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NON-DESTRUCTIVE EXAMINATION OF SPEARHEADS FROM THE CEMETERY IN KOŃSKIE, THE KOŃSKIE DISTRICT

The research project of non-destructive examination of spearheads from the cemetery in Końskie is based on results of former metallographical research of spearheads found in the territories of Poland, the Czech Republic, Slovakia, the Baltic Republics, Belarus, Ukraine and Russia. The main goal of the project was to test the possibility of non-destructive analysis of early medieval spearheads. By using these kinds of methods we can receive new data and do no damage to the artefacts. The first stage of the project was the macroscopic examination of the surfaces of the artefacts. The second stage involved X-ray photos of the artefacts. During the project we examined 7 out of 12 spearheads found during the excavations of the early medieval cemetery in Końskie. The artefacts were singled out for the examination taking into consideration three criteria. The first was the presence of remains of ornamentations. The second, also very important, was the condition of artefact. The third was the archaeological context, that is, the grave goods inventory to which a given spearhead belonged. The selected spearheads came from graves which were furnished with grave goods to a different degree.

The cemetery in Końskie was accidentally found in April 1925 during the ground works for the Main Steam Locomotive Workshop. At the beginning the archaeological excavations were conducted by Ludwik Sawicki. After a few weeks, at the end of April, L. Sawicki handed over the excavations to Roman Jakimowicz. The history of the collection of the artefacts gained during the expedition was very tumultuous. Since 1928 it was in the State Archaeological Museum in Warsaw. Then, during the German occupation of Poland 1939-1945, it was transferred to the Archaeological Museum in Poznań. There the artefacts, and of course many others, were used to barricade windows of the Museum when the German army was preparing for the defence of Poznań. Due to this, the finds were considerably mixed. Fortunately, thanks to the almost heroic work of J. Gąssowski, R. Jakimowicz and L. Sawicki, after the war the whole collection and documentation were put in order¹. Today the collection of artefacts from Końskie is kept in the State Archaeological Museum in Warsaw.

The cemetery was situated on the top of a low gravel hill, which had to be levelled because of the planned development. Thanks to this the whole site was excavated². 171 graves were found and documented altogether. Unfortunately, about 8 graves had been completely destroyed before archaeologists came to the site³. Based on the grave goods the cemetery was dated to between the mid-11th and the beginning of the 12th c.⁴ Spearheads were found in 9 male graves. Another 2 spearheads were in destroyed graves, but it is unknown whether they come from 2 different or only 1 grave.

As mentioned, the project consisted in macroscopic observations of the surface of the artefacts at small magnification and in making X-ray photos. The goal was to reveal differences of the construction of the spearheads. Comparing the results of our project with results of metallographic research of spearheads made in the past, it is possible to reveal a lot of information about the technology of production of this kind of weapons. Furthermore, it is not necessary to take large samples for metallographic examinations. The results of long-lasting studies of J. Piaskowski demonstrate that some spearheads found in Poland were forge-welded of several pieces of iron, which were carburised to a various degree. This technique was used to manufacture the spearheads found during the excavations of the cemetery in Lutomiersk in Graves 7, 9, 10, 16, 30, 55, 98, 106, and 133⁵ and the spearheads found at the cemetery in Buczek in Grave 2⁶. On the other hand, the spearheads from the cemetery in Lutomiersk from Grave 13, the cemetery in Buczek from Grave 6,⁷ the stronghold in Czerchów⁸,

² *Ibidem*, p. 99.

³ *Ibidem*, p. 157.

⁴ *Ibidem*, p. 168.

⁵ J. Piaskowski, *Metaloznawcze badania wyrobów żelaznych*, [in:] A. Nadolski, A. Abramowicz, T. Poklewski, *Cmentarzysko z XI wieku w Lutomiersku pod Łodzią*, Łódź 1959, pp. 118-120.

⁶ J. Piaskowski, *Metaloznawcze badania wczesnośredniowiecznych wyrobów żelaznych na przykładzie zabytków archeologicznych z Łęczycy, Czerchowa i Buczka*, „*Studia z dziejów górnictwa i hutnictwa*”, Vol. III, 1959, p. 92.

⁷ *Ibidem*, p. 92.

⁸ *Ibidem*, p. 67.

¹ J. Gąssowski, *Cmentarzysko w Końskich na tle zagadnienia południowej granicy Mazowsza we wczesnym średniowieczu*, „*Materiały Wczesnośredniowieczne*”, Vol. II, 1950, p. 99.

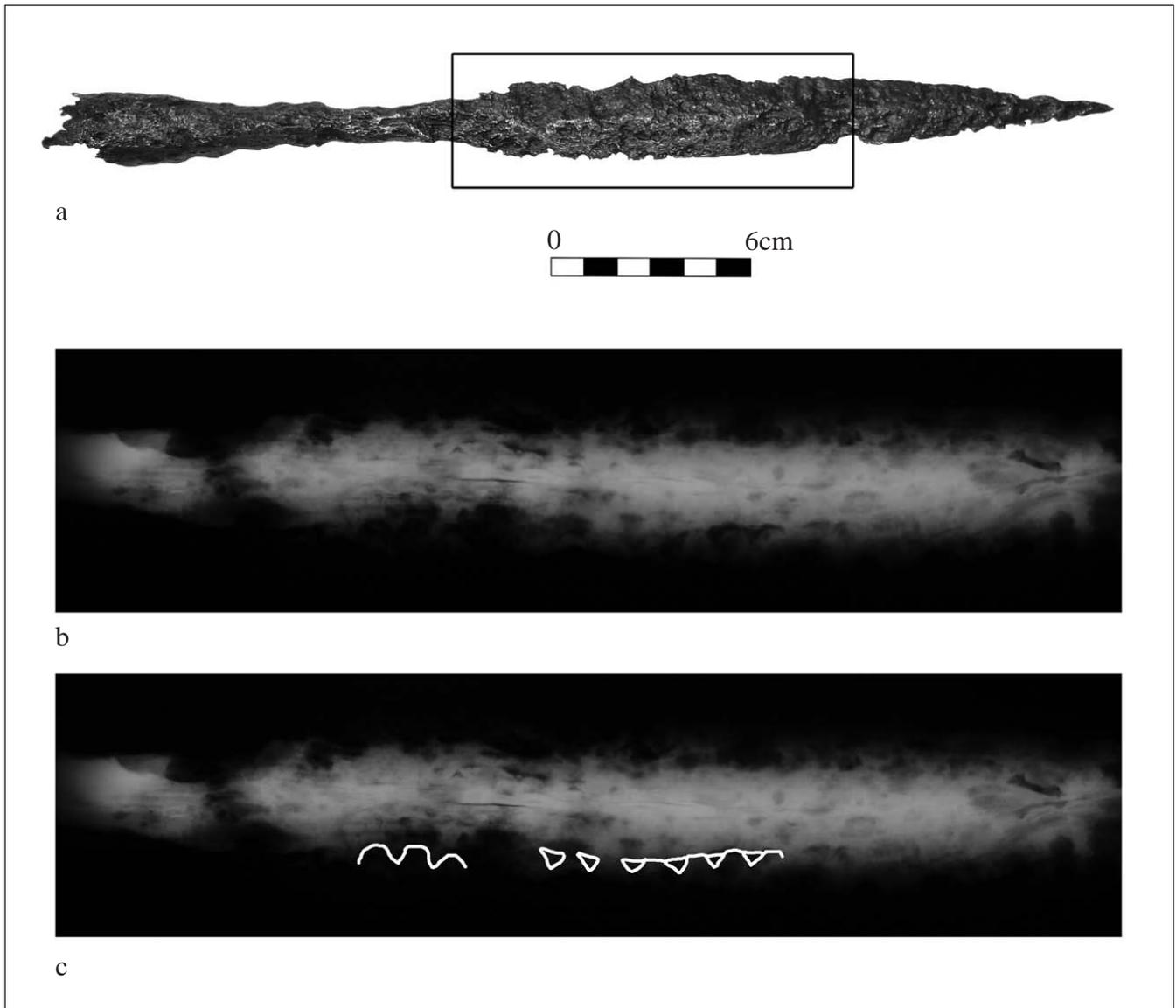


Fig. 1. Spearhead from Grave 45: a) photo of the spearhead, b) X-ray photo of the spearhead c) X-ray photo of the spearhead with marked signs of decoration. Photo: A.Sierosławski, W. Weker.

and from „Castle Hill” in Sieradz⁹, were made from one piece of iron and then surface-carburised. In the case of the first technique, inclusions originating during the welding process gathered in the places of welding. These traces are well visible on the X-ray photos. Disturbances of the crystal structure of metal also demonstrate that the forge-welding technique was applied. The results of research conducted by J. Piaskowski, R. Pleiner¹⁰, A. Anteins¹¹ and B. A. Kolčín¹² enabled us to identify techniques which were used

⁹ J. Piaskowski, *Metaloznawcze badania wczesnośredniowiecznych wyrobów żelaznych i żużla z Sieradza*, „Prace i Materiały Muzeum Archeologicznego i Etnograficznego w Łodzi: seria archeologiczna”, Vol. 7, 1962, p. 231.

¹⁰ R. Pleiner, *Iron in Archaeology. Early European Blacksmiths*, Praha 2006, p. 219.

¹¹ A. Anteins, *Damasskaâ stal*, Riga 1973, pp. 64 – 124.

¹² B. A. Kolčín, *Černaâ metallurgîâ i metalloobrabotka v drevnej Rusi*, Moskva 1953, pp. 139-140.

for manufacture of early medieval spearheads. Today we can identify the technique by using X-ray photos. Based on microhardness tests, we can establish which parts of the spearhead were made of harder (more carburised) iron, and which parts were made of softer iron. In addition, on the X-ray photo we can sometimes see the pattern which was created by blacksmiths during forge-welding of pieces of iron with different carbon content. With the use of these methods of analysis, we can examine a great number of artefacts doing them no harm, which is crucial for the preservation of the archaeological heritage.

7 spearheads, which were examined, were found in 6 different graves. The furnishings of these graves were diversified; however, all these graves can be ranked as richer ones. In Grave 45, apart from the spearhead, the following items were found: a temple ring made of bronze wire with an S-shaped loop, an iron knife in 2 pieces, a piece of leather and 2 pieces of wood. In Grave 52, apart from

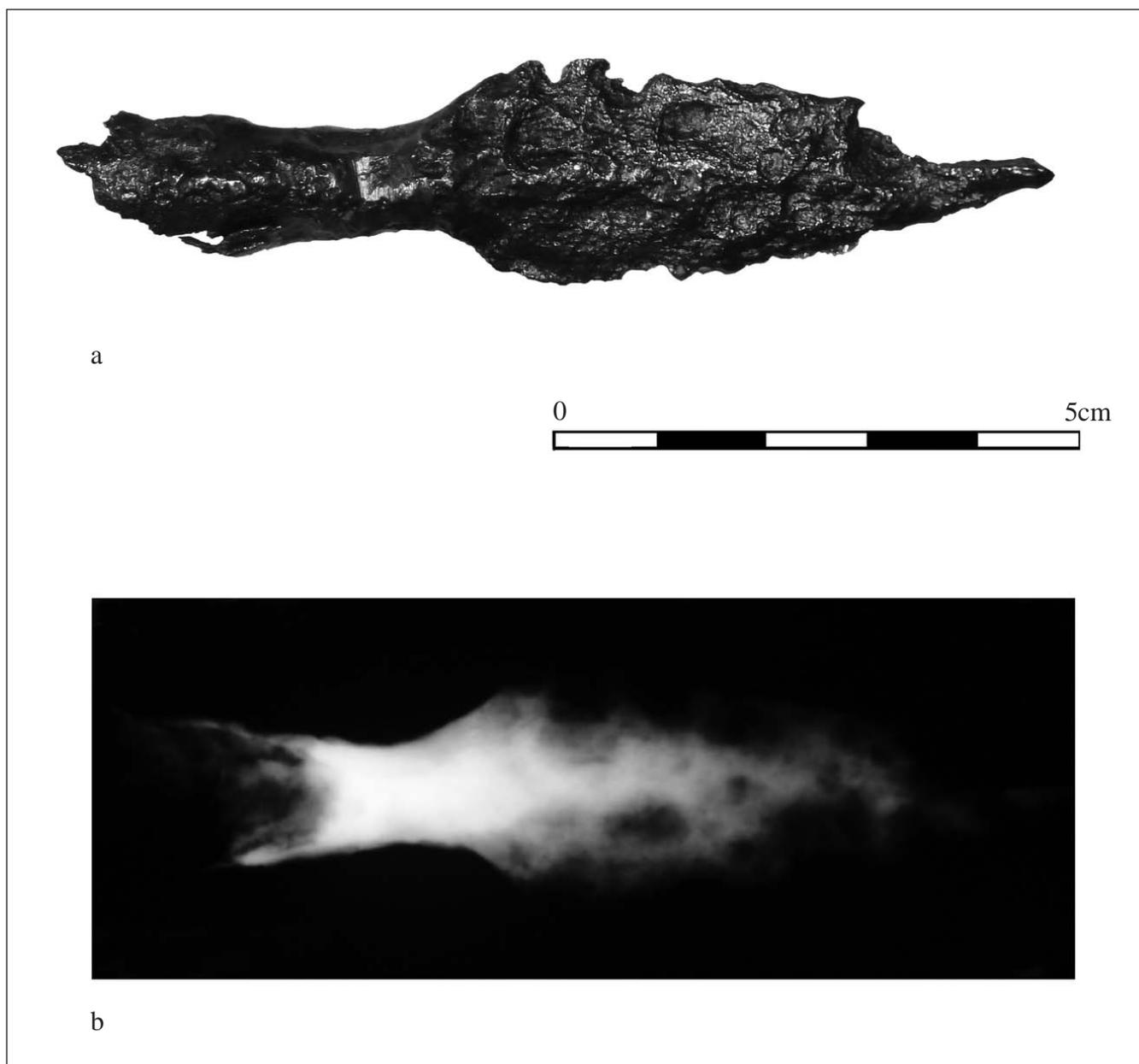


Fig. 2. Javelin head from Grave 52: a) photo of the javelin head, b) X-ray photo of the javelin head. Photo: A.Sierosławski, W. Weker.

the spearhead, there were 2 S-shaped temple rings made of bronze wire, 3 temple rings (round) made of silver wire, 2 iron knives and 4 pieces of unidentified iron objects. Grave 53, apart from the spearhead, also contained 2 pieces of an earring made of silver wire, glass beads (6 complete and 5 pieces), an iron knife, a lyre-shaped buckle made of bronze, 2 iron rings with 2 knobs each, and a double fire striker with a flint. Grave 78, apart from the spearhead, yielded an iron knife, pieces of bucket hoops made of iron and 2 slow wheel-made pottery vessels ornamented with horizontal grooves. In Grave 89, apart from the spearhead, there were pieces of an iron bucket handle. In Grave 170, apart from two spearheads, there were the following finds: an iron sword (Type Petersen X), an iron axe (Type Nadolski IVa), 2 iron spurs (Type Hilczerówna II/2), a whetstone, an iron bucket handle and iron bucket hoops.

The first of the examined spearheads was found in Grave 45. It belongs to Type V according to A. Nadolski.¹³ The blade has the shape of a willow leaf, and the section of the blade has the shape of a rhombus. The section of the socket is round. Measurements: total length – 31.9 cm; length of the blade – 21.9 cm; length of the socket – 10 cm; width of the blade – 2.5 cm; thickness of the blade – 0.5 cm; diameter of the socket – 2.4 cm (Fig. 1a). A line of forge-welding of different bars of iron can be seen on the X-ray photos. This line could indicate that originally on the surface of the blade there was an ornament of a wavy line,

¹³ A. Nadolski, *Studia nad uzbrojeniem polskim w X, XI i XII wieku*, Łódź 1954, p. 54.

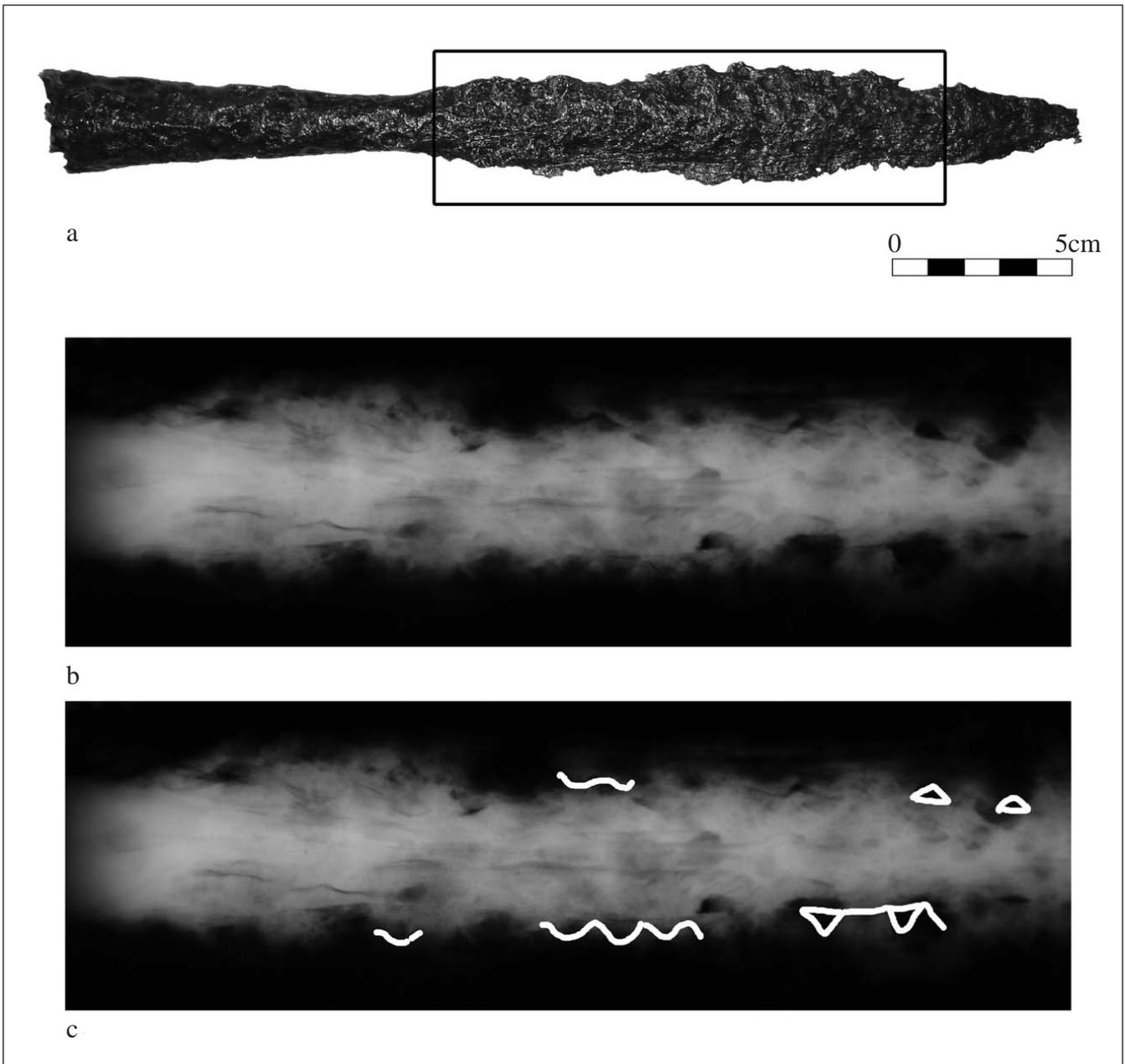


Fig. 3. Spearhead from Grave 53: a) photo of the spearhead, b) X-ray photo of the spearhead c) X-ray photo of the spearhead with marked signs of decoration. Photo: A.Sierosławski, W. Weker.

which separated the core of the blade and the welded-on edges (Fig. 1b-c).

The spearhead found in Grave 52 is the smallest of all the spearheads from this site. The blade widens strongly toward the socket and its section is rhomboid. Such spearheads were classified as Type VII by Nadolski, and were defined as javelin heads.¹⁴ Due to the corrosion damage, the original length and the diameter of the socket are unknown. Measurements: total length – 9.2 cm (preserved); length of the blade – 6.2 cm; length of the socket – 3 cm (preserved); width of the blade – 2.1 cm; thickness of the blade – 0.5 cm; diameter of the socket – 1.6 cm (Fig. 2a). The X-ray photos

did not reveal any signs of disturbance in the internal metal structure (Fig. 2b). Because of that we can suppose that this javelin head was made of one piece of iron.

The spearhead found in Grave 53 also has a willow leaf-shaped blade of considerable length and a rhomboid section. The section of the socket is round. This find can be classified as Type V according to A. Nadolski. Measurements: total length – 28.3 cm; length of the blade – 18.3 cm; length of the socket – 10 cm; width of the blade – 3.3 cm; thickness of the blade – 0.6 cm; diameter of the socket – 3 cm (Fig. 3a). On the X-ray photo we can see discontinuities in the structure of metal. This demonstrates that the artefact was made by forge-welding. In the core of the blade there are traces of fibres or inserts, onto which the edges were forge-welded (Fig. 3b-c).

¹⁴ *Ibidem*, p. 56.

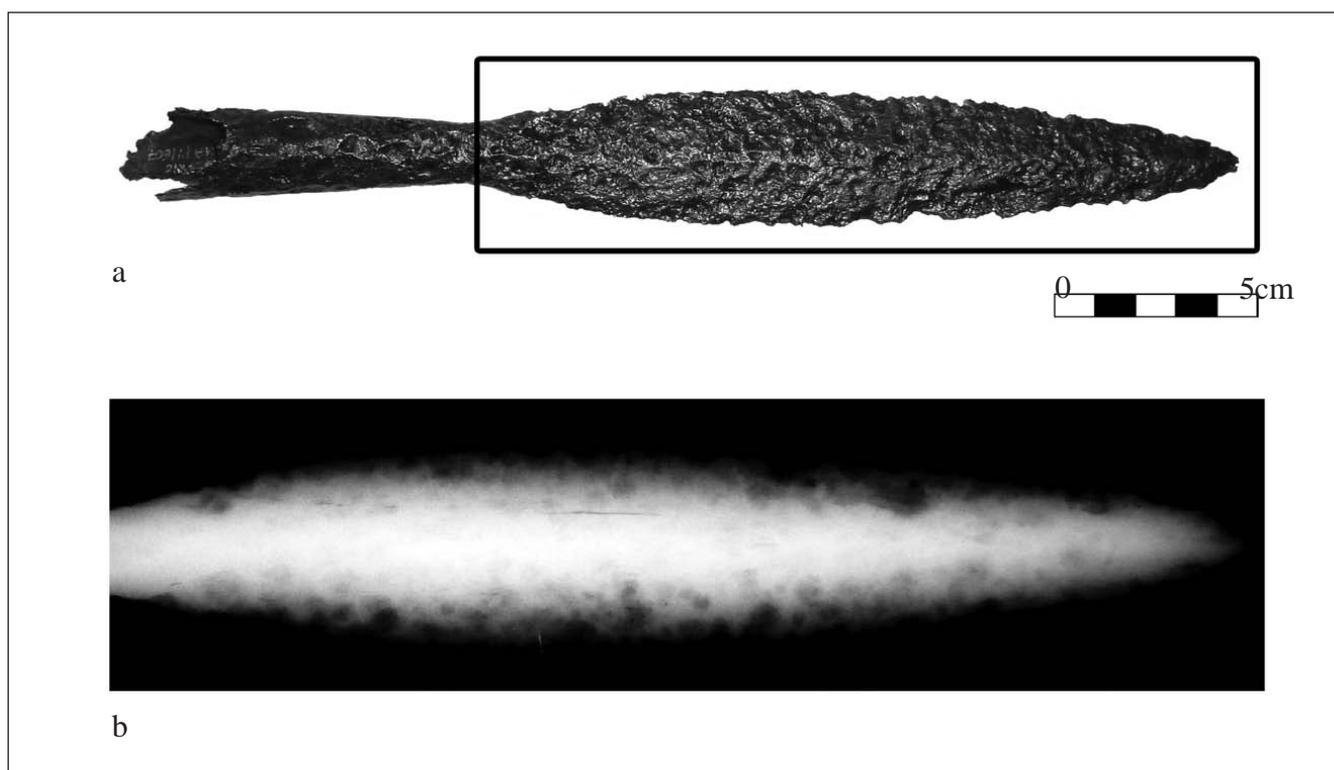


Fig. 4. Spearhead from Grave 78: a) photo of the spearhead, b) X-ray photo of the spearhead. Photo: A.Sieroslawski, W. Weker.

The spearhead from Grave 78 is very similar to those from Graves 45 and 53, but the entire artefact is little more massive. It can also be classified as Type V according to A. Nadolski. The section of the socket is round and it widens toward its mouth, analogously to most finds of early medieval spearheads from the territory of Poland. The end of the socket is damaged, therefore we do not know the original size of its diameter. Measurements: total length – 27.5 cm; length of the blade – 18.5 cm; length of the socket – 9 cm; width of the blade – 3.3 cm; thickness of the blade – 0.65 cm; diameter of the socket – missing data (Fig. 4a). On the X-ray photos we can see two dark lines, which are parallel to the axis of the spearhead. These can be interpreted as an effect of an intentional procedure (forge-welding) or as traces of the laminar structure of metal which originated in result of repeated forging of one piece of iron (Fig. 4b).

The spearhead found in Grave 89 is shorter and wider than other spearheads from this site. It is almost two times shorter and its broader blade is heart-shaped. This spearhead could be classified as Type IV according to A. Nadolski. It should be mentioned that at Końskie only 2 spearheads of that type were found. Measurements: total length – 18.5 cm; length of the blade – 11.8 cm; length of the socket – 6.7 cm; width of the blade – 4.8 cm (preserved); thickness of the blade – 0.4 cm; diameter of the socket – 2.6 cm. On the surface of the blade there are two pairs of “golden” lines. They are parallel to the edges, so the ornament looks like two letters “V” – the smaller one is within the bigger one (Fig. 5a). The X-ray photos clearly show that the spearhead was forge-welded. The lines of welds overlap with the

lines which are visible on the surface. With a closer look we can see on the X-ray photos that the internal structure of those lines is slightly different than the structure of the rest of the blade (Fig. 5b-c).

In Grave 170 two spearheads were found. Their blades are willow leaf-shaped, but slightly wider near the sockets than in other finds from this cemetery. Due to this, they are almost deltoid. The sections of the blades are rhomboid while the sections of the sockets are round. Both spearheads are classified as Type V according to A. Nadolski. The measurements of the first item are: total length – 28.1 cm; length of the blade – 18.1 cm; length of the socket – 10 cm; width of the blade – 3.9 cm; thickness of the blade – 0.7 cm; diameter of the socket – 2.4 cm (Fig. 6a). The measurements of second spearhead are: total length – 30 cm; length of the blade – 16.4 cm; length of the socket – 13.6 cm; width of the blade – 3.1 cm; thickness of the blade – 0.5 cm; diameter of the socket – 2.1 cm (Fig. 7a). The X-ray photos did not reveal any traces of discontinuities in the internal metal structure. We can therefore suppose that those spearheads were made of one piece of iron each (Fig. 6b and 7b).

Research of J. Piaskowski demonstrates that blades of spearheads which were forged from one piece of iron were carburised either on the whole surface¹⁵ or only near the edges, like in case of the spearhead from the stronghold in Czerchów.¹⁶ This procedure was intended to improve the

¹⁵ J. Piaskowski, *Metaloznawcze badania wyrobów...*, p. 118.

¹⁶ J. Piaskowski, *Metaloznawcze badania wczesnośrednio-wiecznych wyrobów...*, p. 68.

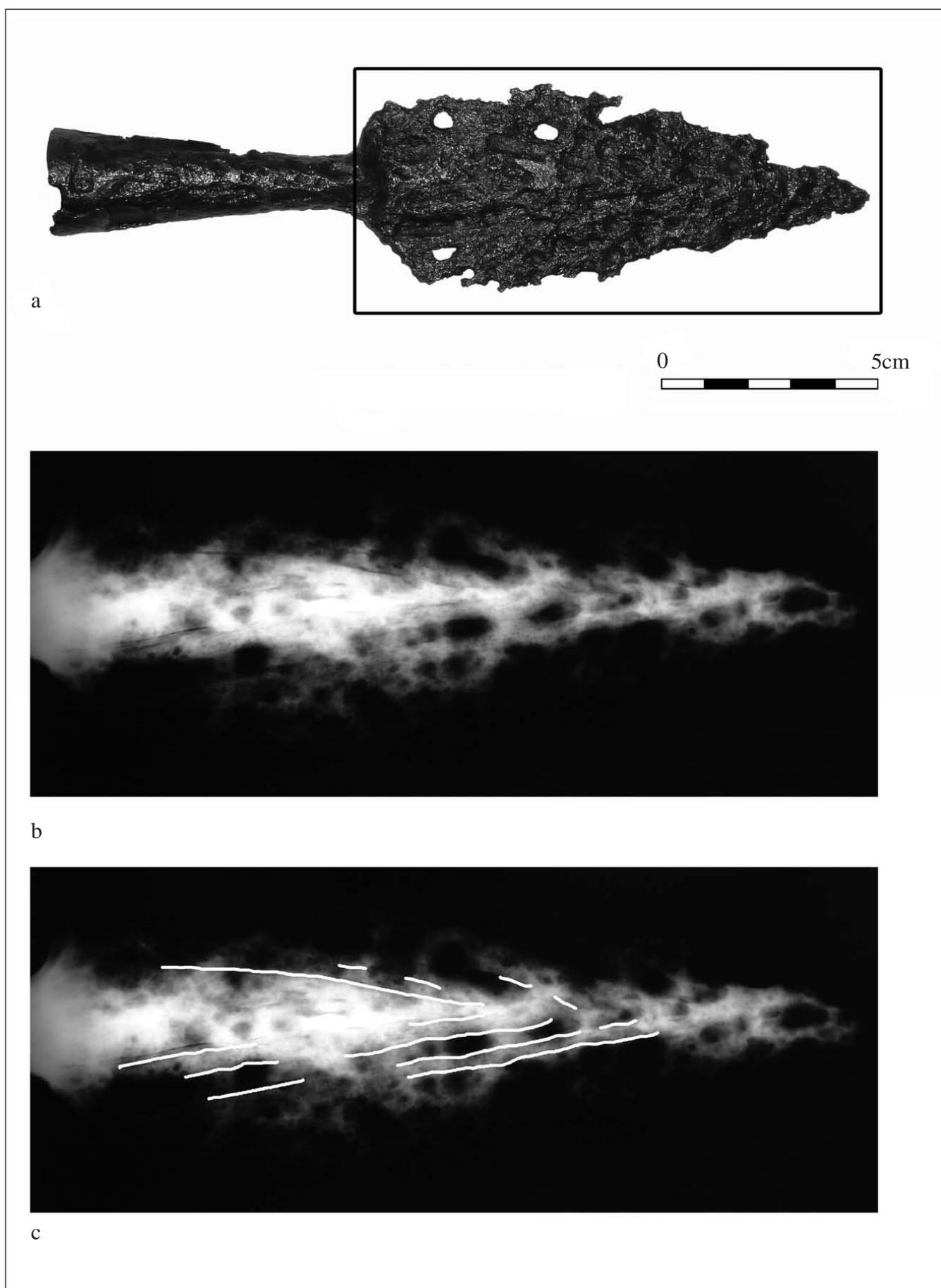


Fig. 5. Spearhead from Grave 89: a) photo of the spearhead, b) X-ray photo of the spearhead c) X-ray photo of the spearhead with marked signs of decoration. Photo: A.Sierosławski, W. Weker.

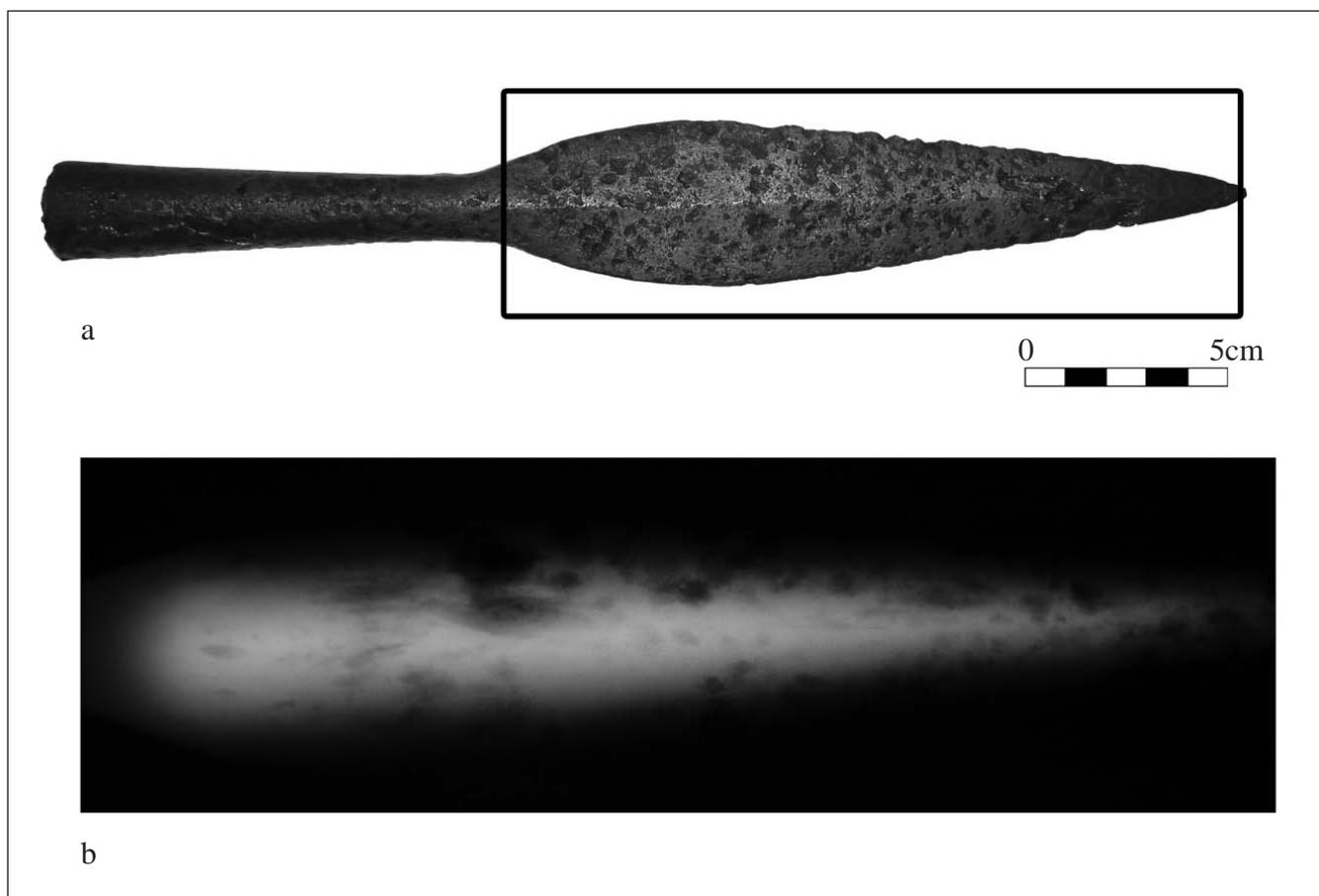


Fig. 6. First spearhead from Grave 170: a) photo of the spearhead, b) X-ray photo of the spearhead. Photo: A.Sierosławski, W. Weker.

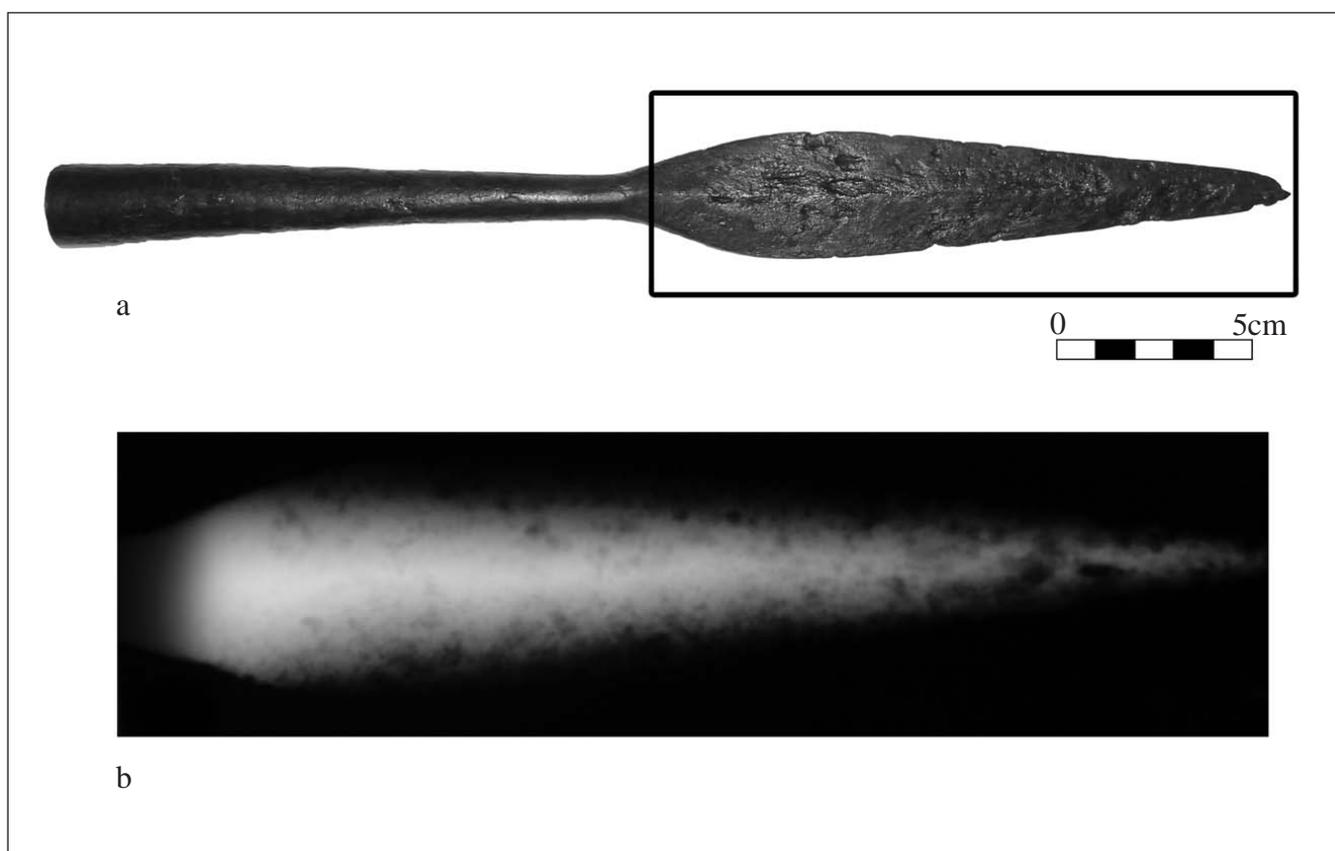


Fig. 7. Second spearhead from Grave 170: a) photo of the spearhead, b) X-ray photo of the spearhead. Photo: A.Sierosławski, W. Weker.

functional properties of the spearhead, especially the hardness and sharpness of the edges. The technique of forge-welding was used for the same reason, but also to decorate the blade, as it can be seen in the case of the spearheads from Graves 89, 45, and 53. The X-ray photos of the find from Grave 53 reveal very interesting pieces of information. On one side of the blade we can see a wavy line and two dark triangular spots (Fig. 3c). Those triangles are a continuation of the wavy line. On the other side of the blade we have a similar situation. It is very probable that this spearhead was decorated with two serrated lines, which went along about $\frac{2}{3}$ of the length of the blade and then converged toward its tip. This kind of ornament was quite popular in the Baltic Sea region and was classified by A. Anteins as Type IV.¹⁷ The spearhead from Grave 45 was probably decorated in the same way, but on the X-ray photos the traces of decoration are visible only on one side of the blade (Fig. 1c).

As J. Piaskowski recounts, in western Russia spearheads made of one piece of iron are very rare¹⁸. So was this technique also used in the state of the Piasts? An argument for this possibility is that the head of the javelin from Grave 52 was made with this technique. Javelins, as thrown weapons, so by definition one time use, were usually made locally. However, we cannot be a hundred percent sure about the function of this weapon, because it was found in grave of a teenage boy. So this weapon can be in fact a smaller version of a spear, which was used for practicing or it could be especially made for the funeral as a grave good¹⁹. We have to recall spearheads found at the cemetery in Lutomiersk, the Pabianice District²⁰. Out of 25 finds of spearheads, 12 were examined²¹. It turned out that only one of them was made of one piece of iron²². This is why it was considered to be a possible import (from Rus?)²³.

Out of the mentioned spearheads from Buczek, Czerchów and Castle Hill in Sieradz only the spearhead found in Grave 2 in Buczek was made by forge-welding technique²⁴. The remaining ones were made from single pieces of iron²⁵.

¹⁷ A. Anteins, *op. cit.*, p. 65, 66.

¹⁸ J. Piaskowski, *Metaloznawcze badania wczesnośredniowiecznych wyrobów...*, p. 68.

¹⁹ More about this issue in T. Kurasiński, *Militaria jako element wyposażenia wczesnośredniowiecznych pochówków dziecięcych – próba interpretacji na przykładzie znalezisk z ziem polskich*, „Archeologia Polski”, Vol. LIV/2, 2009, but this suggestion concerned smaller versions of axes.

²⁰ The end of use of this cemetery is dated to the same time when the cemetery in Końskie commenced to be used, that is, in the mid-11th c. Apart from that, these two cemeteries are similar in many respects (J. Gąsowski, *op. cit.*, pp. 160, 161, 162, 168).

²¹ A. Nadolski, A. Abramowicz, T. Poklewski, *op. cit.*, p. 56.

²² J. Piaskowski, *Metaloznawcze badania wyrobów...*, pp. 118-120.

²³ A. Nadolski, A. Abramowicz, T. Poklewski, *op. cit.*, p. 56.

²⁴ J. Piaskowski, *Metaloznawcze badania wczesnośredniowiecznych wyrobów...*, p. 92.

²⁵ *Ibidem*, p. 67, 91; J. Piaskowski, *Metaloznawcze badania wczesnośredniowiecznych wyrobów żelaznych i żuźla...*, p. 231

It should be mentioned that the find from Grave 2 in Buczek is classified as Type I according to A. Nadolski, which is very rare in Poland²⁶.

While analysing the technology of spearhead manufacture in early medieval Poland one has to take into consideration the research of Radomir Pleiner. In his work about blacksmith techniques in Great Moravia he publishes results of examination of 3 spearheads.²⁷ In his opinion 2 of them were made of a single piece of iron. The construction of the third find was more complicated. The tip of the blade was made of soft steel, then there was a band of high carbon steel (0.5-0.7% C). The cutting edges were made of low carbon iron bands²⁸. Research of early medieval spearheads from Bohemia was also carried out by J. Hošek. The results demonstrate that in early medieval Bohemia spearheads were made both of single piece of iron and by forge-welding technique²⁹. Unfortunately, we do not know anything about the ornaments, which were made this way. More information about decoration of the blades made by using the forge-welding technique is available for the Baltic Sea region. In this territory, more than 380 spearheads ornamented in this way have been found.³⁰ There were 12 different groups of ornaments among finds from Lithuania alone.³¹ Such a decorated spearhead was also found in Haithabu³².

A thorough analysis of presented data causes many doubts concerning techniques which were used by blacksmiths in early medieval Poland. Out of 23 examined spearheads only 8 were made of single piece of iron. One of them was the spearhead from Grave 13 in Lutomiersk, which was interpreted as an import. We can therefore suppose that spearheads made this way were imported to Poland. However, at Końskie more than 50% of examined spearheads were made with this technique. Furthermore, one of them was the head of the javelin from Grave 52. It was not a luxurious weapon and it could be even a hunting weapon, so less valuable than a weapon of war. The doubts concerning techniques which were used in Poland in the 10th and 11th c., including possible regional differences can be clarified only via a coherent research project on early medieval spearheads from the entire territory of Poland.

²⁶ J. Piaskowski, *Metaloznawcze badania wczesnośredniowiecznych wyrobów...*, p. 92.

²⁷ R. Pleiner *Die Technologie des Schmiedes in der Großmährischen Kultur*, „Slovenská Archeológia”, Vol. XV/1, 1967, p. 77.

²⁸ *Ibidem*, p. 90.

²⁹ J. Hošek, *Metalografie ve službách archeologie*, Praha 2003, p. 126.

³⁰ A. Anteins, *op. cit.*, p. 66.

³¹ A. Anteins, *Melnais metāls Latvijā*, Riga 1976, p. 57, fig. 65.

³² R. Pleiner, *Iron...*, p. 219, 376; R. Thomsen, *Metallografische Untersuchung einer wikingerzeitlichen Lanzenspitze aus Haithabu*, „Berichte über die Ausgrabungen in Haithabu”, Vol. 5, 1971, pp. 78-79.

Streszczenie

Nieinwazyjne badania grotów włóczni z cmentarzyska w Końskich, pow. Konecki

W artykule zaprezentowane zostały wyniki badań grotów włóczni odkrytych na cmentarzysku w Końskich, pow. konecki. Uwagę zwrócono na problem możliwości rozpoznania cech konstrukcyjnych tej kategorii oręża przy użyciu nieniszczących metod analitycznych. Uzyskane wyniki odniesiono do rezultatów dotychczas przeprowadzonych badań metaloznawczych tej kategorii zabytków,

pochodzących z terenów Polski, Czech, Słowacji, Białorusi, Ukrainy i Rosji.

Po obserwacji powierzchni grotów włóczni pod niewielkim powiększeniem, przeprowadzono badania rentgenograficzne zabytków. W sumie do badań wytypowanych zostało 7 z 12 odkrytych na cmentarzysku okazów. W grupie tej udało się rozpoznać trzy groty wykonane techniką zgrzewania, pozwalającą uzyskać efekt ozdobienia ich liści.

