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ARCHAEOMETALLURGICAL AND MILITARY HISTORICAL ASPECT OF SABERS OF THE 9–10TH CENTURY CARPATHIAN BASIN

Theses of PhD Dissertation

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I. PREVIOUS RESEARCH AND RESEARCH ISSUE

In the last nearly one hundred and fifty years, the research of weaponry of the Hungarian conquest has evolved to be so diverse that it is hardly possible to conclude their investigation with novel results in every aspect, in a monographic work.

Diversity has led to fragmentation, and although this scientific evolution has fundamentally increased our knowledge of the era, now we need to be qualified as historians, archaeologists, natural scientists (mostly physicists, chemists, material engineers) and art historians to be able to perform an in-depth analysis of the subject. As a result, interdisciplinary cooperation is becoming more common in weapons research, however, experience shows that due to their incipient condition, communication interfaces between disciplines are still in an extremely unstable state, examining any new phenomenon easily deforms them and upsets the emphasis, proportions and structure of the dialogue. Although the same weapon type is in the focus of different disciplines, the questions are so different, that the phenomenon under investigation is intrinsically not the same. That is why intensification of interdisciplinary communication is required.

This dissertation aims to offer a general overview about the methods and results that have been applied and achieved in the research of sabers, and to establish a practical connection between the different approaches.

II. Methodology and sources

In his candidate dissertation (*Vooruženie vengrov obretatelej rodiny: sabli, boevye topory, kop'ja*, 1980) Kovács László summarized the occurrence, context, distribution, and their archaeological conclusions of the Conquest period sabers. In his work he divided the swords into four groups according to their occurrence: 1: certified tombs from the 10th century (71 cases), 2: verifiable stray finds from the 10th century (36 cases), 3: uncertain data (28 cases), 4: weapons, falsely dated to the 10th century (12 cases). The database of the dissertation consists of Kovács's mentioned work supplemented with his other papers (*Szablya-kard fegyverváltás. A kétélű kardos 10–11. századi magyar sírok keltezéséhez,* 1990), and with my own research.

Using the programming language and software (R) for statistical computing, we have had the opportunity to interpret size measurement data of sabers, altogether of 140 finds. With the help of statistical analysis, we have established new categories defined by exact numeric values instead of the old system, which differentiated sabers according to main categories (i.e. short or long). Besides correlation calculations and explorative data analysis methods, mathematical classification of cluster analysis was an important part of the research.

However, formal features play significant role in classification – this is a main reason of the prominent role of hilts in grouping – considering the research tendencies of straight bladed sword we can notice, that technological features are becoming increasingly important factors in defining types.

In the University of Miskolc, Institute of Physical Metallurgy, Metalforming and Nanotechnology with the help of specialists of ARGUM we took 6 samples from 4 sabers – blades: Karos-Eperjesszög grave II/20, Miskolc-Airport grave 5, Unknown saber from Herman Ottó Museum (Miskolc), guards: Karos-Eperjesszög grave II/5, Miskolc-Repülőtér grave 5 (1–1 samples from both endings).

After preparing the surface – polishing, etching with nithal (2%) - the shape and distribution of tissue elements and phases were examined with optical microscopy (Zeiss AxioImager M1m).

Also SEM-EDS analysis was made with scanning electron microscopy equipped with energy dispersive spectroscopy (Zeiss EVO MA10). Some of SEM-pictures were backscattered electron images revealing the metallic phases and the slag inclusions (the elements with high atomic number produce lighter areas).

Sampling was significantly limited by how much the object is damaged and what level of protection it is entitled to. Usually access to such objects with lower quality and with damaged core was obtained. Of course, this can be attributed to archaeometallurgical methods. It is hopeful for the future that more and more non-destructive methods are appearing in weapons technology research. For the time being, however, the researcher can choose only two options from the “archaeometallurgical trinity” (relevant information value, affordable price, and non-destructive analysis).

Examining the technological traces, we sought answers to the following questions: 1: Is there any chemical element in the slag inclusions (e.g. P, As), that indicates the smelting of bog iron ore? 2: What kind of yield of smelting can we estimate on the basis of the ratio of /FeO+MnO/:SiO_2 in the slag inclusions? 3: Is it possible to find the traces of pattern welding, or any other type of welding? 4: Is it possible to find the traces of heat treatment that allows conclusions to be drawn about the use of the weapons?

III. RESULTS

Based on the examination of the formal features (like the length of blade /Hp/, breadth of blade /Szp/, and length of “elman” /Hf/) and spread of weapons, the distribution of types of cross-sections and of guards has two focal points in the area. Cross-section type 1 and Guard type 1A can be mainly located in the North-Eastern Carpathian Basin (primarily Upper-Tisza-region) while Cross-section type 2, and Guard type 1B appear more often in the region of the Upper-Danube and the northern part of the region between the Tisza and the Danube. Guard type 2 appears in the eastern part of the Carpathian Basin. Also the examples of the Hp-Szp:C∩Hp-Hf:D cluster intersection can be located in the Upper-Tisza-region. Average values: Hp: 749mm, Szp: 28,5mm Hf: 207,5mm.

Based on the metric data and their statistical analysis, a grouping regularity can be formulated: Blades belonging to Cross-section type 2 are longer and thinner than the examples of Cross-section type 1.

In the case of Cross-section type 1: $Hp < (Szp + 39) \times 10$

In the case of Cross-section type 2: $Hp \geq (Szp + 39) \times 10$

So we can draw conclusions in the case of a fragment, based on cross-section and width.

Cross-sectional type 2 and Guard type 1B are expected to be later stages in the development of the saber, however, it is hard to searate these groups chronologically. The *terminus post quem* of Cross-section type 1 and Guard type 1B (according to the burials with sabers and coins) is the first fifth of 10^{th} century (TPQ895/96 – 918/19). The dating interval of the Guard type 1B is longer, it is not evident, that the *terminus post quem* is later (TPQ895/96–942). This question requires the re-examination of the burials with coins and weapons.

Based on the archaeometallurgical analyses, the following answers can be given to material and technology questions: 1: Various levels of P-content can be detected in the examined inclusions (0–2,05%), so we can suppose biogenic origin, but these values alone are not sufficient to make a safe conclusion on bog iron ore smelting. 2: Based on the extremely high Fe-ratio (46,32–71,56%) in the slag inclusions of the samples, we can suppose a week yield of smelting. We have only one exception: sample 4, its slag inclusion contains the highest Si-content (35.56%), and the smallest Fe-content (5,79%).

Also this is the only blade without P-content inclusions, so it is possible that its ore has another origin (but we can also suppose, that it is a technological difference). 3: Based on the metallographic analysis and the data of archaeometallurgy the saber from Gnadendorf, we can notice, that the sabers of this region was made from a single material. 4: We have found examples for heat treatment by considering martensite in sample 4.

Metallographic examinations and experiments offer great help in reconstructing the *chaine opèratoire* to provide a more detailed picture about technology.

As for the forging technique of sabers, swords have no effect on them. In the opposite case we have evidences only for sword hilt modifying.

The independence of saber craft can be proved by the survival of light calvary and its weaponry (B. Szabó János: *A középkor magyarországi könnyűlovassága,* 2017). Furthermore, according to Regino, Liutprand, Widukind, VI. Leōn, and Abu al-Ḥasan ʿAlī ibn al-Ḥusayn ibn ʿAlī al-Masʿūdī in some cases also melee combat was used by 9–10th century Hungarian warriors.

Based on the difference of cross-section, archaeometallurgical investigations, and the reconstructed *chaine opèratoire,* it is doubtful, that swords were reshaped to saber. It is more likely that the incoming weapons were sold in the arms trade. Abu'l-Qasim Ubaydallah ibn Abdallah ibn Khordadbeh mentions in *Kitāb al*

Masālik w'al Mamālik rūs, and rāḏanīya merchants exporting swords from Europe. In addition, foreign military elements could have influenced the weapon culture of the 9–10th century Carpathian Basin not only through the objects but also through the movement of the masters or the demands coming from the battlefield experience.

The change in tactics and related weaponry is most noticeable with the appearance of infantry. This can be attributed to the new features of state organizations.

It is also remarkable, that double-edged swords are less regarded as the weapon of a limited social level. So we can suppose, that this alternative of long bladed weapons was available for wider circle in the end of 10th century.

The catalog of the dissertation can be further expanded by more detailed examination. Expanding metric data can also help improve classification. The question remains: what extent and in what parts the blade was heat treated.

In the relation of the manufacture and use, archaeometallurgy and military history play important roles. The results show that the research of a historical interaction is also capable of producing a scientific interaction. The actual value of the method, however, will be determined by the results and feedback of further scientific works.

LIST OF PUBLICATIONS ON THE SUBJECT OF THESIS

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