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## A SWORD FROM GDAŃSK – A TECHNOLOGICAL REVOLUTION OR A PAGEANT REPLICAS?

**Abstract:** This paper focuses on a sword discovered during post-1945 archaeological excavations in Gdańsk, now stored as a deposit in the Castle Museum in Malbork (Dep. 76). The weapon underwent technological examinations by J. Piaskowski, who said that the sword was an example of Late Medieval mass manufacture of cheap and low quality weaponry with the use of cast refined iron. This assumption was maintained in later scholarship.

As doubts concerning the authenticity of the sword were raised by visual examination, it was decided to repeat technological examinations. It was found out that the metal in the blade was in fact cast. However, qualitative EDS analysis of slag inclusions demonstrated a very high presence of S and Mn, which testifies to the fact that the metal in the blade was obtained with the use of one of late 19<sup>th</sup> or early 20<sup>th</sup> c. steelmaking processes (the Bessemer or Martin process). Based on this and on some external features of the sword (traces of lathe processing, punched typescript letters on the tang), it was assumed beyond doubt that the sword was a pre-1945 replica.

**Keywords:** archaeometallurgy, technological examinations, sword, weaponry, pageant replica

### Introduction

The sword in question was discovered during post-1945 archaeological excavations in Gdańsk. Its find place, referred to as Site 9, was located near the south-western corner of Targ Rybny (Fish Market), at its junction with ulica Tobiasza (Tobiasz street). The find context was defined as the fill of the moat of the 14<sup>th</sup>-15<sup>th</sup> c. fortifications of the town<sup>1</sup>. The sword was kept in the Archaeological Laboratory of the Institute of History of Material Culture of the Polish Academy of Sciences (inv. No. 1120/54) and now it is stored in the Castle Museum in Malbork as a deposit (Dep. 76).

The sword survived in a very good condition and the corrosion damages are limited to some surface pitting (Fig. 1). The blade is broad at the hilt and it tapers evenly towards the sharp “carp’s tongue” point. The cross-section of the blade is of flattened rhomboid in its upper part while in the lower part it is lenticular. The tang is very narrow and it is slightly bent. There are iron ferrules on the tang – they were obviously used to fasten the grip, which regrettably did not survive. The pommel is circular in its frontal view and it is slightly chamfered near the tang. On both frontal faces of the pommel there is a circular rim. On the top of the pommel there is a small knob, which secures it on the tang. The crosspiece is rather massive, thick in its central part and

flattening and widening towards its ends. The metrical data of the sword are the following:

- total length: 1120 mm
- total weight: 1560 g
- blade length: 900 mm
- blade width at the hilt: 61 mm
- blade thickness at the hilt: 6 mm
- blade width at the point: 36 mm
- blade thickness at the point: 4 mm
- hilt length: 220 mm
- tang length between the crosspiece and the pommel: 146 mm
- tang width at the crosspiece: 11,5 mm
- tang thickness at the crosspiece: 6 mm
- tang width at the pommel: 6 mm
- tang thickness at the pommel: 6 mm
- pommel width: 52 mm
- pommel thickness: 24 mm
- pommel height: 60 mm

J. Piaskowski generally dated the weapon to the 14<sup>th</sup>-15<sup>th</sup> c.<sup>2</sup> M. Głosek and A. Nadolski classified the weapon as E. Oakeshott’s Type XIIIa, I, 5 and proposed a more precise chronology of the late 13<sup>th</sup>-early 14<sup>th</sup> c.<sup>3</sup>

<sup>1</sup> Piaskowski 1959, 171; Piaskowski 1960, 9, 107.

<sup>2</sup> Piaskowski 1959, 150, 174; Piaskowski 1960, 60.

<sup>3</sup> Głosek and Nadolski 1970, 35, cat. No. 12; Głosek 1984, 156, cat. No. 240.

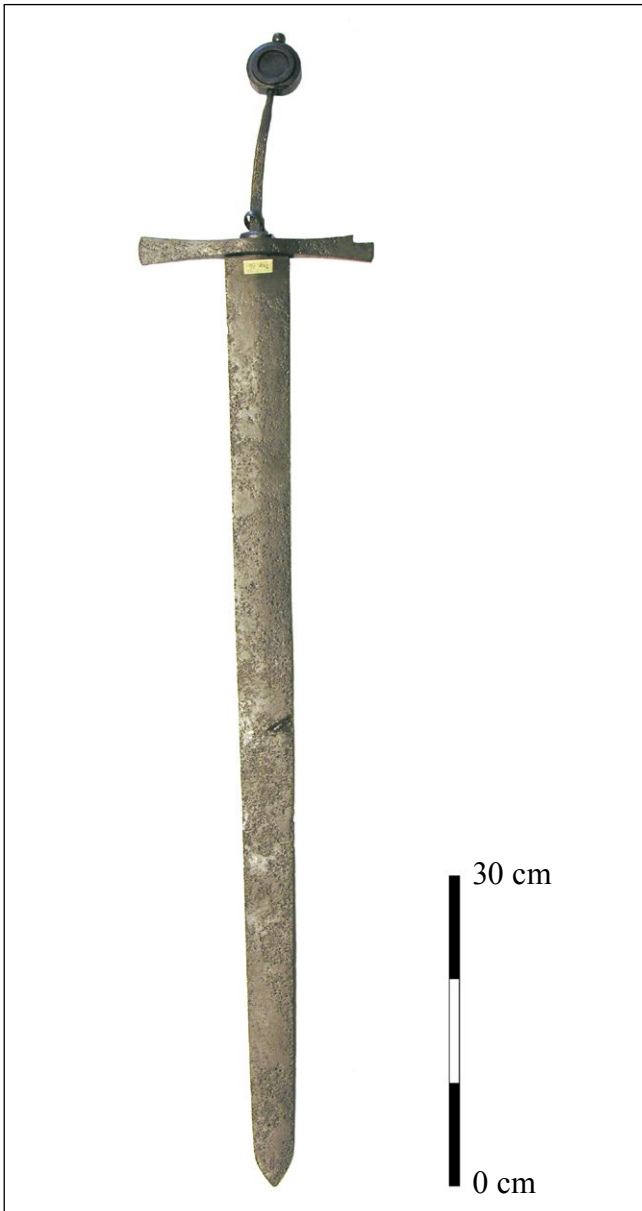


Fig. 1. Sword from Gdańsk, the Castle Museum in Malbork, Dep. 76. General view. Photo G. Żabiński.



Fig. 2. Microstructure of the blade of the sword from Gdańsk, the Castle Museum in Malbork, Dep. 76. Sample was etched with nital, 100x. After J. Piaskowski 1959, 170, Fig. 116.

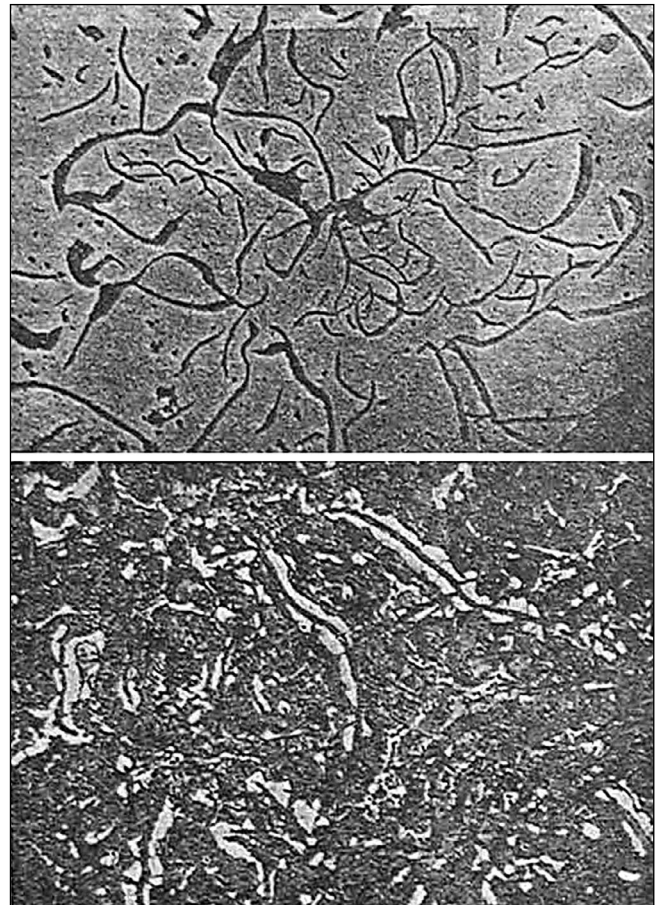


Fig. 3. Microstructure of the pommel of the sword from Gdańsk, the Castle Museum in Malbork, Dep. 76. Top: not etched, distribution of graphite flakes in grey cast iron, 100x. Bottom: etched with nital, graphite flakes, pearlite, small amount of ferrite and phosphorus eutectics (steadite), 100x. After J. Piaskowski 1959, 172, Figs. 118 and 119.

This sword underwent technological examinations, carried out by J. Piaskowski. This scholar commenced his analysis with a statement that in the 14<sup>th</sup>-15<sup>th</sup> c. a new way of iron smelting spread in Europe. Bloomery smelting started to be gradually replaced with blast furnace smelting, which results in production of cast pig iron. As such material was too rich in carbon to be malleable iron, it could undergo a fining process. In result of it, pig iron could be almost completely decarburised or decarburised to some degree only. J. Piaskowski says that it occurred more often that decarburised pig iron was carburised again to a desired degree<sup>4</sup>.

For the purpose of his analysis, J. Piaskowski took samples from the blade, the crosspiece, the pommel and the ferrules on the tang (Figs. 2 and 3). With regard to the blade, this scholar proposed that it had been made of soft refined iron, with a very small amount of slag inclusions and the hardness of HV=115.9 kG/mm<sup>2</sup>. The crosspiece and the ferrules were made from analogous material<sup>5</sup>.

<sup>4</sup> Piaskowski 1959, 169-171.

<sup>5</sup> Piaskowski 1959, 170-171, Fig. 116.





Fig. 4. Sword from Gdańsk, the Castle Museum in Malbork, Dep. 76. Details of the pommel. Photo G. Żabiński.



Fig. 6. Sword from Gdańsk, the Castle Museum in Malbork, Dep. 76. Detail of the crosspiece. Photo G. Żabiński.

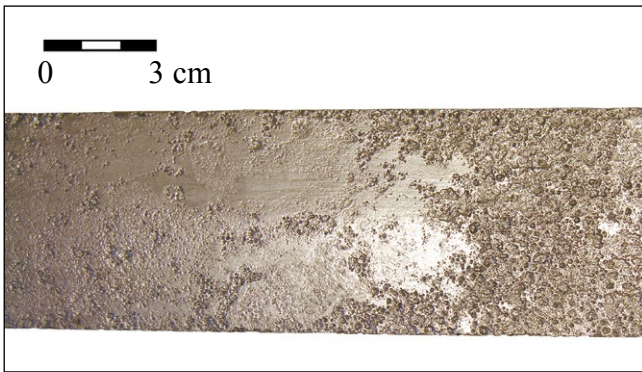


Fig. 5. Sword from Gdańsk, the Castle Museum in Malbork, Dep. 76. Detail of the blade. Photo G. Żabiński.

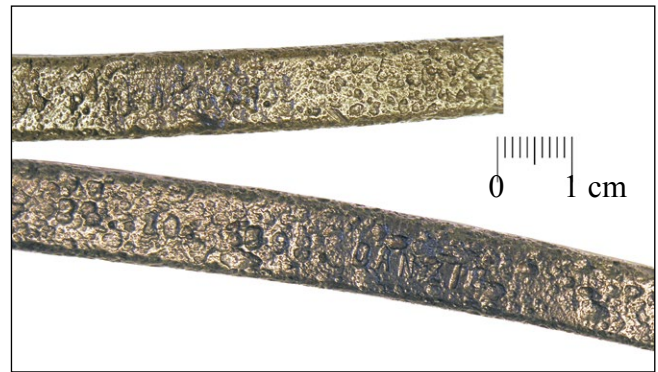


Fig. 7. Sword from Gdańsk, the Castle Museum in Malbork, Dep. 76. Remains of punched inscriptions on the tang. Photo G. Żabiński. Top – **P. FEDER** (?). Bottom – **10 92. DANZIG**.

Concerning the pommel, J. Piaskowski stated that it was made of grey cast iron. Its hardness reached the level of  $HV=183 \text{ kG/mm}^2$ .

All in all, J. Piaskowski considered the weapon to have perhaps been made in Western Europe. As no hardening procedures were used, J. Piaskowski related the low quality of the blade to mass-scale manufacture for the needs of large Late Medieval armies<sup>7</sup>.

The theory of the use of refined iron for sword manufacture was accepted in later scholarship<sup>8</sup>. Some doubts have recently been raised by A. Michalak, who pointed to the lack of good documentation of the sword and the absence of data concerning the grounds on which its chronology was defined<sup>9</sup>. It was therefore decided to carry out new technological examinations of the weapon.

<sup>6</sup> Piaskowski 1959, 172, Figs. 118 and 119.

<sup>7</sup> Piaskowski 1959, 171-172; see also Piaskowski 1960, 60-63, 107-109, Figs. 195-196.

<sup>8</sup> E. g., Głosek 1998, 29; Nowakowski 1994, 200 – without explicitly mentioning the sword from Gdańsk; Nowakowski 2005, 65, and Biborski et al. 2004, 201 – with reference to this sword.

<sup>9</sup> Michalak 2011, 377.

A careful inspection raised several reservations concerning the medieval origin of the sword. Both the material and the shape of the pommel suggest that it was in fact cast. Traces of regular scratches which can be seen on its surface (Fig. 4) imply that it was processed using a lathe. All this speaks rather for a later origin of the pommel than Late Medieval. The same seems to be true for the knob on the top of the tang.

Similar observations could be made concerning the blade (Fig. 5). Furthermore, it does not precisely match Type XIIIa. There is no fuller and the form of the point is different. It is shaped as the “carp’s tongue” and not ogivally<sup>10</sup>. In general terms, the blade seems to be closer to Type Ia according to M. Aleksic, although it is much shorter. Moreover, M. Aleksic’s Type Ia seems to be at least 150 years earlier than the proposed chronology of the sword from Gdańsk<sup>11</sup>. The same can be said with regard to the crosspiece (Fig. 6). The indentation marks the spot where J. Piaskowski took his sample.

<sup>10</sup> cf. Oakeshott 2000, 95-108.

<sup>11</sup> Aleksic 2007, 26, 77-78.

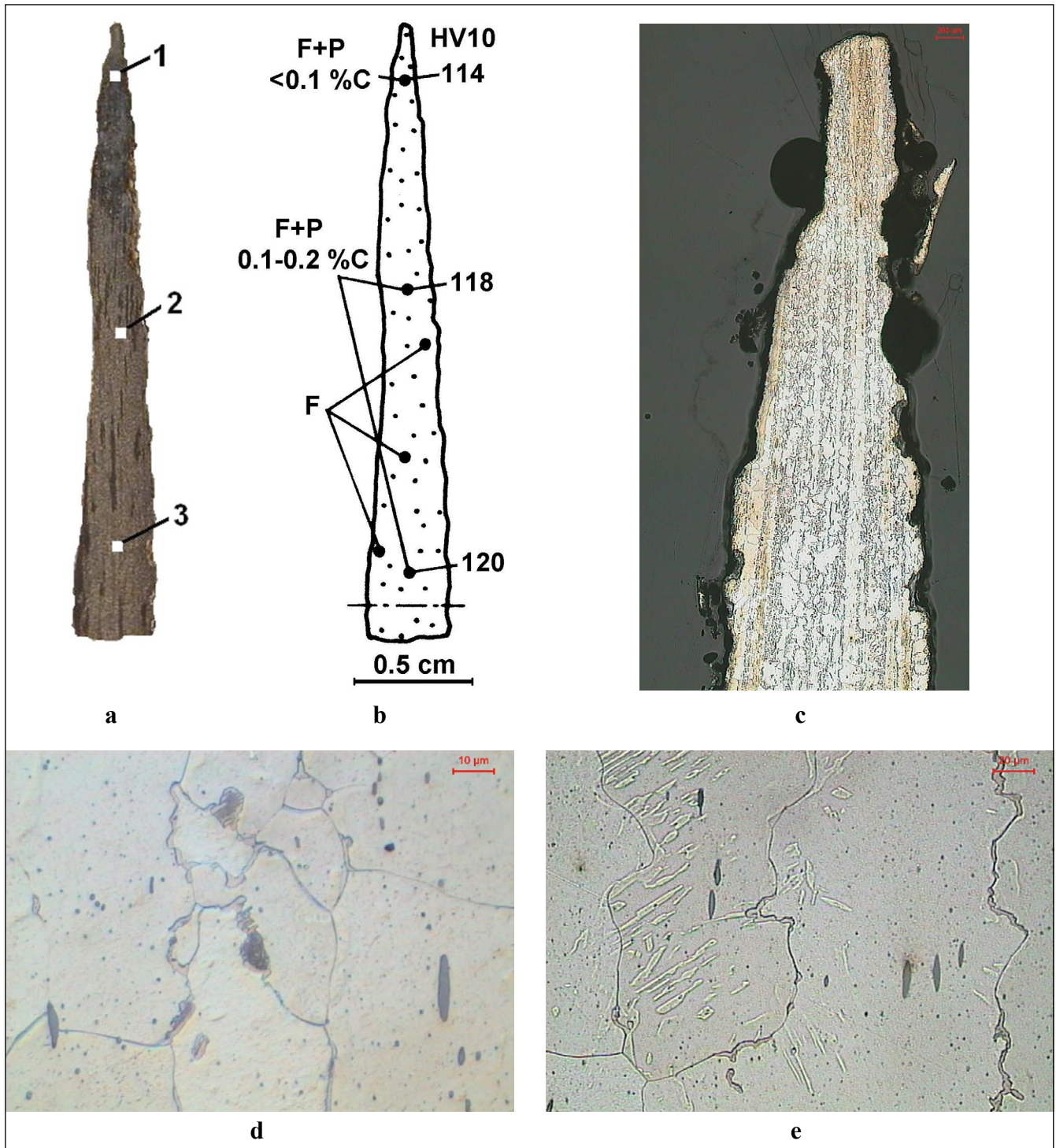


Fig. 8. Sword from Gdańsk, the Castle Museum in Malbork, Dep. 76. Photo J. Stępiński: a – schematic depiction of the macrostructure of the sample with spots of microscopic observations (1-3); b – schematic depiction of distribution of structural components and hardness tests (P-pearlite, F-ferrite, dots mark the presence of carbon); c – cutting edge of the sword (Spot 1); d – few colonies of pearlite (partially degenerated) in the ferrite matrix and fine slag inclusions in the edge of the sword (Spot 1); e – ghosting structure and fine slag inclusions in the edge of the sword (Spot 1).

What is more, it was of crucial significance that there were punched inscriptions on the tang, clearly made with typewriting letters (Fig. 7).

#### Technological examinations

The sample was taken from the central part of the blade, in the spot where the sword was sampled by J. Piaskowski

(see Fig. 1). The sample was sunk in epoxy resin and it was then ground and polished using diamond pastes. The surface of the sample was then etched with 4% nital reagent in order to reveal the microstructure. Macro- and microscopic observations were carried out using a Leica DMLM optical microscope. Carbon content in examined samples was approximately assessed based on microscopic observations. Hardness



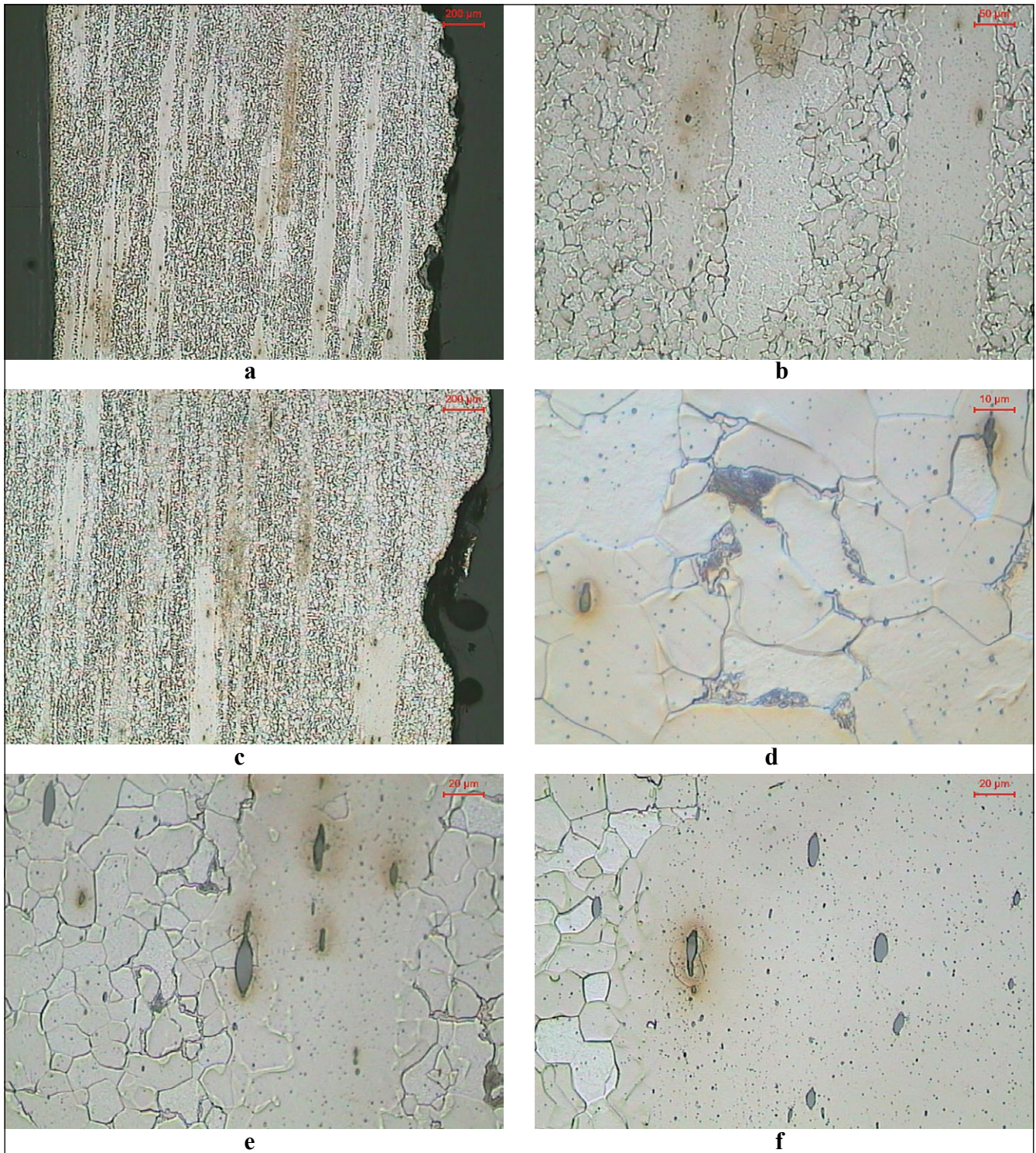


Fig. 9. Sword from Gdańsk, the Castle Museum in Malbork, Dep. 76. Photo J. Stępiński: a – change of the microstructure in Spot 2; b – strips of coarse-grained ferrite in the ferritic-pearlitic matrix in Spot 2, ghosting structure can also be seen; c – change of the microstructure in Spot 3, near the centre of the cross-section; d – degenerated pearlite in the ferrite matrix and very fine slag inclusions in Spot 3; e, f – very numerous fine slag inclusions in the matrix of ferrite in Spot 3.

tests were carried out using the Vickers method with a 10 kG load and every result is an average of several tests. Additionally, a qualitative analysis of slag inclusions was made, using a scanning electron microscope (SEM) equipped with an energy dispersive X-ray spectrometer (EDS).

The macroscopic image of the cross-section of the blade with spots of microscopic observations (1-3) and a schematic

presentation of distribution of structural components and hardness tests (HV10) can be seen in Fig. 8a-b. As it can be seen in Fig. 8a, the cross-section is characterised with diversified darkening of the macrostructure, which testifies to differences in carbon content in the cross-section.

In the entire examined cross-section of the sample (Fig. 8a-b) one can see fine-grained ferritic-pearlitic microstructure.



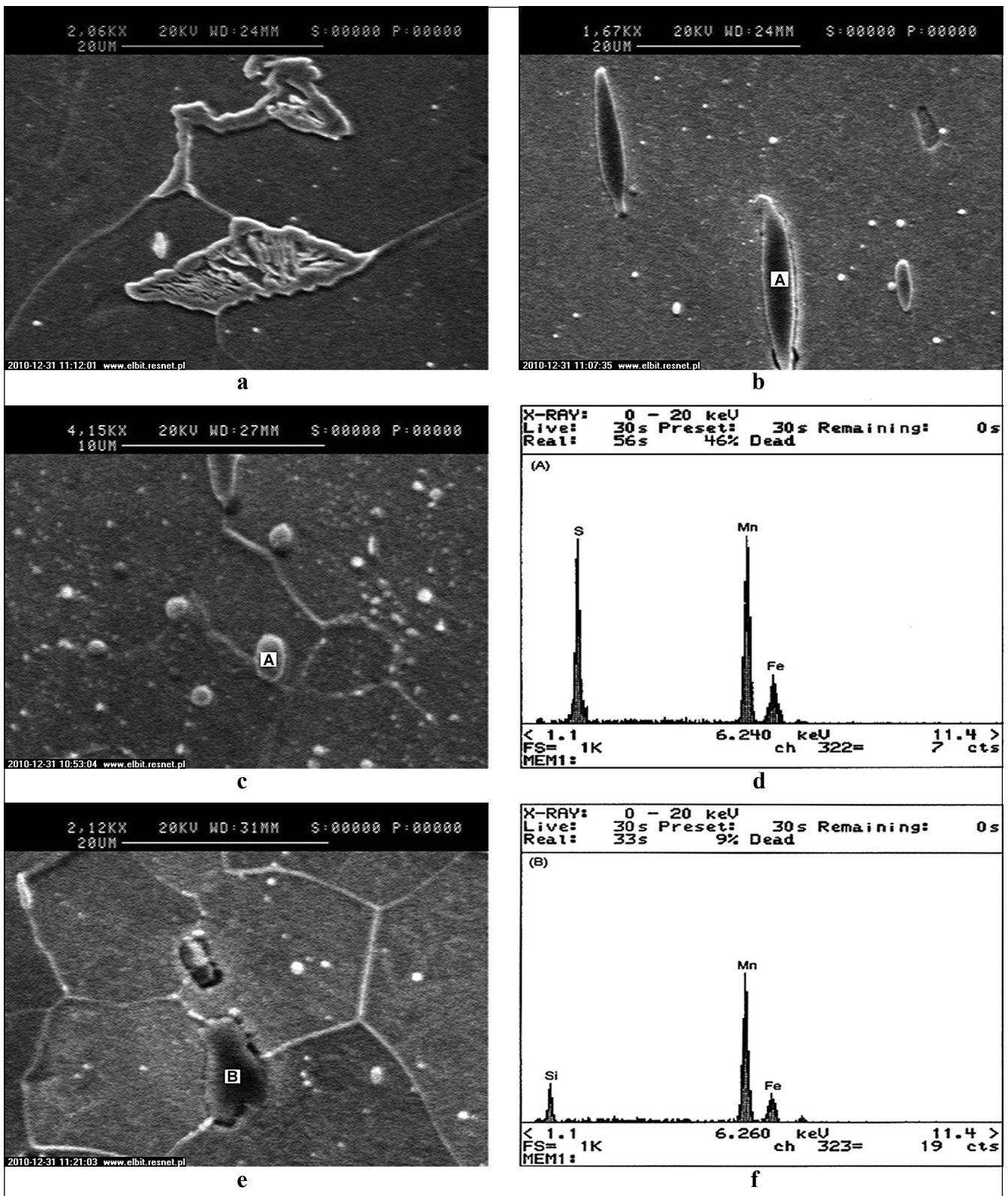


Fig. 10. Sword from Gdańsk, the Castle Museum in Malbork, Dep. 76 – EDS analysis of slag inclusions. Photo J. Stępiński: a – SEM observations of degenerated pearlite in the ferrite matrix; b, c – analysed slag inclusion in Spot A; d – EDS point analysis in Spot A, peaks from Mn, S and Fe can be seen; e – analysed slag inclusion in Spot B; EDS point analysis in Spot B, peaks from Mn, Si and Fe can be seen.

On its background, there are strips or bands of coarse-grained ferrite, which are distributed in a random manner (Figs. 8c, 9a and 9c). Ferritic-pearlitic and ferritic bands which are elongated towards the edge originated in the course of plastic working (rolling, hammering) of metal. They are also

related to phosphorus segregation in the metal of the sword. Remarkable features of the discussed microstructure are a considerable degeneration of cementite plates in pearlite (Figs. 8d, 9d and 10a), as well as the presence of the so-called ghosting structure in ferritic areas (Figs. 8e and 9b).



Fig. 11. Visit of Emperor Wilhelm II to the Castle of Malbork, 5 June 1902. Archive of the Castle Museum in Malbork, Department of History.



Fig. 12. Prussian soldiers in "Teutonic" costumes at the Castle of Malbork, 5 June 1902. Archive of the Castle Museum in Malbork, Department of History.

These features of the microstructure clearly testify to the presence and uneven distribution of phosphorus in the metal of the blade. In the course of forging process, areas containing phosphorus were subject to a less considerable elongation in line with the direction of forging than areas with no phosphorus content (Fig. 9a). Furthermore, the presence of phosphorus in deformed areas hampers their re-crystallisation. Due to this, strips of coarse-grained ferrite are even more conspicuous, together with recrystallised fine-grained ferritic-pearlitic areas.

The carbon content in the examined cross-section falls within the range of 0.1-0.2% C, which is typical for soft steel. The hardness value in the examined cross-section is almost independent from the spot of test and it is on average 117 HV10.

#### Analysis of slag inclusions

Very numerous and tiny slag inclusions, which are round or slightly elongated towards the edge, can be seen on the cross-section (Figs. 8d-e, 9e-f and 10b-c).

Fig. 10 presents the results of the EDS analysis of slag inclusions. Analysed lens-shaped and globular inclusions (Fig. 10d) chiefly contain such elements as S, Mn and Fe. Apart from that, there are also sporadically slag inclusions which contain silicon, manganese and iron. Their morphology and analysis can be seen in Fig. 10e-f.

#### Interpretation

In the light of the examinations it can be said that the blade was in all probability forged from one piece of soft steel (0.1-0.2% C), which was quite evenly carburised and contained increased amount of phosphorus. Both the microstructure and the chemical composition of examined fine slag inclusions, which mainly contain manganese and sulphur, allow to conclude that the metal went through the liquid state. It can be supposed with considerable certainty that

it was one of steelmaking processes which were available at the end of the 19<sup>th</sup> or the beginning of the 20<sup>th</sup> c., e.g., the Bessemer or Martin process<sup>12</sup>.

After forging, the blade underwent the process of normalisation by annealing, which is why very fine grains can be seen in the microstructure of ferritic-pearlitic areas. The presence of strips of coarse-grained ferrite is due to the segregation of phosphorus in the metal.

Based on all these features of the sword in question, both external ones and those concerning the technology of its manufacture, one can conclude with certainty that the sword in question is not a medieval weapon, but a late 19<sup>th</sup> c. – pre-1945 replica.

A question concerning the origin of this sword is difficult to answer. It will be recalled, however, that "historical re-enactment" is not an invention of our days. In pre-1945 Prussia there was an especially strong tradition of the Teutonic Order. The Prussian 152<sup>nd</sup> Teutonic Order Infantry Regiment (*Deutsch Ordens-Infanterie-Regiment*) which was stationed in Malbork (Marienburg) and Sztum (Stuhm), cultivated this tradition and its soldiers often appeared in "Teutonic" costumes on various occasions (Figs. 11 and 12). It cannot be therefore excluded that the discussed sword was made for this or similar purpose.

On this occasion, a short note on liquid iron in medieval Europe should be made. In China, the process of casting of iron in "blast furnaces" was known already c. 600 BC. Pig iron which was obtained in such a way contained over 2% C, so it was not malleable and as such could be used for casting only. Alternatively, it could undergo a process of fining (blowing air over liquid iron) and thus be converted into malleable wrought iron. Another way was to anneal white cast iron in order to break the brittle cementite ( $Fe_3C$ ) into iron

<sup>12</sup> On these processes, see, e.g., Tylecote 1976, 144-148.

and carbon (as graphite) and thus receive malleable grey cast iron. The latter was used in China from the 4<sup>th</sup> c. BC to make tools and weapons, including swords<sup>13</sup>. In Europe, the blast furnace was introduced only in the High Middle Ages. It may have taken place in Sweden c. 1200. During the excavations at Lapphyttan (Västmanland County, Norberg Municipality, central Sweden) lumps of white and grey cast iron were discovered. Furthermore, traces of finery hearths were also identified. Similar archaeological evidence from that time is also known from other part of Europe, such as Schwäbische Alb or the Sauerland-Siegerland region (western Germany)<sup>14</sup>.

In the 14<sup>th</sup> and 15<sup>th</sup> c. the blast furnace and fining processes spread to other parts of Europe. Cast iron was used for guns in the Late Middle Ages, alongside with wrought iron bars and copper alloys, although cast iron barrels were very brittle and thus extremely dangerous for their users. A. R. Williams says that the blast furnace and fining processes made iron easily available, also for the purpose for manufacturing large quantities of cheap swords, guns and armour. There was, however, no automatic improvement in the quality of iron, so the manufacture of high quality swords and armour still had to rely on steel<sup>15</sup>. Cast iron could be converted into medium-carbon or low-carbon steel in a variety of ways<sup>16</sup>. There is evidence from the 16<sup>th</sup> c. for a mass scale manufacture of low quality “munition armour,” made of iron or low-carbon steel<sup>17</sup>. On the other hand, within a group of 52 post-AD 1000 swords analysed by A. R. Williams, there were only 4 made of low-carbon steel (Group IV – c. 0.4% C). 2 of these came from the 11<sup>th</sup> c., 1 from the 13<sup>th</sup> c. and 1 from the 15<sup>th</sup> c.<sup>18</sup>. On chronological grounds, only the 2 later ones can be taken into consideration. In both cases, however, the presence of quite large slag inclusions suggests that they were made of bloomery steel<sup>19</sup>.

#### Technological examinations and the issue of authenticity of medieval swords

The case of the sword from Gdańsk is very informative with regard to the role of archaeometallurgical examinations in proving or disproving the authenticity of medieval swords. This way, it has recently been possible to confirm the medieval origin of “Szczerebiec” (The Jagged Sword) – the coronation sword of the kings of Poland, which is possibly of a mid-13<sup>th</sup> c. date<sup>20</sup>.

On the other hand, it must also be said that – as with the sword from Gdańsk – a careful visual inspection can to a lot of introductory job before it comes to technological

examinations. A good example is another sword from the collection of the Castle Museum in Malbork (inv. No. MZM/146/MT) (Fig. 13). This sword was purchased by the Museum before 1970 from Dr Tadeusz Jakubowski, a collector from Kraków. Dr T. Jakubowski acquired the sword in 1939 from the collection of Henryk Loewenfeld in Chrzanów. The sword was classified as E. Oakeshott's Type XII, G, 2 and dated to c. 1300-1400<sup>21</sup>. A. R. Chodyński expressed serious doubts concerning the medieval provenance of this weapon (A. R. Chodyński, personal communication).

Basic metrical data of the sword are the following: total length – 108 cm; total weight – 1.58 kg; blade length – 91.4 cm; blade width at the hilt – 5.4 cm; hilt length – 16.6 cm. Some reservations are provoked by the weight of the weapon. Although it may still be not that heavy per se, the sword is very poorly balanced and thus difficult to wield. Further doubts are raised by a visual examination of the weapon. As it can be seen, the edges and the surface of the fuller are uneven and it is evident that the fuller was forged and not ground (Fig. 14).

Furthermore, the pommel was fixed on the tang with the use of a washer, in a rather careless way. As it can be seen on the circumference of the pommel, it may have been made by means of fitting two circular plates onto an iron ring. What is more, the pommel was fastened from below with the use of a small wedge (Fig. 15). An analogous solution can be seen in the crosspiece (Fig. 16). Such a careless manufacture seem to have been unacceptable for a weapon of war.

As it was not possible to sample this sword, it was decided to carry out surface polishing. The polishing, was done with sandpaper (gradations of 800, 1000, 1200 and 2000 grits) and them with diamond pastes (6 and 1 μm). Then, the surfaces were etched with 4% nital. Observations were made with an optical metallographic microscope (Fig. 17).

As it can be seen, both the pommel and the blade were made of low-carbon ferritic-pearlitic steel, with carbon content of merely 0.1-0.2% C. As only very fine slag inclusions can be seen, it could be supposed that steel of 19<sup>th</sup>-early 20<sup>th</sup> c. date was used for the manufacture of the sword in question. This, together with the afore-mentioned external deficiencies of the sword, very strongly suggests that the sword is not a genuine medieval weapon.

A combination of visual inspection and technological analyses has been used with success also in the case of other swords of putative medieval origin. K. Rybka has recently analysed a series of such swords. Concerning a sword from the collection of the Castle of Golub-Dobrzyń, doubts were already raised by several external features, such as i.a. an uncommon bladesmith's mark on the tang, careless fitting of the crosspiece, too strong flattening of the blade in its lower part and imprecise way of conducting the fuller.

<sup>13</sup> Tylecote 1976, 48; Williams 2009, 68-76; Williams 2012, 38-39.

<sup>14</sup> Williams 2012, 187-192; see also Tylecote 1976, 65.

<sup>15</sup> Williams 2012, 192-201.

<sup>16</sup> Williams 2012, 210-222.

<sup>17</sup> Williams 2012, 212-213; see also Williams 2003.

<sup>18</sup> Williams 2012, 232-233.

<sup>19</sup> Williams 2012, 283-285.

<sup>20</sup> Biborski et al. 2011, 93-148.

<sup>21</sup> Chodyński 2003, 35-36, No. 28; Chodyński 2006, 32, 52, cat. No. 116.



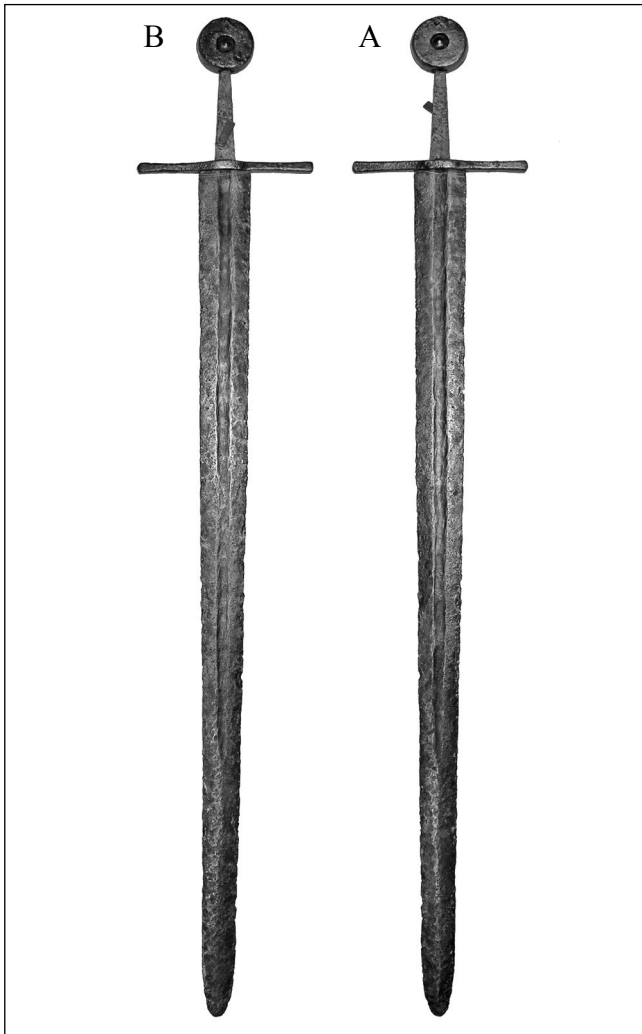


Fig. 13. Sword from the collection of the Castle Museum in Malbork, inv. No. MZM/146/MT. General view. Photo G. Żabiński.

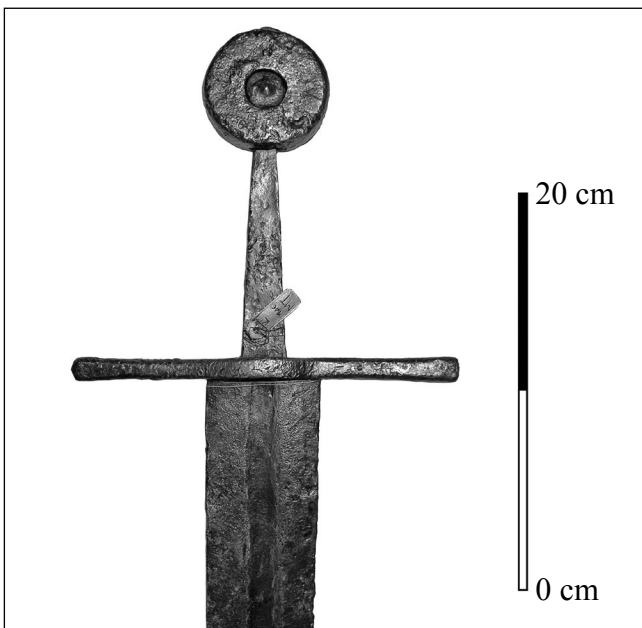


Fig. 14. Sword from the collection of the Castle Museum in Malbork, inv. No. MZM/146/MT. Details of the hilt and the upper part of the blade. Photo G. Żabiński.

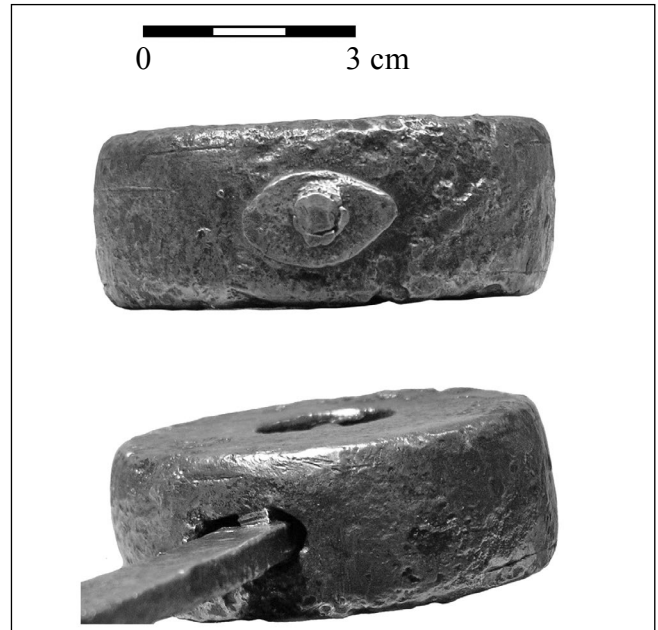


Fig. 15. Sword from the collection of the Castle Museum in Malbork, inv. No. MZM/146/MT. Details of the hilt. Photo G. Żabiński. Top: View from above. Bottom: View from below.

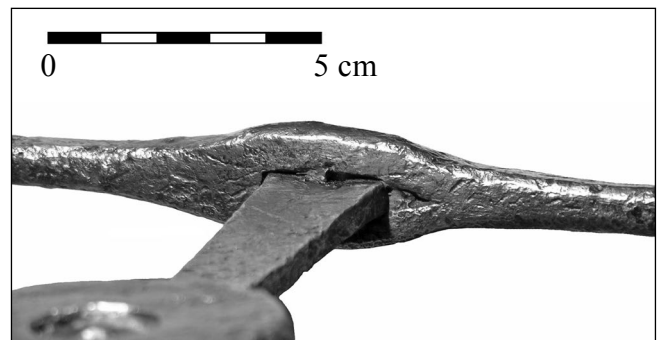


Fig. 16. Sword from the collection of the Castle Museum in Malbork, inv. No. MZM/146/MT. Details of the crosspiece. Photo G. Żabiński.

Furthermore, no traces of corrosion micro-damage (which are typical for historic iron artefacts) could be seen. Metallographic examinations revealed that the weapon was made of one piece of low-carbon ferritic-pearlitic steel with no slag inclusions. Concerning the chemical content of the metal, attention is attracted by a very high content of copper (0.17-0.19% Cu), which may be related to the use of scrap steel in the smelting processes. A high content of nickel in the cutting edge (0.21% Ni) is also noteworthy. On these grounds it was proposed that the sword was a 19<sup>th</sup> c. replica<sup>22</sup>. The case of four swords from private collections in Szczecin was similar. It was found out these swords had undergone procedures which had been supposed to provide them with “antique” features. Concerning their chemical content, a very high proportion of copper, manganese

<sup>22</sup> Rybka 2011, 114-116, Fig. 3, 121-122, Tab. 1.

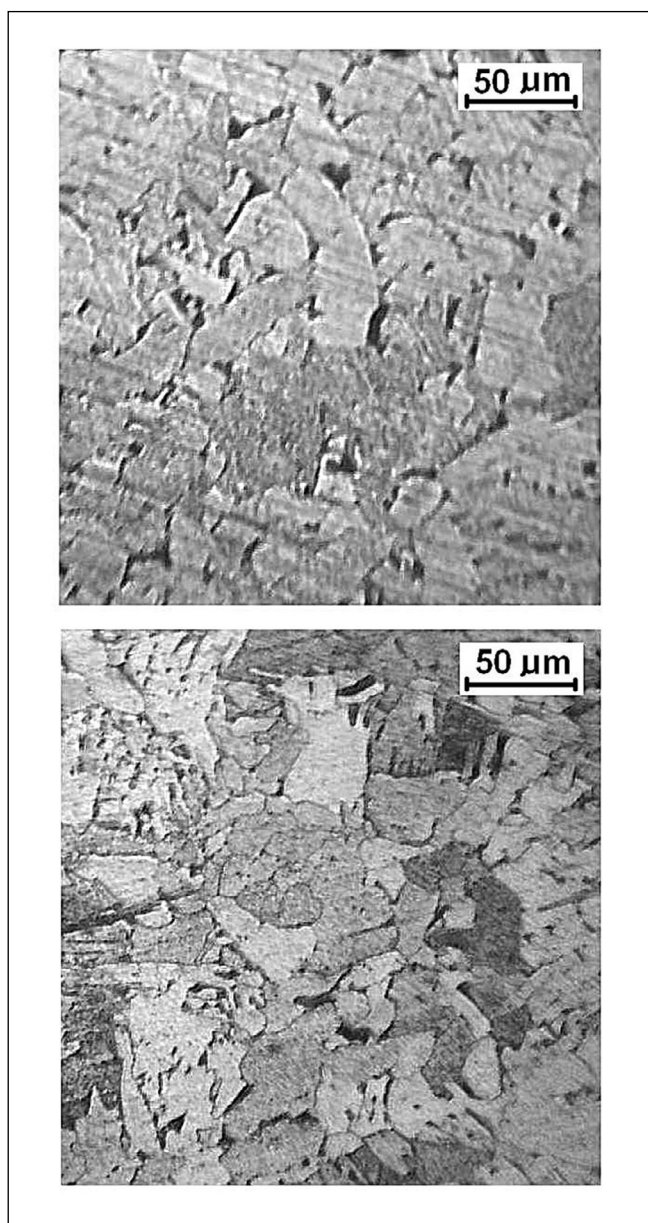


Fig. 17. Sword from the collection of the Castle Museum in Malbork, inv. No. MZM/146/MT. Photo G. Żabiński. Top: microstructure of the pommel – grains of ferrite and a network of pearlite (dark areas at the grain boundaries). Bottom: microstructure of the blade near the cutting edge – grains of ferrite and a network of pearlite (dark areas at the grain boundaries).

and chrome was found<sup>23</sup>. The last sword, from a private collection in Sanok and of a putative 13<sup>th</sup> c. date, was also made in a very careless manner. Its ornamentation, perhaps supposed to relate the sword to a military order, finds no counterparts among medieval swords. Furthermore, the chemical analysis demonstrated a high content of copper (0.25-0.29% Cu), chrome (0.02-0.04% Cr) and manganese (0.43-0.54% Mn). Therefore, this sword was considered to be of a 19<sup>th</sup> c. date as well<sup>24</sup>.

<sup>23</sup> Rybka 2011, 116-118, Fig. 4, 121-122, Tab. 1.

<sup>24</sup> Rybka 2011, 118-120, Fig. 6, 121-122, Tab. 1.

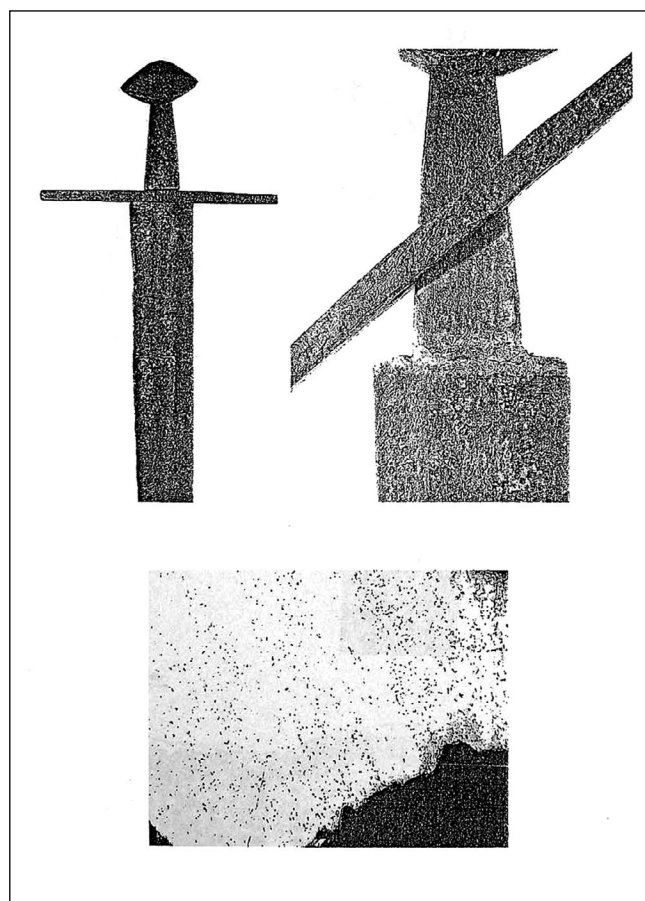


Fig. 18. Sword from a private collection – a modern replica. After Edge and Williams 2003, 196, Fig. 4. Top: general view and a notable weld between the hilt and the blade. Bottom: microstructure at 90x magnification. Regular bands can be seen.

Furthermore, attention is also drawn to examinations carried out by D. Edge and A. R. Williams. A putatively 12<sup>th</sup> c. sword proved to be a modern replica, based on a series of external and internal features (Fig. 18). It was found out that the hilt and the blade had been welded together. The microstructure of the sword consists of ferrite and a small amount of pearlite, with no visible slag inclusions. Furthermore, the pearlite is concentrated in noticeable bands (0.1% C). As the microstructure of the sword is very uniform and due to the absence of slag, it was proposed that the sword had been made of mild steel, additionally homogenised by melting. The latter suggest a post c.1880 date. Furthermore, mechanical rolling is suggested by regular bands<sup>25</sup>.

### Conclusions

It seems that the most important conclusion of this paper is a proper chronological assessment of the sword from Gdańsk as a late 19<sup>th</sup>-early 20<sup>th</sup> c. replica and thus a denial of a Late Medieval “technological revolution” which was supposed to rely on mass manufacture of cheap low quality fined cast iron swords. There is no question that

<sup>25</sup> Edge, Williams 2003, 194, 196, Fig. 4.



the issue of different quality patterns in the manufacture of Late Medieval and Early Modern weapons requires further research. It will be recalled, however, that a majority of swords from that period which were analysed by A. R. Williams was at least of reasonable quality, with the use of steel and hardening procedures<sup>26</sup>. It seems evident that in the case of swords there was hardly a way to counterbalance the low quality of material – unlike in armour, where the use of low-carbon steel could be at least partially compensated for by greater thickness of plates.

On the other hand, a role of careful visual (and macroscopic) inspection should not be underestimated, either. As demonstrated both by the research on the discussed sword and by examinations carried out by A. R. Williams and K. Rybka, a comprehensive external examination is capable of yielding a great deal of useful information. In such cases, technological analyses (with special reference to archaeometallurgy) usually have a final say with regard to defining the chronology of a given weapon.

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<sup>26</sup> Williams 2012, 230-285.

**Streszczenie****Miecz z Gdańska – rewolucja technologiczna czy replika na potrzeby „rekonstrukcji historycznej”?**

Artykuł omawia miecz odnaleziony podczas powojennych badań archeologicznych w Gdańsku, przechowywany obecnie jako depozyt w Muzeum Zamkowym w Malborku (Dep. 76). Zabytek został poddany badaniom technologicznym przez J. Piaskowskiego. Badacz ten uznał, iż miecz jest przykładem późnośredniowiecznej taniej i masowej produkcji uzbrojenia z wykorzystaniem lanego żelaza fryserskiego. Stwierdzenie to zostało podtrzymane w późniejszej literaturze.

Analiza wizualna budziła wątpliwości co do autentyczności zabytku. Zdecydowano się więc na powtórzenie badań technologicznych. Stwierdzono, iż metal główni jest istotnie żelazem lanym. Jednakże analiza jakościowa EDS wtrąceń żużla wykazała znaczną obecność S (siarka) i Mn (mangan), co dowodzi, iż metal otrzymano w jednym z późnodziewiętnastowiecznych lub wczesnodziewiętnastowiecznych procesów stalowniczych (besemerowskim lub martenowskim). W oparciu o to i o niektóre cechy zewnętrzne miecza (ślady obróbki na tokarce, litery bite pismem maszynowym na trzpieniu), uznano ponad wszelką wątpliwość, iż miecz jest repliką sprzed 1945 r.