

Technology—Manufacturing Techniques

Unfortunately technological, in particular metallographic, examination has not played a significant role in Avar archaeology, partly due to the lack of interest but also as a consequence of both the cost of the approach and for a lack of relevant expertise. Consequently, very few weapons have been analysed using such methods, few results have been published, and their results has not yet been used by most archaeologists, despite the fact that the results of such examinations can offer relevant information on the use, quality and the general technical history of artefacts.

Besides the forging, several other technical methods were used during the manufacture of swords, as these weapons were also decorated with various jewellery techniques, and therefore the complete manufacture of a sword might include blacksmithing, wood carving, leatherworking and jewellery work. These latter techniques, however, will not be described here. Forging techniques were described in the methodology chapter and therefore we intend to offer here a summary and interpretation of the results of former metallographical examination of Avar-age polearms and edged weapons.

Metallographic examination has rarely been made of Avar-age artefacts. One of the main researchers in this field has been the Czech scholar Radomír Pleiner who examined the use of iron, including ore extraction, mining, smelting, and the various forging techniques of early medieval blacksmiths. Pleiner mainly focussed on the work of Moravian blacksmiths which included a description of the manufacturing techniques applied to a sabre from the Late Avar burial of Holiare.¹ Significant metallographic analyses were also made of iron artefacts from the Early Avar period Környe cemetery by the Polish researcher Jerzy Piaskowski.² The Košice Technical University has played a significant role in the archaeo-metallographical study of Avar weapons, and L'ubomír Mihók and his team examined several artefacts from the two great Avar cemeteries in Slovakia, at Želovce³ and Košice-Šebastovce.⁴

Metallographic examination of weapons have been carried out quite frequently in Austria thanks to the research activity of Erik Szameit, the Vienna

1 Pleiner 1967, 90.

2 Piaskowski 1974, 113–130.

3 Mihók et al. 1991, 67–101.

4 Mihók et al. 1995, 145–188.

Institute of Archaeological Science (VIAS), founded by Falko Daim, and a project financed by the Austrian National Bank⁵ on the metallographical examination of early medieval weapons, as undertaken in the studies of Matthias Mehofer and Norbert Hofer.⁶

Hungarian research has been somewhat late in contributing to this field, compared to its northern and western neighbours. During the writing of this monograph X-ray and electron-microscopic investigations were carried out on spearheads from the Budakalász cemetery, in cooperation with the Metal Technological Research Group of the Budapest Technical University,⁷ while CT and electron-microscopic analyses were made on swords from the Szegvár–Oromdűlő cemetery and spears from the Budakalász cemetery by the Széchenyi University of Győr.⁸ The Hungarian National Museum also examined iron artefacts of Merovingian (and partly Avar) origin under the auspices of the European Union project termed 'ANCIENT CHARM EU'⁹ by means of PGAA and TOF, based on neutron diffraction.¹⁰

Only 30 edged weapons and polearms have been examined metallographically,¹¹ this small number being partly as a consequence of its expensive

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- 5 Project No. 9394, with the title 'Metallographische Untersuchungen an Schutz- und Angriffswaffen des Mittelalters'.
- 6 Publications from this project: on the Holy Lance of Vienna: Mehofer – Leusch – Bühler 2005; artefacts from Upper Austria: Mehofer – Szameit 2003, 127–169; the metallography of the sword of Hohenberg: Mehofer 2005, 251–253; reconstruction of the Hohenberg sword: Scheiblechner 2005, 255–267; the metallography of the early Hungarian sabre of Gnadendorf and the Avar sabres of Zillingtal: Mehofer 2006, 159–174.
- 7 I am indebted to the head of the research group, Dr. János Dobránszky.
- 8 Spearheads from grave Nos. 291, 437, 710 and 1472 at the Budakalász–Dunapart cemetery, and swords of grave Nos. 137, 333, 335, 540 and 930 at the Szegvár–Oromdűlő cemetery. These investigations were carried out by the Materials Science Laboratory Széchenyi István University in Győr by Csizmazia Ferencné.
- 9 These are abbreviations for 'Analysis by Neutron Resonant Capture Imaging and other Emerging Neutron Techniques Cultural Heritage and Archaeological Research Methods'; see: <http://ancient-charm.neutron-eu.net/ach>.
- 10 The Hungarian coordinator of this project is Zsuzsanna Hajnal, and am grateful to her for this information.
- 11 The examined weapons were: a sabre from grave No. 102 at Holiare (Pleiner 1967; Pleiner 2006, 207, fig. 68), the sword of Hohenberg (Mehofer 2005, 251–253), the sabres from grave Nos. B-23 and D-330 and the single-edged sword from grave No. D-3 at Zillingtal (Mehofer 2006, 162–163), the sword of Dabas/Gyón-Paphegy (Simon – Székely 1991, 204), Csolnok (Somlósi 1988, 207–210), the swords from grave Nos. 78, 97 and 149 at Környe and two swords (stray finds from Környe) and two spearheads (grave No. 129 and stray find) from the same cemetery (Piaskowski 1974, 128), 8 edged-weapons from the Želovce cemetery