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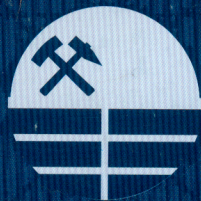
# METALLA

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Abstracts

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# S-shaped temple rings from Vrbno, characterization of manufacturing processes

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This contribution is focused on the typological and technical study of a set of 54 S-shaped temple rings found within the excavations of an early medieval cemetery in Vrbno (Czech Republic) conducted by I. Štefan and L. Varadzin in 2005 and 2007 (Institute of Archaeology of the Academy of Sciences of the Czech Republic, Prague, v.v.i.). The goal of the study was to identify the different types of S-shaped temple rings present in the set, and to point out the different techniques used in their manufacture. The temple rings were characterized by observation under optical stereomicroscope (Olympus SZ60), and scanning electron microscopy (SEM), supplemented by results of X-Ray Fluorescence spectrometry (XRF) and electron microanalysis (EDAX) analysis as well as metallographic examination.

Temple rings are ornaments which were worn by women and children on the head, near the temples, attached to a fabric between the 9<sup>th</sup> and the 13<sup>th</sup> century in Central Europe. S-shaped temple rings are characterized by a typical shape forming an open ring with one end having a curly S-shape. The typological study evidenced four different types present in the set (Fig.1). The different types were distinguished according to the treatment of the end opposite to the curly S-shaped end and according to the number of wire used to form the body of the temple ring. In type 1, the opposite end is simply cut (type 1), whereas it is flattened and pierced in type 2. It can also ends with an other curly S-shape end (type 4) or be formed by the loop of the twisted wire used to make the open ring (type 3). S-shaped temple ring of type 1

Grave number	number	Fe	Cu	Zn	As	Ag	Sn	Sb	Au	Pb	Bi	Type of alloy
H246	1413 core	100										Copper
H 246	1413 plating	24,20				71,37				4,43		Ag-Cu-Pb
H247	1414 core	100										Copper
H247	1414 plating	2							98			Au-Cu
H193	1173 core	98,75								1,25		Cu-Pb
H 193	1173 plating	1,27				98,73						Ag-Cu
H131	736 core	99,71				0,29						Copper
H131	736 plating	2,04				97,96						Ag-Cu
H130	711	84,80	15,20									Cu-Zn
H114	618 core	91,11	4,01			3,54			1,34			Cu-Zn-Sn-Pb
H 114	618 surface	71,32	11,84			10,84			6,01			Cu-Zn-Sn-Pb
H93	501 non plated surface	77,64	0,47			7,89			13,99			Cu-Pb-Sn (Zn)
H93	501 plating	66,34	1,52			29,23			2,91			Cu-Sn-Pb-Zn
H 93	502 core	98,51				0,71			0,79			Copper
H93	502 plating	0,36	27,75			64,97				3,78		Sn-Cu-Pb

Fig.2: Results of analysis by SEM/EDS on plated temple rings.

are the most frequent (74% of the set), while type 2 represents 18% of the set, type 3 only 6% and type 4 less than 2%. The diameter of the temple rings and the thickness of the wire are varying in time. The oldest temple rings are the smallest but also the thickest (average external diameter 18 mm and thickness of the wire can reach up to 4,5 mm). In the 12th century, the diameter is increasing up to 67 mm whereas the thickness of the wire is reduced to around 2 mm. The use of a drawplate to make thin wires was evidenced by metallography (Fig.6-a). Section of temple ring No.1143 etched in alcoholic ferric chlorides revealed worked and annealed grain structure with variable grain size and visible twinning. Strain lines present near the surface characterize the microstructure of drawn wires. The invention of the drawplate which facilitated the production of thin wires is mentioned by Theophilus at the 12<sup>th</sup> century in his essay on Divers

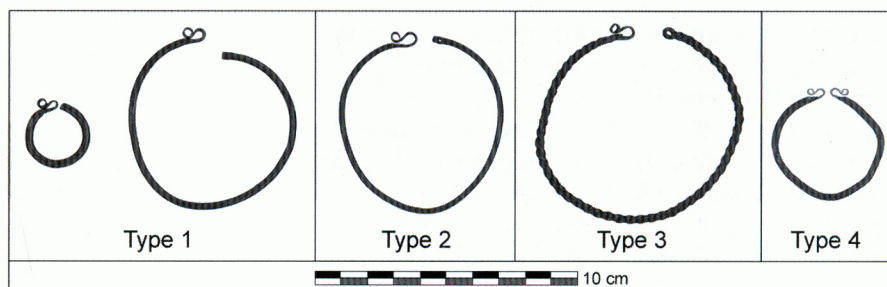


Fig.1: Typology of Vrbno S-shaped temple rings.

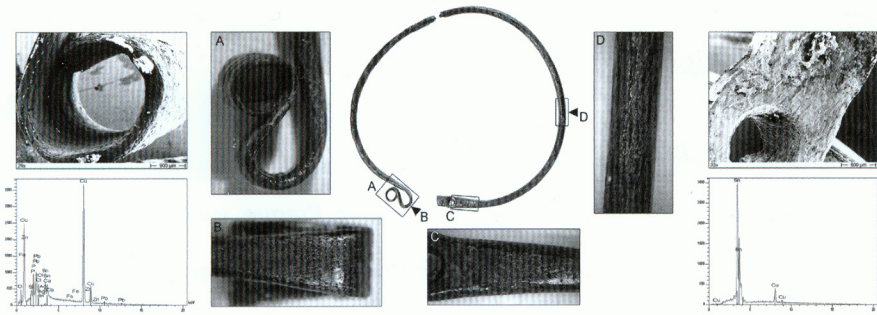


Fig.3: Tinned temple ring (n°501).

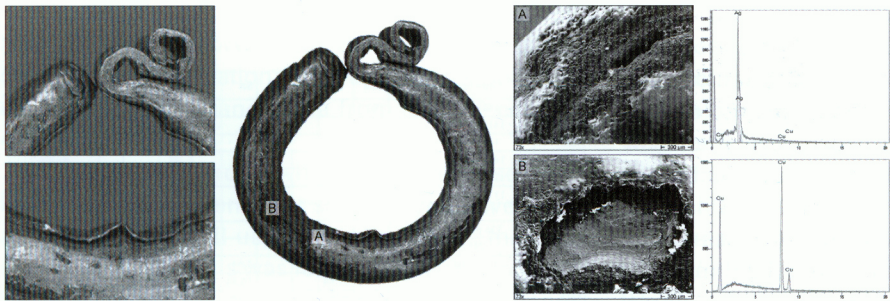


Fig.4: Silver plated temple ring (n°1173).

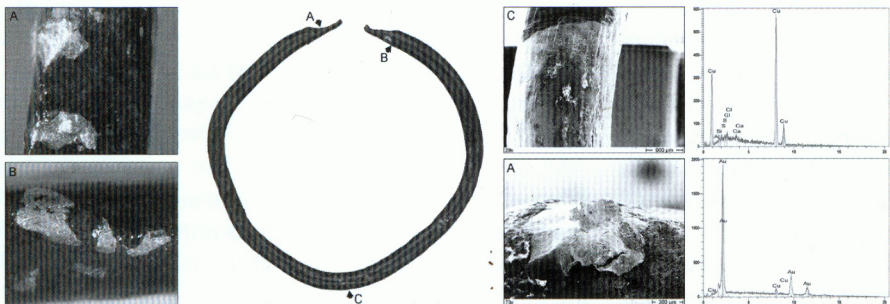


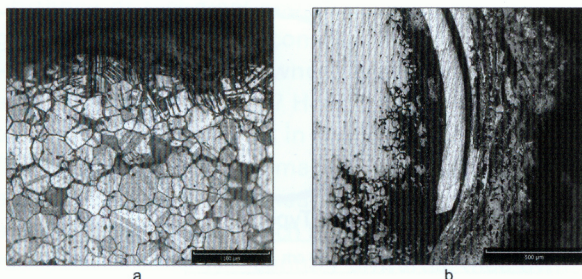
Fig.5: Gilded temple ring (n°1414).

Arts and coincides with the development of bigger diameter temple rings from thinner wire at the 12<sup>th</sup> century.

Results of elemental analysis have shown that most of the temple rings were made of copper with small amounts of tin, lead and zinc although some were made of almost pure copper and a few of low zinc brass. Further investigation (Fig.2) also revealed

that several temple rings made of almost pure copper were tinned by hot-dip tinning (Fig.3), silver plated either with a 0,1 mm thick foil of silver (98,72 Ag %, 1,27% Cu) attached mechanically (Fig.4-6) either with a silver amalgam (71,37% Ag, 24,20% Cu, 4,43% Pb) or gilded with a foil of almost pure gold (98% Au, 2% Cu) (Fig.5).

Fig.6: Metallographic examination: a-section of temple ring No.1143 etched in alcoholic ferric chlorides which show the worked and annealed grain structure with twinning visible, variable grain size and strain lines near the surface;b- section of temple ring No.1122, etched in alcoholic ferric chlorides showing the overlapping of the silver foil over the copper alloy core.



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