, which is notched. At approximately its midpoint, the two opposite faces both 'descend' toward the opposite end to the final 'edge', i.e. to a point when viewed from the 'side'. The surface of this (functional) part is smooth, that at the notched end is rougher. The decorative notches form the letter H on each side (when the artefact is viewed in the vertical position). A groove runs lengthwise down the middle of one side. Grey schist with a reddish-brown tint. L 65.5; max. CS 8 × 7.

795 Flat artefact of rectangular cross-section widening slightly from the end with a conically expanding hole (D 2). Although the opposite end is probably broken off, the beginning of the terminal has been preserved. One wider side is straight and perfectly smoothed, the other is uneven (unclear whether this was its original condition). The sides are smoothed, the edges rounded. Grey schist with thin quartz veins. Preserved L 66; CS 17-18 × 5-6.

804A Originally a nearly regular artefact of rectangular cross-section with a conical hole (D 2-3) at one end; one side has concave wave resulting from grinding. Smoothed faces partially covered with dirt/patina (from soil?). Edges are neither sharp nor rounded. Light brownish-grey to bluish grey fine-grained sericite quartzite. L 121; CS 15-17 × 12.

823 Artefact of square cross-section with perfectly smoothed and straight faces, and rounded edges expanding from the perforated end, filled with corroded metal, to the opposite end that is bevelled precisely in the direction of the stone's foliation. Banded silt with alternating greyish-brown and greyish-beige. L 45; CS 11-12 × 9-12.

831 Flat, smooth artefact, both sides of which are rounded. The end with a hole (D 2.5) is rounded. Grey sericite quartzite. L 65; CS 12 × 5-7 ('widens' from the perforated end).

913 Regular artefact of square cross-section, with smoothed faces and rounded edges, having a hole (D 3-5) at one end. Glued from two parts. Crosswise cracks probably indicate was in fire (cremation burial). Banded silt alternating grey and beige-grey tones. L 37.5; CS 13 × 13.

949 Artefact of square cross-section with sharp edges expanding from the perforated end, filled with corroded metal, to the opposite end. Faces are slightly convex and perfectly smoothed. The fine-grained banded

silt features alternating brownish-grey and greenish-grey colour. L 75; CS 12.5-15.5 × 11-16.5.

950 Three-sided artefact with straight and smoothed walls having one rounded edge, expands from the perforated end filled with a corroded wire remnant. Banded silt with greenish-grey colour alternating with various shades of grey. L 60; additional dimensions can be given as 15 × 14.5.

955 Fragment of an artefact of rectangular cross-section, with straight and perfectly smoothed faces and rounded edges. It expands from the perforated end, filled with corroded metal, toward the opposite (missing) end. Fine-grained banded silt with alternating greyish-violet and greenish-grey. Preserved L 77; CS 12-17 × 11-13.5.

964 Smoothed artefact of rectangular cross-section, with rounded edges widening from the end with a hole (D 2.5), which is bevelled, toward the opposite. It is split lengthwise, but complete. Grey fine-grained quartzite (?). L 42; CS 10-13.5 × 8.

973 Perfectly smoothed cubiform artefact of rectangular cross-section, without a hole. The faces slightly swell, and the edges are sharp. Rough traces of cutting on the wider end. The banded silt combines a greenish-grey colour with various shades of grey. L 42; CS 21-23 × 21-23.

991A Artefact of irregular pentagonal cross-section with rounded edges, straight faces which are perfectly smoothed and a hole at the narrower end. The banded silt alternates between greenish-grey and dark grey. L 43; max. height and width can be approximately established as 19 × 18.

1014 Roughly worked flat artefact with rounded sides and ends widening from the end with a hole toward the opposite end. Both surfaces are smooth yet bumpy. A remnant of an iron chain with a forging for the connection of a strap is preserved in the hole. Light brownish-grey sericite quartzite. L 72; CS 6-11 × 10-12.5.

1020 Flat artefact of rectangular cross-section widening from the end with a hole (D 2) with the remnant of a ring. All faces are smoothed, but slightly wavy from grinding. Rounded edges. Light grey schist with a darker secondary crust. L 98; CS 11-16 × 10-12.

1035 Artefact of trapezoidal cross-section tapering from the end with a hole (D 1.5) toward the partially chipped opposite end. The faces are smoothed yet slightly rough, the edges rounded. Dark grey schist (?). L 69; max. CS 8 × 8.

1035 Regularly shaped artefact of square cross-section with straight, smoothed faces and rounded edges, glued from two parts. The artefact widens from the perforated end filled with corroded wire. Brownish-grey banded silt with layers of different colours. L 86; CS 15-19 × 15-19.

1043 Smoothed artefact of rectangular cross-section. The hole (D 2) at one end is surrounded by crosswise notches, on one side face in the shape of a letter H (when viewed in the vertical position). The opposite end tapers as the result of grinding. Grey schist (?). L 89; CS 9 × 6.

1059 Fragment of a cubiform artefact with one preserved (rounded) end. One side is concave from grinding. Grey schist or fine-grained quartzite with a reddish-brown tint. Preserved L 54; CS 6 × 8.

1076 Regularly shaped artefact of slightly rectangular cross-section widening from the end with a hole (D 2-3) filled with corroded metal. The surface of all straight faces is smooth but not polished; the edges are quite sharp. The banded silt has alternating layers of greenish-grey and grey, with shades of violet and beige. L 69; CS 12-16 × 11-12.

1082 Perfectly smoothed artefact of square cross-section with sharp edges tapering toward the end where a hole had been started. The resulting depression is 2.5 mm deep on one side, whereas that on the other is c. 0.5 mm deep. This end has bevelled edges. Grey schist. L 116.5; CS 9-12 × 9-12.

Results of chemical microanalyses of the touchstones from selected burials at Birka: documentation

Due to the number of the streaks, it was already necessary to make a selection in the analysis phase. The chemical composition of the traces of metal detected at different locations was often identical or differed to such a minor extent that, considering the likelihood of the low homogeneity of the metals that left traces on the stone artefacts, the streaks could have been produced by objects with the same chemical composition. The tables below therefore present only a selection of the observed streaks to illustrate their variety, albeit negligible in many cases. Cases in which numerous streaks of the same or of a highly similar metal were recorded are marked with an asterisk in the first column. Nevertheless, certain similar or even identical data remain, and the author apologises for this situation. Quantifications are accompanied in our database by spectra and by photographs recorded at the same (analytical) time, from which a radical selection has had to be made for the purposes of this publication.

In the case of the touchstone from grave 605B, analyses nos. 7 and 8 contain uncertainties: cadmium and cobalt, the presence of which is probably documented by the spectra (Fig. 47: C 5 and D 1), were not quantified during the SEM analysis phase of the research and were only identified subsequently (see pp. 110-111). The measured values of other elements in these analyses do not therefore correspond to reality (as listed with question marks).

Table 12 (following pages). Results of chemical microanalyses of traces of metal on the surface of selected stone artefacts from burials at Birka, Sweden. The first column: above, burial number (in bold); below, analysis numbers (each analysis number belongs to another streak). The semi-quantitative data given in weight percent (wt.%) are calculated at 100 %. Elements present in concentrations below 1 % are marked by +. The geochemical background, i.e. elements deriving from the raw material of the stone, is excluded. For complete results of selected analyses, see Fig. 47.

47	Ag	Cl	Cu	Pb	Zn	Fig.
1		35	65			
2					100	47: A 1
3			5	95		
4	80	19	1			
5		1	99			
6			5	95		
7	93	4	3			

56	Ag	Au	Cl	Cu	Hg	I	Pb	S	Sn	Fig.
1 *	86		1					13		
2 *				27			73			
3	85		7					8		46: A a
4				8			92			
5	67		1	2	17	7		6		46: A b; 47: A 2
6				5			95			46: A c
7			15	75			10			
8	89		7	2				2		
9	66		9	8				17		
10	9	77		14						46: A d; 47: A 3
11			2	3				1	94	
12				3			97			46: A e
13			3	10			14		73	
14	84		5	4				7		

60	Cl	Cu	Pb	S	Sn	Zn	Fig.
1		2		1	97		
2		1	47		51	1	46: A f
3	12	86		2			
4		2	98				
5		2	29		67	2	

81 a	Ag	Au	Cl	Cu	Pb	S	Sn
1	4	86		10			
2					29		71
3	84		2	3		11	
4			+				100
5	92		3			5	

86 b	Ag	Cl	Cu	I	Pb	S	Zn	Fig.
1	71	4	4	16		5		47: A 4
2			3		97			
3							100	47: A 5
4	70	3	3	16		8		46: B a

145	Ag	Cl	Cu	I	Pb	S	Fig.
1			7		93		
2					100		
3	10	6	70			14	
4		5	49		46		
5	80			9		11	47: A 6

220	Ag	Cl	Cu	I	Pb	S	Sn	Zn	Fig.
1					100				
2		3						97	46: B b; 47: B 2
3	53		17	20		10			46: B c; 47: B 1
4		15			74		11		

376A	Ag	Cl	Cu	I	Pb	S	Sb	Sn	Fig.
1					100				
2	91	+	2			7			
3						25	75		46: B d; 47: B 4
4		1	46	50		3			47: B 3
5			4		96				
6			17			+		83	
7						27	73		

414	Cl	Cu	S	Sn
1	2	3	2	93
2	2	84	14	

432	Cl	Cu	Pb	Sn
1	10		43	47
2		3	12	85

475	Fe	Pb	Sn
1		43	57
2	100		

495	Ag	Au	Cl	Cu	I	Pb	S	Fig.
1				97			3	46: B e
2 *	14	60	+	26				46: B e
3						100		46: B e
4 *	85		9		2		4	
5	76		1	1	9		13	
6 *	80		6	3			11	
7	39	28		33				47: B 5
8 *	76		6	6	5		7	46: B f
9	82		4	3	6		5	

496	Ag	Au	Cl	Cu	I	S	Sn	Fig.
1	86		5	3	5	1		47: B 6
2	81		5	3	6	4	1	
3	6	78		16				
4	100							

524 banded silt with ring	Ag	Cu	Cl	I	Pb	S	Fig.
1 *	88	5	1			6	
2					100		
3	85		+	7		8	47: C 1
4	89		9			2	
5 *	91		7			2	

524 (long) metasiltstone	Ag	Cu	Cl	Fe	S	Sn
1	81	8	2		9	
2	85		2		13	
3					2	98
4				100		

557	Ag	Cl	Cu	I	Pb	S	Sn
1		1					99
2	78	11		7		4	
3	79	7		4		10	
4					100		
5	84	9	2			5	
6	86	14					

561	Ag	Cl	Cu	Pb	S	Zn	Fig.
1			32	57		11	
2	84	2	3		11		
3			75			25	
4			83	17			
5			98		2		
6		10		90			
7	80	9	3		8		
8			30	20		50	47: C 2
9			12	88			

573	Ag	Cl	Cu	Pb	S	Sn	Zn	Fig.
1 *				100				
2			91			9		
3			19	65		16		46: C a
4			5	95				
5		10	88		2			
6				100				
7		2					98	47: C 3
8			49	51				
9	93	+	6		1			
10	94	1	4		1			

605B	Ag	Cd	Cl	Co	Cu	Fe	I	Ni	Pb	S	Zn	Fig.
1	93		5							2		
2			4		81					3	12	
3	95		1							4		
4								100				46: C b; 47: C 6
5	2		2		56				40			46: C c; 47: C 4
6			11						89			
7		?				85/?		15/?				46: C d; 47: C 5
8		?		?				100/?				46: C e; 47: D 1
9	87		5							8		
10						83		17				46: C f
11	13		4		21					33	29	
12	91		9									
13	85		5		3		2			5		
14	86		4		1		2			7		46: D a
15	92		+							8		46: D b

624	Au	Cl	Cu	Pb	Sn	Zn	Fig.
1	4	1	15	10	67	3	
2	44		17		39		46: D c; 47: D 2
3				100			
4	23	+	14		61	2	

660	Ag	Au	Cl	Cu	Ni	Pb	S	Zn	Fig.
1		77			18			5	46: D d; 47: D 3
2 *	91		7				2		
3				7		93			
4				4		96			
5			9	70		21			
6 *	89		11						

667	Ag	Au	Cu	Pb	Sn
1	6	79	15		
2				10	90

674	Ag	Au	Cl	Cu	S	Fig.
1	93		1		6	46: D e
2	3	79		18		

708	Ag	Au	Cl	Cu	S	Sn	Fig.
1	13	75		12			
2				3		97	46: E a
3	88		2		10		
4				19		81	
5	84		2	2	12		
6	86		7		7		46: D f

711A	Ag	Cl	Cu	Pb	Sn
1	8	4	3	79	6
2				100	

715	Ag	Au	Cl	Cu	Fe	Pb	S	Sn
1			1	97			2	
2				9		91		
3								100
4					100			
5				91				9
6								100
7		99	1					
8	86		10				4	

750 banded silt	Ag	Au	Cl	Cu	Pb	S
1 *	79		11	3		7
2	2	98				
3 *					100	
4	85		15			

750 grey	Ag	Cl	Cu	Ni	Pb	S	Sn	Zn
1			99			1		
2							100	
3		2	98					
4	95		5					
5			3		47		50	
6		1	65	12				23
7			100					

752B	Ag	Cl	Cu	Pb	Sn	Zn
1			62		5	33
2	89	11				
3				100		

768	Pb
1	100

776	Ag	Au	Cl	Cu	Pb	S
1			1	98		1
2		100				
3			1	99		
4					100	
5	16	84				
6				23	77	
7				1	99	
8	88					12
9	8	78		14		
10				96		4

777	Ag	Cl	Cu	Pb	S	Sn
1				100		
2		1	3	8		88
3	91	1			8	
4	87	8			5	
5		1	3	10		86
6		1	2	10		87
7				100		

795	Ag	Au	Cl	Cu	I	Pb	S
1				14		86	
2			22	76			2
3		95		5			
4		99	1				
5			26	72			2
6	6		10	68		16	
7	37			14	15	34	
8	86		12				2
9	56		3	6	19		16
10	75		8		10		7

804A	Ag	Cl	S	Sn
1	88	9	3	
2				100

823	Ag	Cl	Cu	Pb	S	Sn
1			68	32		
2			13	14		73
3	7	13	70	10		
4			95	5		
5		6	22	72		
6			97		3	
7		1	7	2	1	89

831	Ag	Cl	Cu	I	S	Fig.
1	69		3	21	7	47: D 4
2	85			3	12	46: E b
3	94	6				
4	86	1	2		11	

913	Cl	Cu	Pb	S	Sn
1	13	86		1	
2	2	15	8		75
3		85		15	
4		86		14	
5	14	77		9	
6 *	3	9	26		62
7 *		11	58		31
8			100		

949	Ag	Cl	Cu	Pb	S	Sn	Zn	Fig.
1			9	91				
2	88	6			6			
3		1			1	98		
4				100				
5		3	71	17			9	
6		1	76			2	21	46: E c

950	Ag	Cl	Cu	Pb	S	Sn
1 *	92	3	4		1	
2			8			92
3 *			12	88		
4	90	7			3	

955	Cl	Cu	Pb	S	Sn	Fig.
1 *			100			
2 *					100	46: E d
3			100			
4				2	98	
5					100	
6					100	
7			100			
8			100			
9	8	42	50			
10	2			7	91	

964	Cl	Cu	Pb	S	Sn
1		8	33		59
2	11	89			
3		5	95		
4		10	30		60
5	+	99		1	
6			100		

973	Au	Cl	Cu	Fe	Pb	S	Sb	Sn	Fig.
1			44		56				
2 *			10		90				
3 *						28	72		46: E e; 47: D 5
4						26	74		47: D 6
5				100					
6		1				1		98	
7	100								

991A	Ag	Au	Cl	Cu	Pb	S	Fig.
1 *				5	95		
2	87		9			4	
3 *					100		
4				8	92		
5				3	97		
6				2	98		
7		98		2			46: E f

1014	Cl	Cu	Pb	S	Sn	Zn
1			100			
2			6		90	4
3	1			1	94	4
4		32		1	67	
5			100			
6		2	19		73	6
7	1			1	98	

This touchstone is deposited among the finds from the grave 1016 at the Swedish History Museum, Stockholm.

1020	Cl	Sn
1	3	97

1035 banded silt, with ring	Ag	Au	Cl	Cu	I	Pb	S	Sn
1							1	99
2				100				
3	72		1	7	3		17	
4						100		
5	5	85		10				

1035 grey	Cl	Cu	Pb	S
1		21	79	
2	1		99	
3		70		30

1043	Pb
1	100

1059	Cl	Cu	Pb	Zn
1	1	5	94	
2		16	78	6
3		2	98	

1076	Ag	Cl	Cu	Pb	S	Sn
1			8	92		
2	89	8			3	
3		14	81	5		
4		1	81	12		6
5			5	95		
6		18	69	13		
7					1	99
8	91	8			1	
9	87	13				

1082	Au	Cl	Cu	Pb	S	Sn	Zn
1			3	97			
2					2	98	
3 *	97	3					
4		1	69		1		29
5	99	1					

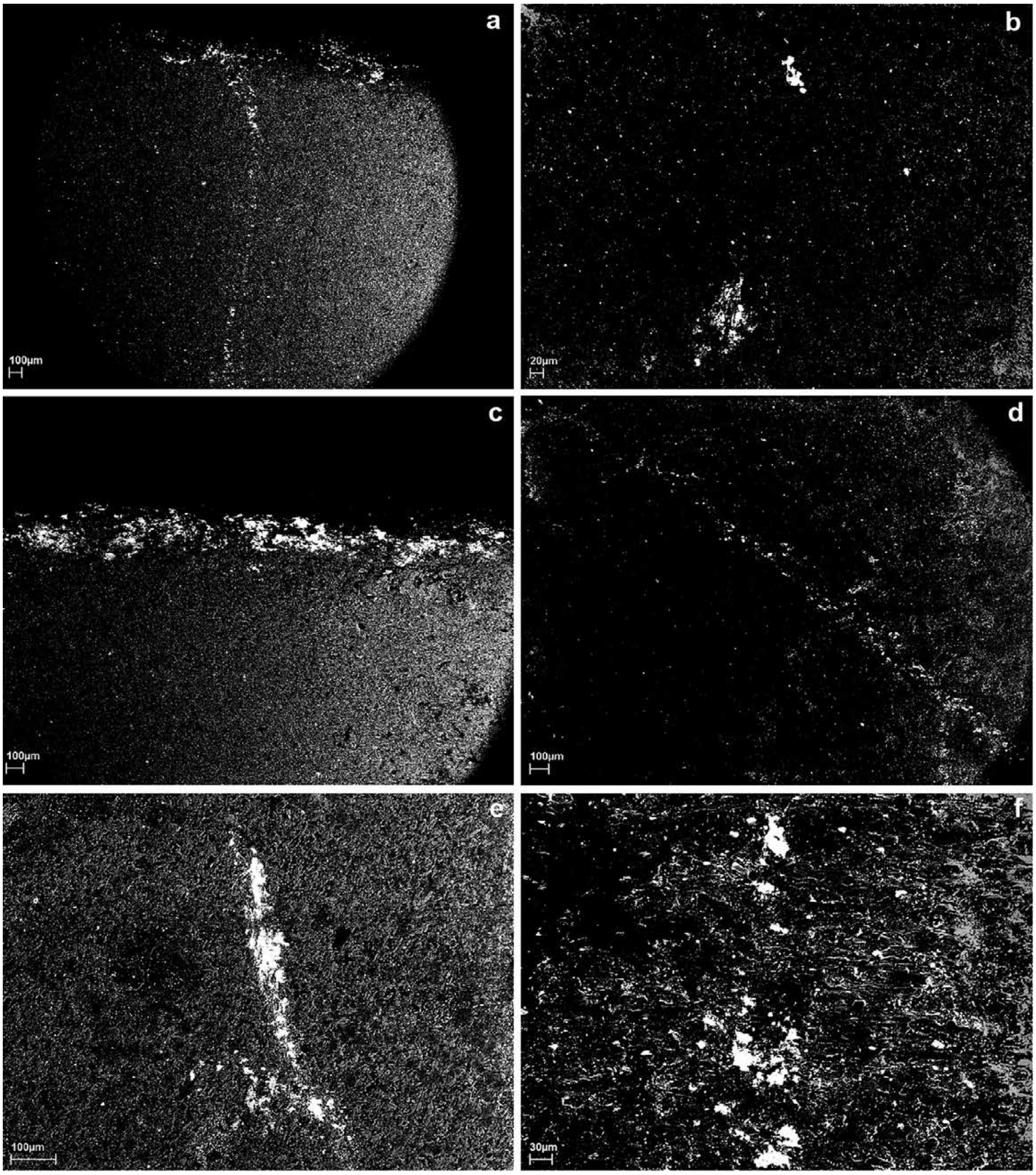

Fig. 46 A. Selected microphotographs of metal traces preserved on touchstones from Birka burials (photos: G. Wife); for the results of chemical microanalyses, see Table 12. **a** *grave 56 (analysis no. 3), silver;* **b** *grave 56 (no. 5), silver with a content of copper, mercury and accompanied by iodine;* **c** *grave 56 (no. 6), lead with a content of copper;* **d** *grave 56 (no. 10), gold with a content of copper and silver;* **e** *grave 56 (no. 12), lead;* **f** *grave 60 (no. 2), a metal composed of tin and lead.*

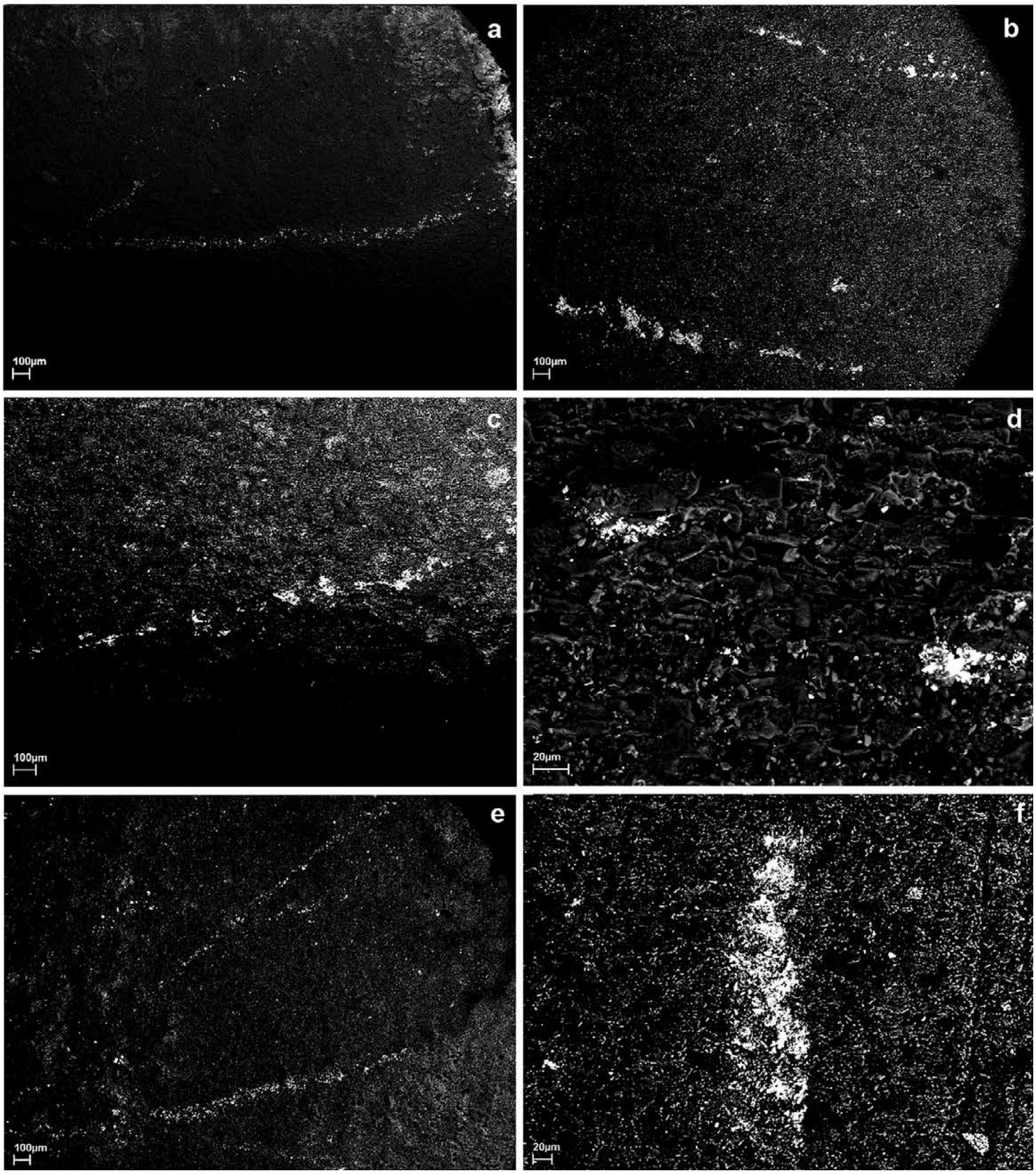

Fig. 46 B. Selected microphotographs of metal traces preserved on touchstones from Birka burials (photos: G. Wife); for the results of chemical microanalyses, see Table 12. **a** *grave 86 b (analysis no. 4), silver with a content of copper and accompanied by iodine;* **b** *grave 220 (no. 2), zinc;* **c** *grave 220 (no. 3), silver with a content of copper and accompanied by iodine;* **d** *grave 376A (no. 3), Sb_2S_3 (antimonite?);* **e** *grave 495, top (no. 1), copper; centre (no. 3), lead; bottom (no. 2), a metal composed of gold, copper and silver;* **f** *grave 561 (no. 8), a metal composed of zinc (50 %), copper (30 %) and lead (20 %).*

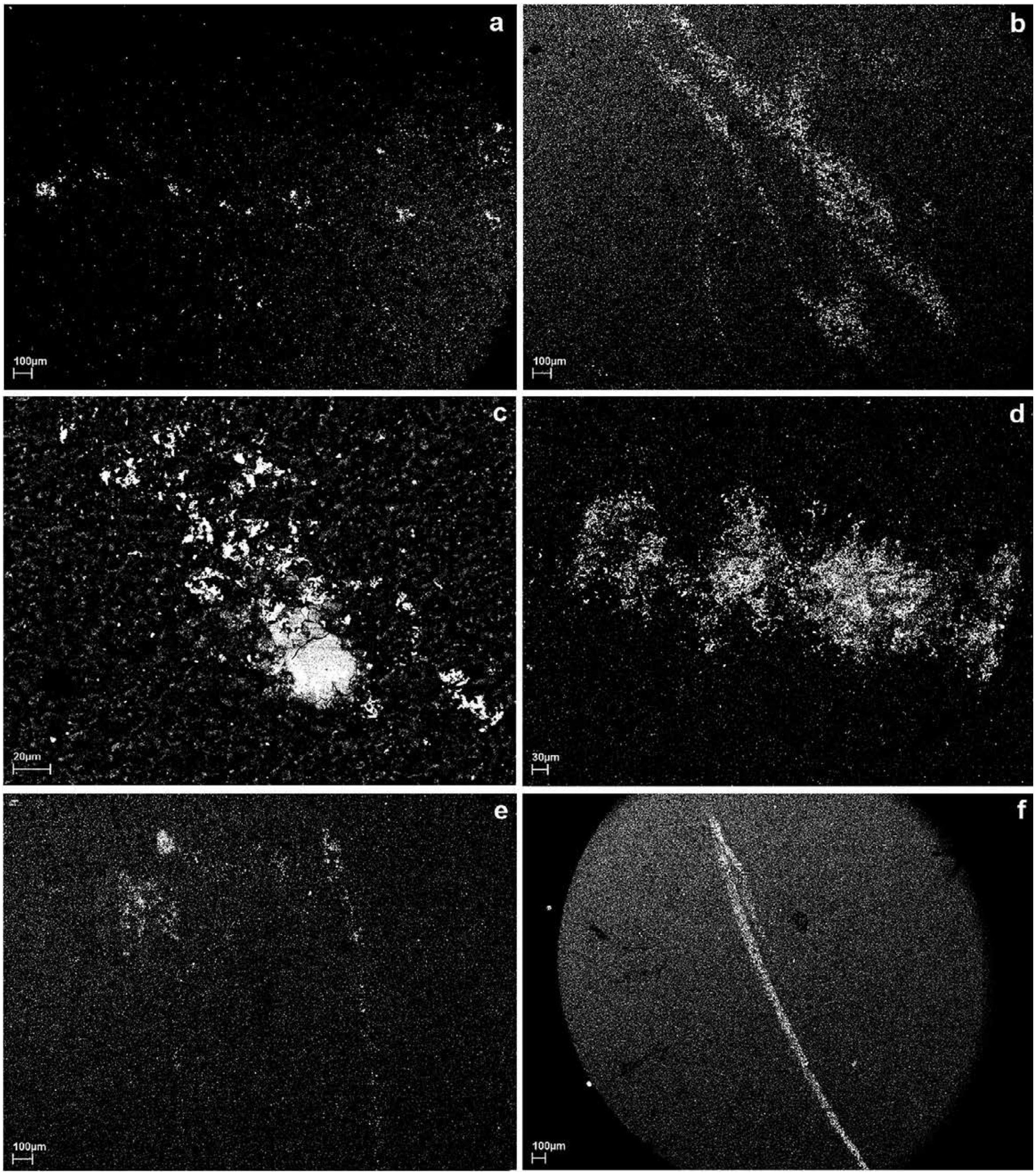

Fig. 46 C. Selected microphotographs of metal traces preserved on touchstones from Birka burials (photos: G. Wife); for the results of chemical microanalyses, see Table 12. **a** *grave 573 (analysis no. 3), a metal composed of lead, copper and tin;* **b** *grave 605B (no. 4), nickel;* **c** *burial 605B (no. 5), a metal composed of copper and lead, with small amount of silver, and probably also cadmium;* **d** *grave 605B (no. 7), iron with a content of nickel;* **e** *grave 605B (no. 8), nickel – with a content of cobalt? and cadmium?;* **f** *grave 605B (no. 10), iron with a content of nickel.*

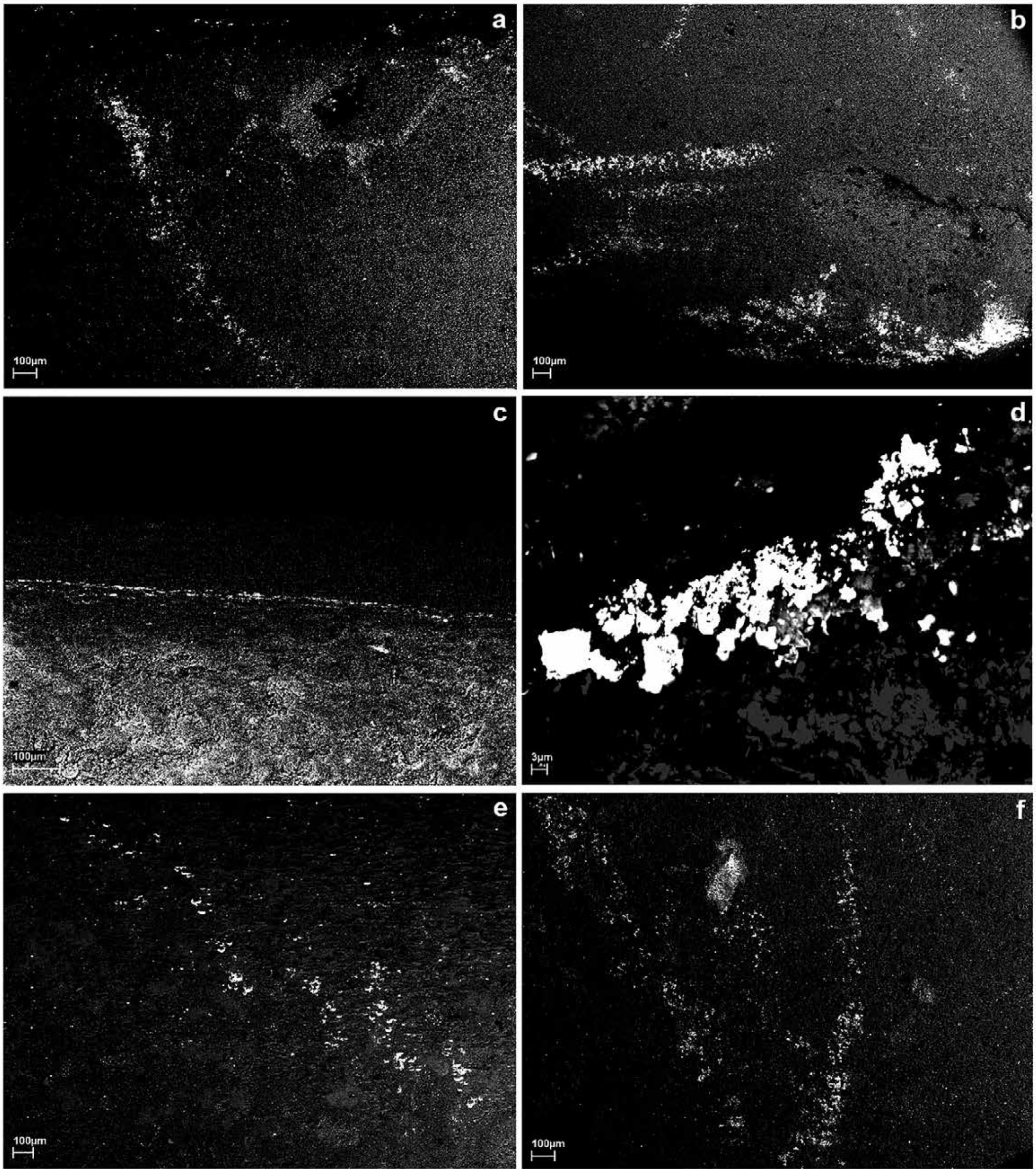

Fig. 46 D. Selected microphotographs of metal traces preserved on touchstones from Birka burials (photos: G. Wife); for the results of chemical microanalyses, see Table 12. **a** *grave 605B (analysis no. 14), silver with a content copper and accompanied by iodine;* **b** *grave 605B (no. 15), silver;* **c** *grave 624 (no. 2), a metal composed of gold, tin and copper;* **d** *grave 660 (no. 1), gold with a content of nickel and zinc;* **e** *grave 674 (no. 1), silver;* **f** *grave 708 (no. 6), silver.*

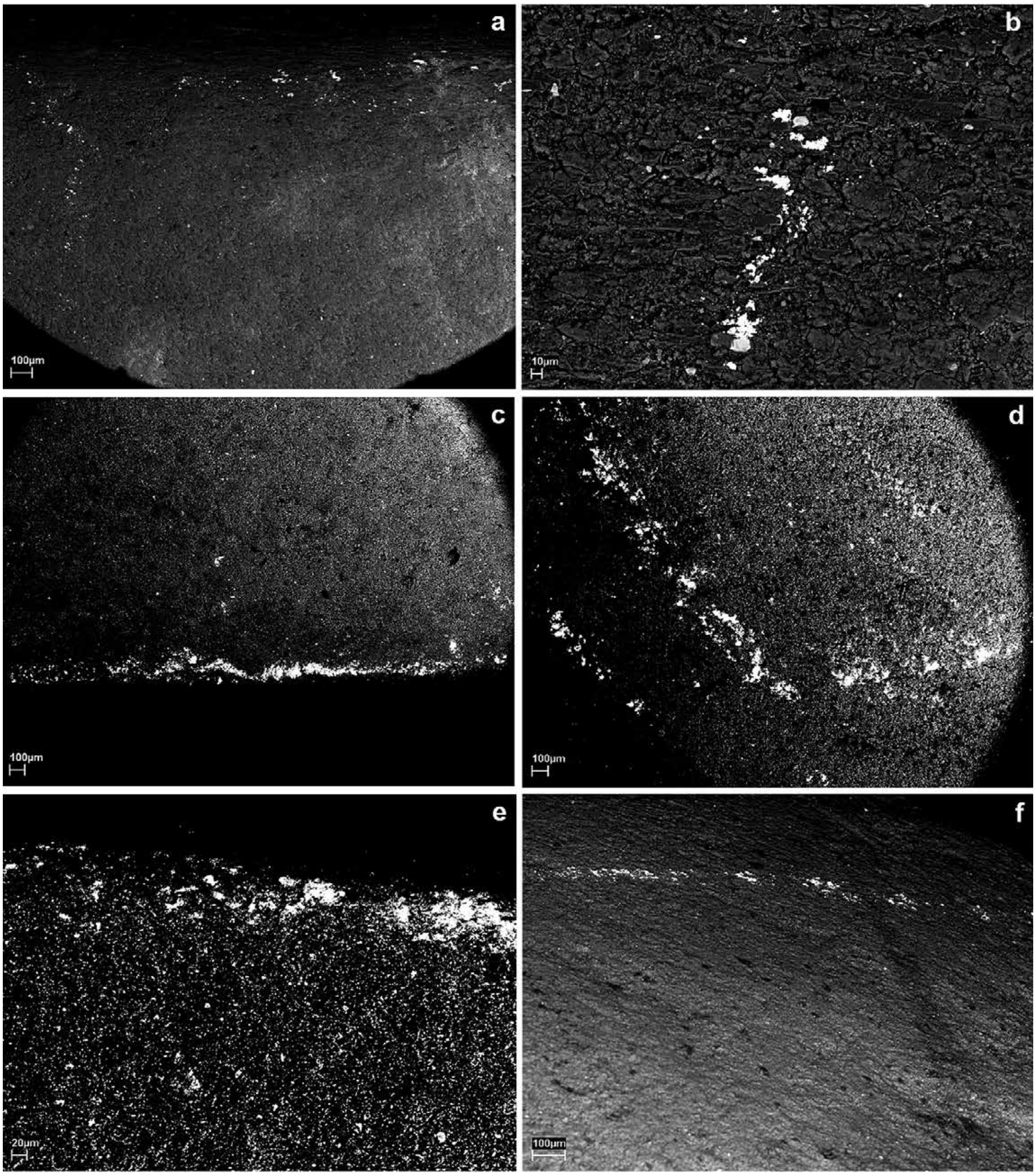

Fig. 46 E. Selected microphotographs of metal traces preserved on touchstones from Birka burials (photos: G. Wife); for the results of chemical microanalyses, see Table 12. **a** *grave 708 (analysis no. 2), tin with a content of copper;* **b** *grave 831 (no. 2), silver accompanied by iodine;* **c** *grave 949 (no. 6), brass;* **d** *grave 955 (no. 2), tin;* **e** *grave 973 (no. 3),* Sb_2S_3 *(probably antimonite);* **f** *grave 991A (no. 7), gold.*

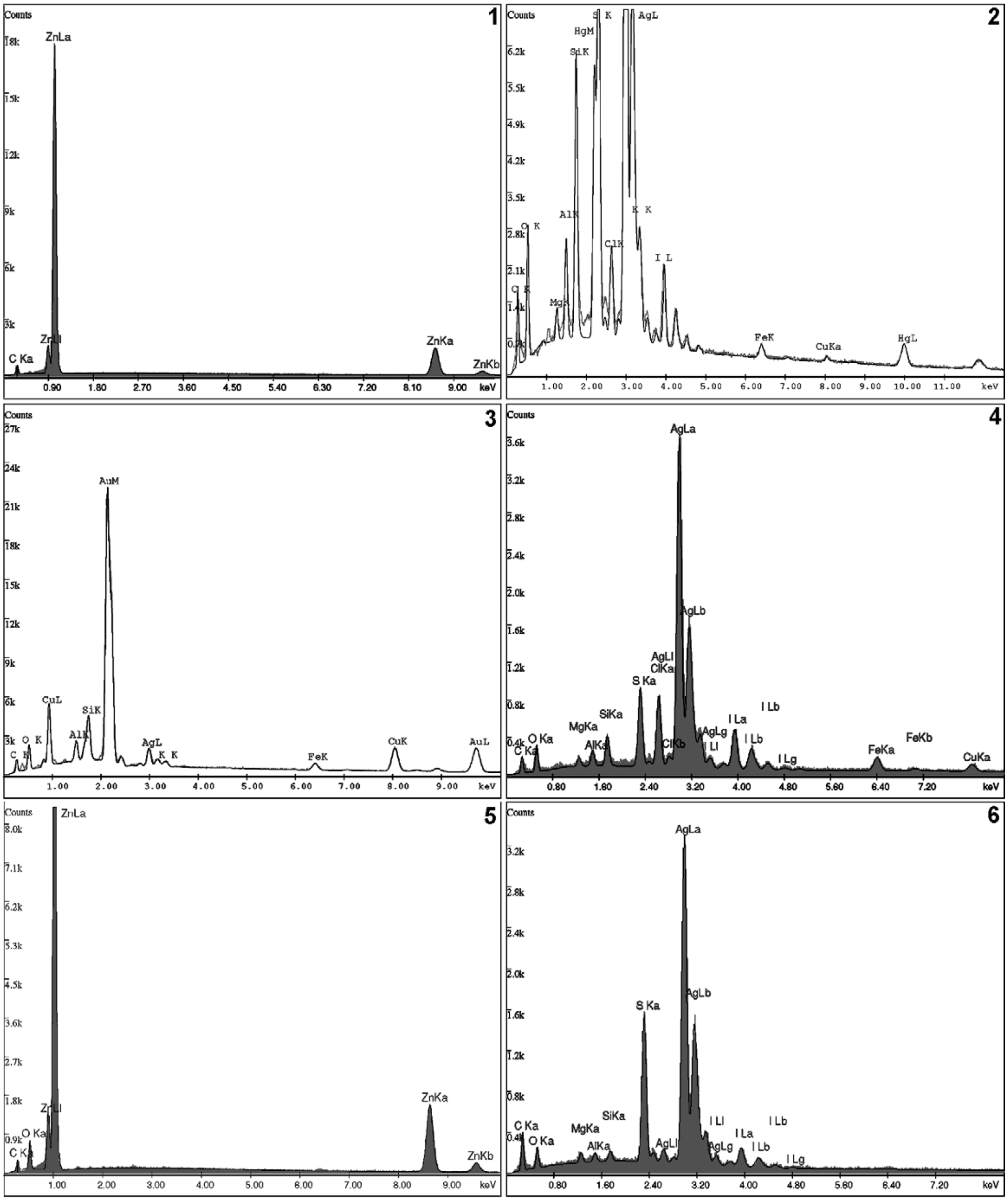

Fig. 47 A. Selected spectra of metal traces preserved on touchstones from Birka burials (see Table 12).
1 *grave 47 (analysis no. 2);* **2** *grave 56 (no. 5);* **3** *grave 56 (no. 10);* **4** *grave 86 b (no. 1);* **5** *grave 86 b (no. 3);*
6 *grave 145 (no. 5).*

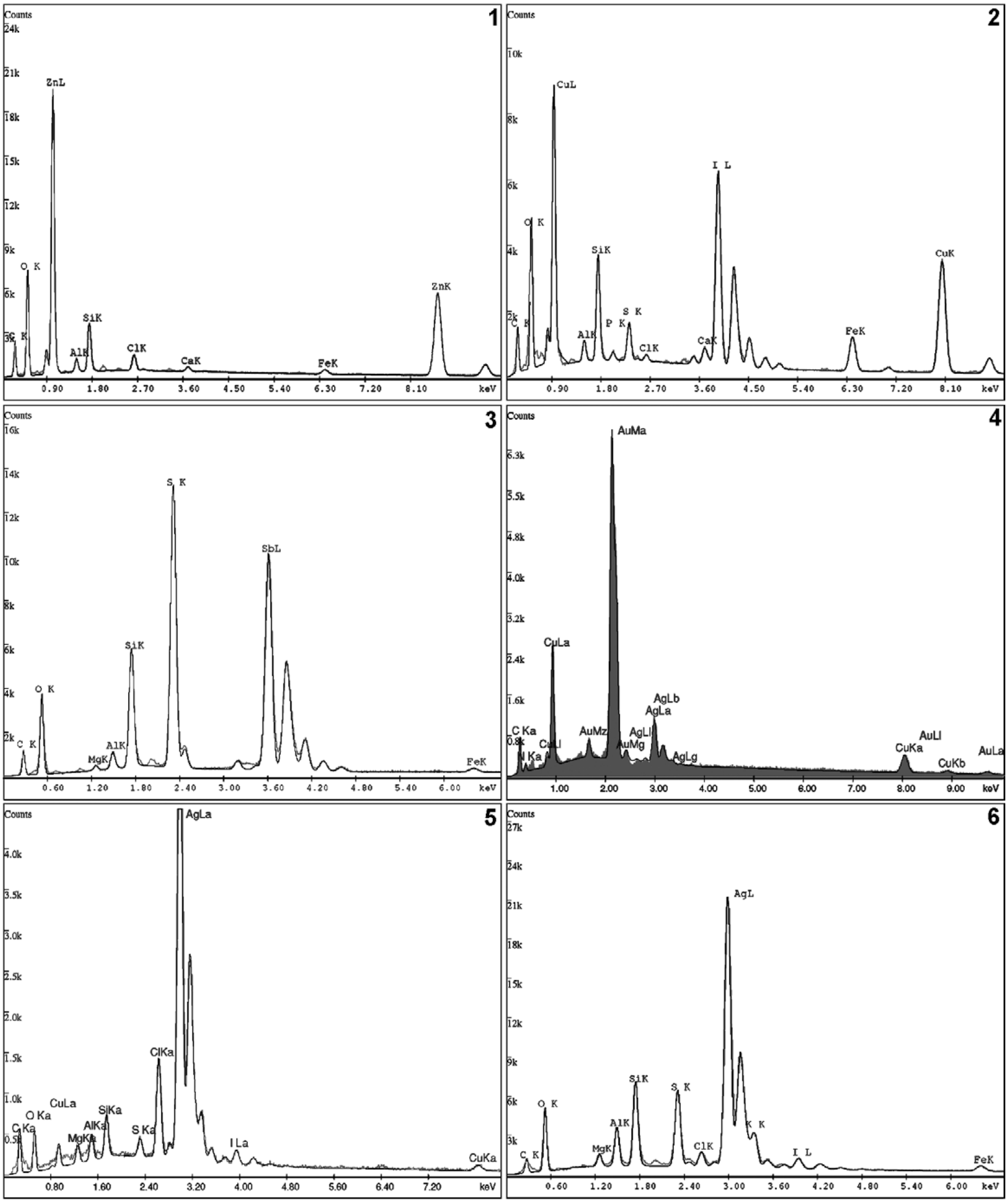

Fig. 47 B. Selected spectra of metal traces preserved on touchstones from Birka burials (see Table 12). **1** *grave 220 (analysis no. 3);* **2** *grave 220 (no. 2);* **3** *grave 376A (no. 4);* **4** *grave 376A (no. 3);* **5** *grave 495 (no. 7);* **6** *grave 496 (no. 1).*

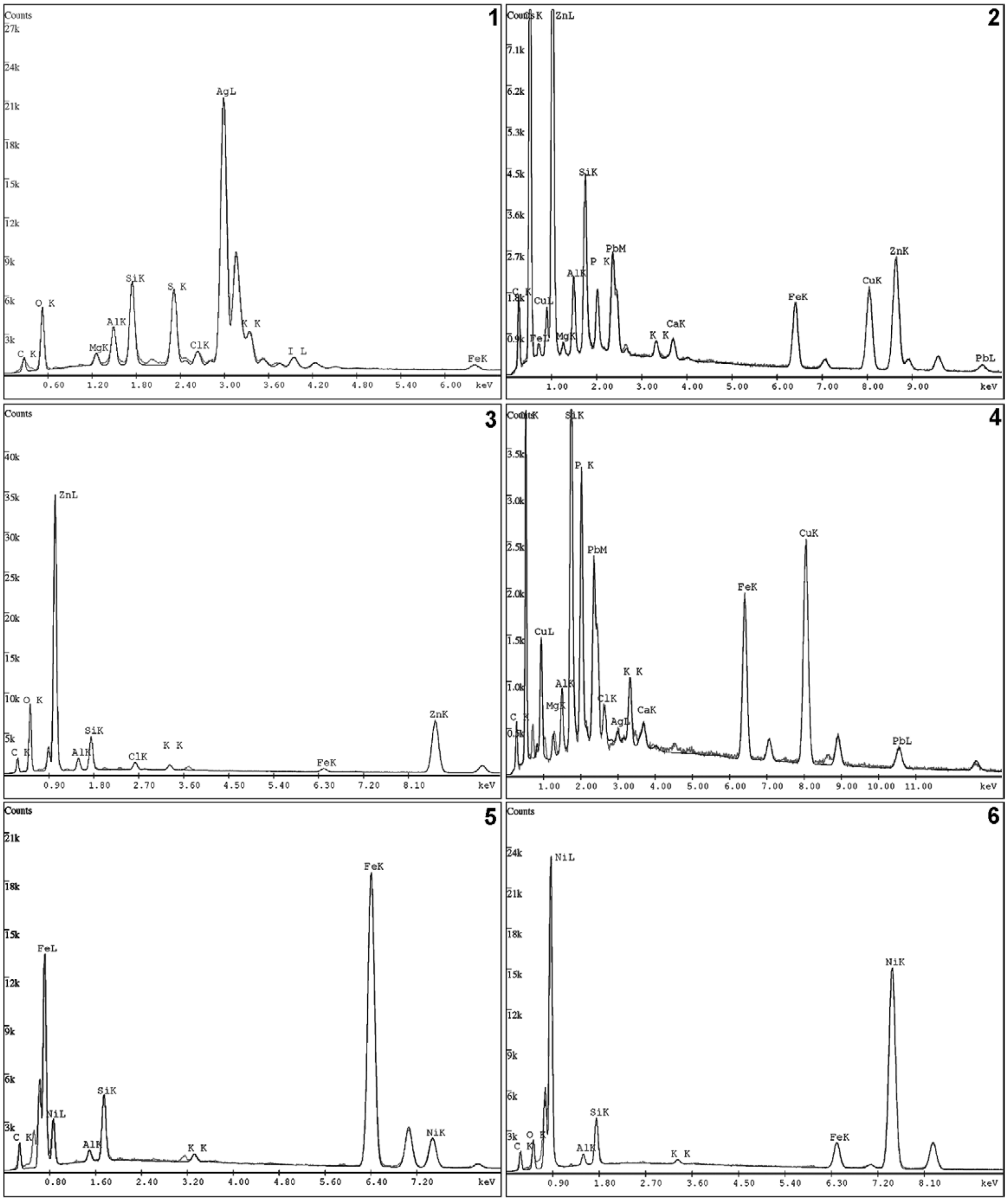

Fig. 47 C. Selected spectra of metal traces preserved on touchstones from Birka burials (see Table 12). **1** *grave 524 (shorter specimen; analysis no. 3);* **2** *grave 561 (no. 8);* **3** *grave 573 (no. 7);* **4** *grave 605B (no. 5);* **5** *grave 605B (no. 7);* **6** *grave 605B (no. 4).*

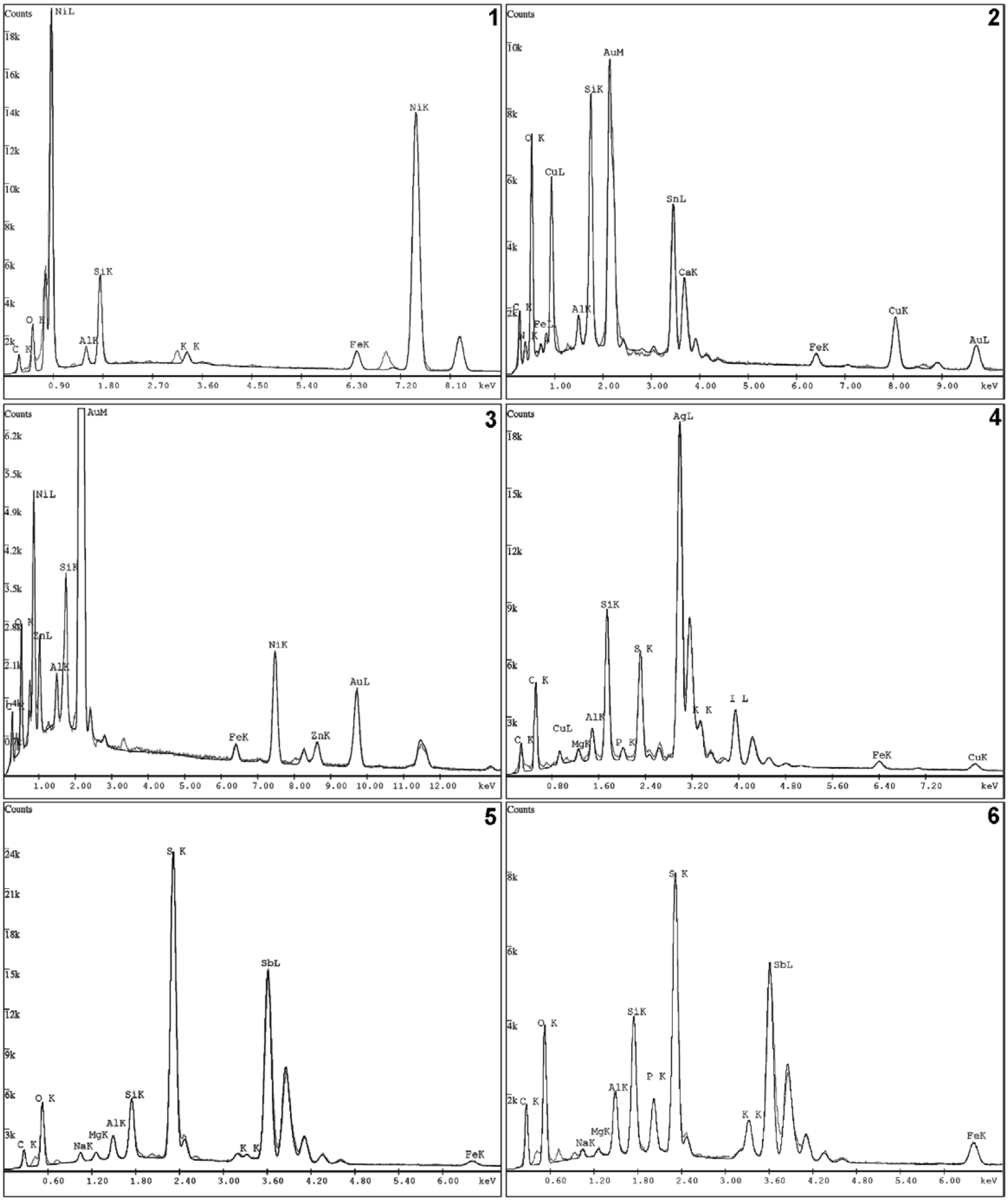

Fig. 47 D. Selected spectra of metal traces preserved on touchstones from Birka burials (see Table 12). **1** *grave 605B (analysis no. 8);* **2** *grave 624 (no. 2);* **3** *grave 660 (no. 1);* **4** *grave 831 (no. 1);* **5** *grave 973 (no. 3);* **6** *grave 973 (no. 4).*

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Compiled by *Denis Hakszer*

ARCHAEOLOGY OF TOUCHSTONES

Did ancient Europeans truly believe in an active after-life, as modern Europeans would like to think they did? What purpose did grave-goods actually serve? Are archaeology and the historical sciences in general able to shed, once and for all, a curse placed upon them at their inception as research disciplines in the early nineteenth century? Searching for answers to these questions is the aim of this book which has been written on the basis of widely spread, typical components of grave-goods. For the last two centuries, they have been interpreted incorrectly, because of being aligned with archaeologists' ideas about the spiritual world of the society in question.

The book introduces a recently discovered phenomenon that accompanied mankind from his discovery of the uses of metal all the way through to the Middle Ages – that is the importance of touchstones, tools used to determine the nature and test the value of non-ferrous metals. Of the hundreds of thousands of such finds, which have most often been regarded as 'whetstones', the author has made a selection of specimens that cast light on the role of touchstones in the culture of ancient societies, especially in the burial ritual.

Forming a key part of the book are the results of chemical microanalyses of metal streaks on the touchstones, a hitherto unused source of information for the skills of ancient metallurgists. Streaks of precious metal are not as important today as the common streaks of lead, tin, brass, etc.; streaks of metals composed of zinc, nickel, mercury, etc., raise new questions. Viking Age Birka serves as a fine example. It has yielded the largest known assemblage of touchstones and also boasts the largest number of such finds to have been analysed in the scanning electron microscope. However, this site has counterparts in Mesopotamia and the Near East, in the ancient Mediterranean region, in the Cimmerian and Scythian environments, in Europe of the Bronze Age, Iron Age, Roman and Migration periods, and, in particular, in the northern part of Europe during the Early Middle Ages – anywhere trade was not dominated by coins minted by local authorities. The four-millennium continuity of the essentially unified spiritual life shared by a large part of the Old World came to an end with the onset of Christianity in Europe.

This book is intended for archaeologists, anthropologists, historians, ethnologists, archaeometallurgists, and for everybody who wishes to marvel at the consistent symbolic behaviour of ancient societies of the Old World from between, at the least, Mesopotamia, the Altai Mountains and Iceland, despite their cultural, ethnic and religious differences.

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