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A copper cross-shaped mount from the stronghold of Stary Książ in Lower Silesia (late 9th–early 10th century) – the earliest known Christian artifact from the territory of present-day Poland? An attempt at cultural and technological verification

Abstract. In 1991, during research on the early medieval stronghold of Stary Książ (Wałbrzych area, Lower Silesia, southwestern Poland), a gilded copper plaque in the shape of a cross was found. Initially, the object was referred to in published research as late medieval (13th–14th century). However, subsequent studies showed the object to be older. The closest analogies for this artefact come from the Great Moravian Empire (Staré Město-Valy, Mikulčice). A fragment of a Great Moravian axe (*bradatica* type) was also discovered at the Stary Książ stronghold, dated to the late 9th–early 10th century. This paper presents the results of metallurgical research on the cross from Stary Książ. The technology used in the production (and gilding) process is analogous to that used in artefacts known from Great Moravia (e.g., from the Bojná site).

Keywords: early Middle Ages, Lower Silesia, Christianisation, Great Moravian State, devotional objects – crosses.

Stary Książ Castle[1] (German: *Alte Burg Fürstenstein*) (50.838173 N, 16.293014 E; Fig. 1) located in Lower Silesia within the Wałbrzych Foothills (Central Sudetes), entered the sphere of archaeological interest as late as at the turn of the 1990s. Situated next to the far better-known Książ Castle (German: *Fürstenstein*), from which it is separated merely by the rocky gorge of the Pełcznica River, Stary Książ has always remained in the shadow of that monumental stronghold – the third-largest castle

[1] From an administrative point of view, the site is currently located within the municipal borders of Walbrzych, Wałbrzych commune, Lower Silesian Voivodeship.



Fig. 1. Location of the Stary Książ hillfort in Lower Silesia and the Great Moravian sites referred to in this article: 1 – Stary Książ (Wałbrzych), 2 – Staré Město (Na Valách), 3 – Mikulčice, 4 – Bojná (developed by K. Jaworski)

in present-day Poland in terms of volume (after the Teutonic Castle in Malbork and the Royal Castle on Wawel Hill in Krakow). As a result, scholarly attention devoted to medieval defensive architecture in Silesia focused primarily on Książ Castle, while Stary Książ was treated either marginally or even overlooked entirely. Consequently, it was virtually absent from academic literature, whereas in guidebooks and popular publications, it was usually described as a site of uncertain chronology. Some authors considered it to be of medieval origin (most often pointing to the 13th century as the time of its construction), while others linked the beginnings of the site only to the final decade of the 18th century, when on the initiative of the owner of Książ Castle Count Hans Heinrich VI von Hochberg, a romantic castle imitating a medieval fortress was erected in that location. The designer and builder of this complex was the Hessian architect and painter Christian Tischbein. However, iconographic, cartographic, and chronicle sources dating from the period preceding the building clearly indicate that Tischbein executed his project on a site of an older defensive structure. Knowledge of these sources had not been incorporated into scholarly discourse until 1987[2].

[2] Jaworski 1987, p. 83 *ff.*, where earlier sources and views concerning the origins of Stary Książ are presented.

The early medieval phase of Stary Książ Castle in Walbrzych

In order to verify the hypotheses concerning the medieval origin of Stary Książ Castle, archaeological investigations were undertaken at the site in 1991. The research was carried out by a team from the Archaeology Department of the University of Wrocław assisted by volunteers from the Student Association of Sudetes Guides in Wroclaw. As early as during the first stage of research (surface surveys conducted in March 1991), a late medieval phase of the site was confirmed, dating to the second half of the 13th century and the first half of the 14th century. This finding refuted the view that the Hochberg family's late 18th-century romantic construction had been erected *in cruda radice* (literally: "on the raw root"). Subsequent excavation work not only confirmed this chronology but also demonstrated that the site had been fortified considerably earlier, namely, in the early Middle Ages[3]. Within one of the ramparts separating two parts of the outer settlement, a deposit of two iron objects was discovered in the body of the rampart: a fragment of an axe and a sickle-scythe[4]. The axe can be classified as a characteristic Great Moravian type known as *bradatica*. This artifact made it possible to date the early medieval phase of Stary Książ to the late 9th–early 10th century. Owing to the association made between the ramparts and the early medieval period, it was also possible to classify the stronghold's layout. As it turned out, the site represented a type of an extensive, multi-part stronghold situated on a rocky spur, separated from the adjacent plateau by a system of transverse ramparts and ditches, and defended on the side of the meandering river by steep, sometimes precipitous valley slopes (Fig. 2). This form is particularly characteristic of early medieval defensive architecture in Bohemia and Moravia. In Czech archaeological literature, strongholds of this type are referred to as *ostrožna*.

As a result of the archaeological research initiated in 1991, the main stages of the site's architectural transformation and development were identified within a relatively short time. The first phase consisted of an extensive, multi-part *ostrožna*-type stronghold dating from the late 9th century to the early 10th century, representing a form unique in the early medieval Silesia[5]. The second phase comprised a ducal

[3] At present, the early medieval phase of the Stary Książ site has been accepted by the majority of scholars (e.g., Boguszewicz 2010, p. 269; Czechowicz 2025, p. 39). A comprehensive multi-authored article devoted to the late 9th century beginnings of Stary Książ has been accepted for publication in the peer-reviewed scholarly journal Zeszyty Naukowe Zamku Książ (Jaworski *et al*. 2026).

[4] In 2020, in the immediate vicinity of the place where this deposit had been discovered, also within the rampart, two additional early medieval iron artefacts were found that may originally have formed part of the same assemblage, namely an iron auger and a torc-like ingot (Jaworski 2025, p. 185 *ff*.; Jaworski *et al.* 2026, Figs. 9, 10).

[5] In the Sudetes part of Silesia, there are two further *ostrožna*-type hillforts, both located at Myślibórz in the Kaczawa Foothills, raised on rocky spurs above the valley of the Jawornik stream. However, these sites are markedly smaller and less complex (single enclosure) than the Stary Książ hillfort.

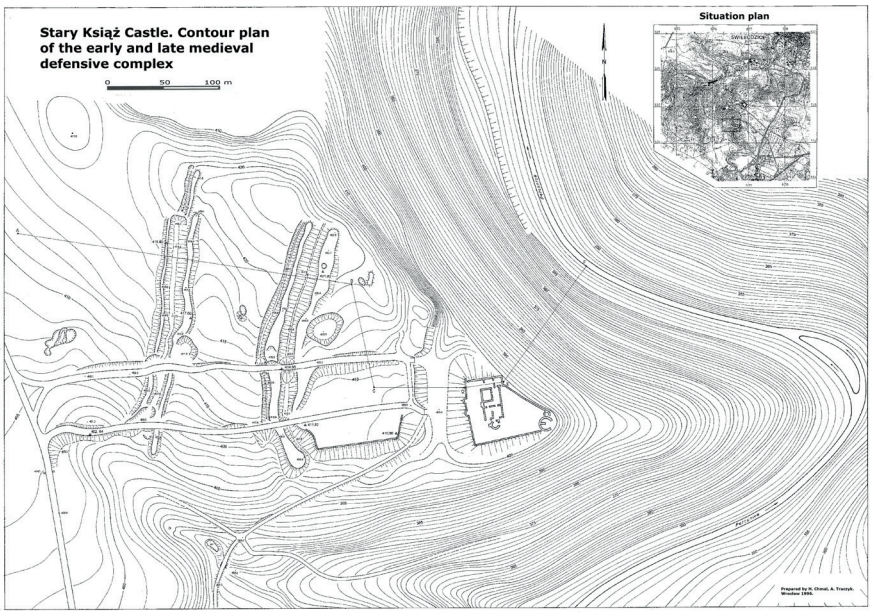


Fig. 2. Stary Książ Castle. Contour plan of the early and late medieval defensive complex (after Jaworski 2005, Fig. 41; developed by H. Chmal and A. Traczyk)

castle from the second half of the 13th century to the mid-14th century, partially built in stone and partially on the preceding structures. Finally, the third phase was the romantic, pseudo-Gothic complex erected at the end of the 18th century. This interpretation of the site holds to the present day despite subsequent research campaigns.

Apart from the two iron objects deposited in the rampart, the excavations conducted in 1991 and 1992 yielded very few artifacts that could be securely attributed to the early medieval phase of Stary Książ. Only a handful of pottery sherds were recovered, all without exception found within the rampart fills (a detailed characterisation of this ceramic material is presented further in this article). In trenches opened on the baileys, exclusively late medieval artifacts were encountered, specifically, ceramic vessels and iron objects.

The copper cross-shaped plaque – form and considerations regarding the object's chronology

In addition to ceramic material and a large number of iron artifacts, only two objects made of non-ferrous metals were recovered during these preliminary archaeological investigations. The first was a bronze profiled spur buckle with

a ribbed support for the prick, which has numerous analogies in Central Europe, most commonly dated to the third quarter of the 13th century (with the latest examples of such buckles produced no later than in the first half of the 14th century). The second object was a pendant or a mount in the form of an equal-armed cross (Figs. 3, 4). With its arm lengths of 4.2 cm and 4.0 cm and a width of 2 cm, the cross was cut in a copper sheet 0.8 mm thick and subsequently gilded on one side. At the time of discovery, a pair of rivet holes with a diameter of 2 mm was visible at the end of one of the arms; however, the artifact was damaged (chipped) in this area during conservation works. Nevertheless, the lower semicircular rim of these holes is still visible on the broken edge. The object was found in the first bailey, at a depth of 15 cm, within the uppermost layer of subsoil. At the findspot, only a few late medieval pottery sherds were present, albeit in a different stratigraphic position, i.e., the overlying layer of forest topsoil.

The earliest publications concerning the research at Stary Książ offer no detailed discussion of the chronology of the bronze cross. At the time, the artifact appeared to be regarded as "typologically vague". It was published on a plate that otherwise included exclusively late medieval iron artifacts. This figure appeared in scholarly publications (Jaworski 1994, p. 522, Fig. 7: h), popular-scientific works (Jaworski 1993a, p. 41, Fig. 7: h), and regional studies (Jaworski 1993b, Fig. 4: h). Attempts to identify close late medieval analogies for this artifact were unsuccessful at the

Fig. 3.



Fig. 4.

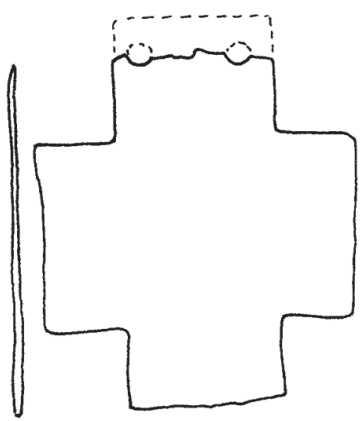


Fig. 3. Stary Książ Castle. Copper, gilded fitting in the shape of a cross. Research conducted in March 1991 (after Jaworski 2005, Fig. 147: a)

Fig. 4. Stary Książ Castle. Copper, gilded fitting in the shape of a cross. The fragment damaged during conservation work on the object is marked with a dashed line. Research conducted in March 1991 (after Jaworski 1994, Fig. 7: h)

time. Likewise, no similar objects from the late Middle Ages have been found in later archaeological literature. The horse harness elements in the form of a gilded bronze cross, published by Norbert Goßler (2011, pp. 127–128, Plates 5.117.10, 17.382.B), differ from the cross from Stary Książ in proportions, thickness, and the presence of a pendant.

The possibility of an early medieval origin of the Stary Książ cross was first raised by Miloš Šolle of the Czech Academy of Sciences (Prague branch) during the international conference "Silesia and Bohemia and the Great Moravian culture" held in Wroclaw in 1995. In the course of discussions on Great Moravian elements of material culture discovered in Silesia, he stated that in his opinion, southern provenance applied not only to the fragment of a *bradatica* axe and the form of the stronghold itself, but to the cross-shaped gilded copper mount, too.[6] In the course of the dispute, this view was supported by Krzysztof Wachowski, who had published the monograph *Kultura karolińska a Słowiańszczyzna Zachodnia* (Wachowski 1992) several years earlier, addressing, among others, the Christian cult-related objects present in the Great Moravian culture. In addition to the dominant forms of cast crosses bearing representations of the Passion of Christ, he also noted two modest crosses cut from a gilded bronze sheet, discovered (together with several other mounts made in the same material) in one of the graves at the Great Moravian cemetery in Staré Město. He described these artifacts as follows, "Cross-mounts with holes at the ends are quite clearly distinguishable. The examples discovered in grave 309/49 at the Staré Město cemetery were made of gilded bronze. One damaged cross had arms of equal width, while the other displayed a widening at the end. Both were undecorated" (Wachowski 1992, p. 71[7]). In Vilém Hrubý's study, both gilded bronze crosses are interpreted as mounts–fittings of a wooden reliquary box.[8]

[6] This discussion resulted in the inclusion of the Stary Książ cross into the early medieval scholarly discourse in the published conference proceedings (Jaworski 1997, p. 121, Fig. 6: c).

[7] The publication lacks references to earlier literature; undoubtedly though, the author relied on the cemetery monograph by V. Hrubý (1955).

[8] Its discoverer describes the artifact as follows, "Rozpadlá dřevěná schránka, kterou však nelze podle uchovalých zbytků rekonstruovat. Zůstalo z ní pět nepravidelných zlomků opracovaného dřeva, sevřených se dvou stran přehnutými proužky bronzového, slabě zlaceného plechu, jenž je na koncích přibitý vždy dvěma hřebíčky. Kromě toho byla v hrobě dřevěná destička ve tvaru kosodélniku o rozměrech 8 × 4 cm, na jejíž licní straně byly pěti hřebíčky přibité dva přes sebe zkřížené proužky zlaceného plechu stejných rozměrů, jake sou na dříve zmíněných zlomcích. Nejpozoruhodnější předmět z tohoto nálezového celku byl křížek o rozměrech 4,8 × 3,7 cm, vyřezaný ze dřeva 1,2 cm silného. Svým tvarem připomíná poněkud t. zv. cyrilometodějské kříže kamenné, známé z mnoha moravských obcí. Na něm je přibitý sedmi hřebíčky jiný křížek, vystřižený ze zlaceného bronzového plechu. Jeho ramena se k zaobleným koncům poněkud rozšiřují a dosahují asi délky dřevěné podložky; jen na spodní straně je plech křížku zahnutý tak, *že* kryje i spodni stranu dřeva. Tento nález, pro který neznám analogií, pochází asi z třetí *čtvrtiny* IX. století, jak se dá soudit podle hliněné *čutory* byzantského charakteru, která jej provázela" (Hrubý 1955, pp. 264–265). Translation: A decayed wooden box, the original form of which cannot be reconstructed on the basis of the preserved remains. What survived consists of five irregular fragments of worked wood, joined on two sides by bent strips of bronze sheet, lightly gilded, fixed at

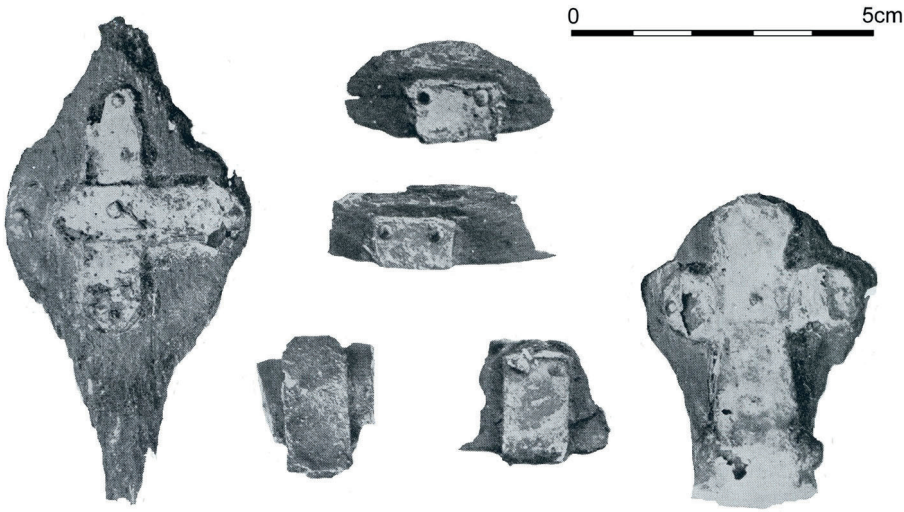


Fig. 5. Staré Město, early medieval cemetery from the 9th century. Grave 309/49. Gilded bronze fittings on a wooden relic box (after Hrubý 1955, Table 68)

Remains of wood adhering to the ungilded surfaces of these objects were identified (Fig. 5) (Hrubý 1955, pp. 264, 460, Plate 68: 1–2; Galuška 1999, p. 260).

The confrontation of the cross from Stary Książ with the materials originating from grave 309/49 at Staré Město was carried out solely on the basis of published literature. The original artefacts have always been inaccessible despite the fact that in 1999, one of the authors of the article exhibited the Stary Książ cross at a scholarly conference held precisely in Staré Město – Uherské Hradiště. In the published conference proceedings, the artefact from Stary Książ was presented as a presumed early medieval cross (Jaworski 2001, p. 202, Fig. 16: c). This hypothesis was objected by neither the audience of the paper nor the readers of the article. In subsequent years, the Stary Książ cross was presented on two further occasions at conferences organised in the Czech Republic and devoted to issues of the early Middle Ages in Great Moravia and neighbouring regions: in 2007 in Olomouc

the ends with two nails. In addition, the grave contained a trapezoidal wooden plate measuring 8 by 4 cm, to the front of which two crossed strips of gilded sheet metal of the same dimensions as those on the fragments mentioned above were attached with five nails. The most remarkable object from this assemblage was a cross measuring 4.8 by 3.7 cm, carved from wood 1.2 cm thick. In terms of form, it somewhat resembles the so-called Cyrillo-Methodian stone crosses known from many Moravian villages. Mounted on it were seven nails, as well as another small cross cut in gilded bronze sheet. Its arms widen slightly towards their rounded ends and reach a length close to that of the wooden base; only on the underside is the sheet metal bent so as to cover the bottom of the wood as well. This find, which has no analogies that I am aware of, probably dates to the third quarter of the 9th century, as inferred from the Byzantine-type clay canteen that accompanied it.

(International Conference "Arcidiecézní muzeum na olomouckém hradě") and in 2013 in Velehrad (International Congress "The Cyril and Methodius Mission and Europe. 1150 Years Since the Arrival of the Thessaloniki Brothers in Great Moravia"). On both occasions, a description of the artefact and photographs were published in the conference volumes (Jaworski, Pankiewicz 2010, p. 42, Fig. 35; Jaworski 2014a, p. 174, Fig. 5; 2014b, p. 178, Fig. 5).

During the Velehrad conference, a world congress marking the 1050th anniversary of the mission of Saints Cyril and Methodius to Great Moravia, the Czech archaeologist Blanka Kavánová drew attention to what she considered a close analogy between the Stary Książ cross and a reliquary fitting discovered near Great Moravian church no. 12 at Mikulčice. This fitting takes the form of a cross cut in bronze sheet (91% Cu, 8% Sn), with a figure of Christ engraved on the front side, rendered in the *Maiestas Domini* type (Kavánová 2003, p. 272, Figs. 88, 92; Kouřil 2014, p. 112, Fig. 1: 4). Three of the four arms of this cross bear two rivet holes each (Fig. 6). On the termination of one of the horizontal arms, the rivet holes did not survive due to damage to the object. According to Blanka Kavánová, the original form of the Stary Książ artefact was likely simpler, lacking the engraved figure of Christ, of a similar fitting from a wooden reliquary box. A comparison in the dimensions of both artefacts lends plausibility to this hypothesis (Fig. 7).

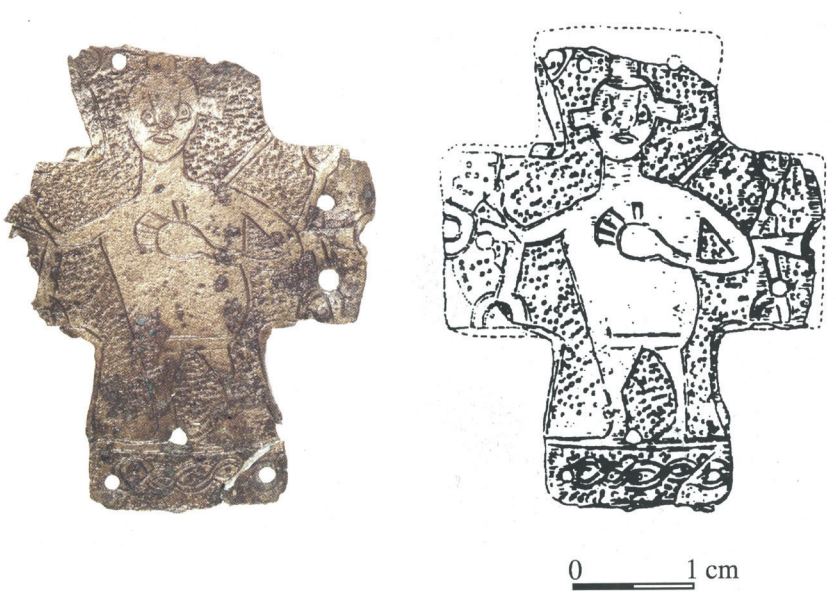


Fig. 6. Gilded bronze plaque in the shape of a cross from Mikulčice with an engraved figure of Christ (after Kavánová 2003, Figs. 88, 92)

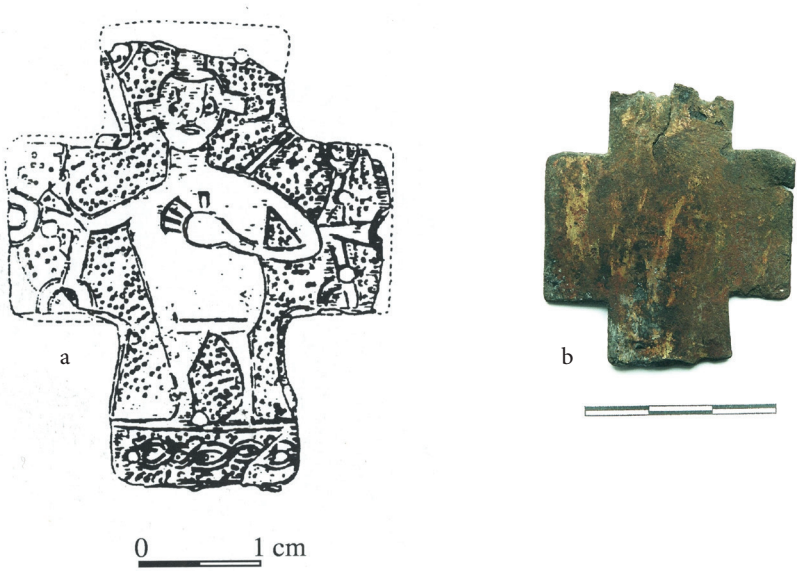


Fig. 7. Size comparison of gilded plaques in the shape of a cross: the copper plaque from Stary Książ (a) and the bronze plaque from Mikulčice (b) (a – after Kávanová 2003, Fig. 88; b – after Jaworski 2005, Fig. 147: a)

Considered an early medieval product, the Stary Książ cross was first presented in Polish archaeological literature in 1997 (Jaworski 1997, p. 121, Fig. 6: c; 2001, p. 202, Fig. 16: c), and somewhat later in a monograph on Sudetes strongholds from the 8th to the 10th centuries, in a section devoted to interregional contacts of their inhabitants (Jaworski 2005, p. 278, Figs. 15, 147: a). Subsequently, it appeared in several studies addressing the problem of a possible 9th-century Christianisation of Silesia initiated from Great Moravia (Jaworski 2011, p. 35, Fig. 7: a; 2014a, p. 174, Fig. 5; 2014b, p. 178, Fig. 5).

In a study devoted to the oldest artefacts known from the present-day Poland attesting to an early medieval perception of the Christian idea, its author Adam Soćko writes about the Stary Książ find, "A Silesian provenance can be also attributed to the simple cross from Stary Książ (today within the city of Walbrzych), where from the turn of the 10th century, a stronghold was operating, replaced by a fortified castle in the 13th century. The find is linked to the earliest phase of the stronghold's occupation. Thus, the Stary Książ cross is probably the oldest mark of Christianity discovered so far in Poland. However, it would be difficult to argue on this basis that the Christianisation of the entire Silesia (and Lesser Poland) took place at the end of the 9th century on the initiative of the rulers of the Great Moravian state" (Soćko 2016, p. 49, Fig. 9). This object is also considered early medieval by Sylwia Rodak, the author of the catalogue of the archaeological exhibition at the Stara Kopalnia

Museum in Wałbrzych, presenting archaeological finds from Stary Książ (Rodak *et al.* 2025, p. 55, Fig. 54).

Unsurprisingly, the link between the cross from Stary Książ and the Great Moravian state, which existed from the 820s until the beginning of the 10th century, raises a number of specific questions. In the light of the most recent findings (Jaworski 2014a; 2014b; Pankiewicz 2020, p. 71 *ff.*), contacts between the inhabitants of the southern part of the present-day Silesia, that is, the areas located in the Sudetes and sub-Sudetes zones of the region, seem no longer debatable. At most, considerations may be raised as to the details and the nature of these contacts. Artefacts originating from Great Moravia have been discovered at numerous archaeological sites in Lower and Upper Silesia; sometimes, the cultural context of such finds could prompt one to argue for the physical presence of Great Moravian population groups in that area. The large, extensive, multi-part stronghold at Gilów near Niemcza about 45 km south-east of Stary Książ is interpreted as an investment made by Great Moravia in the present-day Lower Silesia (Jaworski 2012 – with earlier literature).

However, artefacts of the Great Moravian type most often constituted an alien component within the local Silesian cultural environment, manifested primarily by the exclusive presence of local pottery lacking technological and formal features referring to Moravian or Bohemian ceramics at individual sites. Examples of such sites containing single artefacts of the Great Moravian type include the stronghold on Mount Gromnik in the Strzelin Hills (a *bradatica* axe, a bronze *gombik* button, a knife for woodworking or for grooming horse hooves – cf. Lisowska 2017, p. 410 *ff.*, Fig. 4; Pankiewicz 2020, pp. 120, 374;) and the site at Nowy Jaworów on the Świdnica Plain (a bronze *gombik*; oral information from the site investigator, Jakub Pawlicki). The latter is of particular importance. The site is located only about 7 km from Stary Książ and lies on the same river, the Pełcznica. It has been dated by radiocarbon analysis to the last quarter of the 9th century, and the pottery discovered there displays technological and stylistic features identical to those present on the early medieval ceramic assemblage from Stary Książ.

As mentioned above, early medieval ceramic materials were initially found at Stary Książ exclusively during investigations of the ramparts of the stronghold. It was only during the excavations carried out in 2020 in the courtyard of the outer bailey (part I) that the first early medieval pottery sherds were discovered outside the ramparts, albeit in the same stratigraphic context as the dominant late medieval ceramics. From a typological point of view, the early medieval pottery from Stary Książ may be classified as the so-called smooth pottery, characteristic of sites dated to the second half of the 9th century and the beginning of the 10th century in the southern part of Lower Silesia. According to Aleksandra Pankiewicz, who introduced this pottery type into scholarly discourse and defined its characteristic features, it was produced by the local Slavic population, primarily by potters

operating within the Silesian (*Ślężanie*) tribal community (Pankiewicz 2005, pp. 70, 77; Jaworski *et al.* 2022, p. 87).

Smooth pottery is either the exclusive or the clearly dominant component of ceramic assemblages originating from sites in the Sudetes Foreland and the adjacent parts of the Western and Central Sudetes, dated to the second half of the 9th century and the first decades of the 10th century. Apart from Stary Książ, Nowy Jaworów and Gromnik, it has also been recorded at Grodziszcze, Mierczyce, Stary Zamek, Gniewków, at the stronghold on Mount Janówka near Świebodzice, and at other sites. It is present even at the stronghold in Gilów, although in relatively small quantities, up to 10% within some features and layers (Pankiewicz 2012, p. 95), and may be interpreted as evidence of contacts between the founders and users of the stronghold arriving from the south and the local Silesians population encountered there.

The presence of artefacts of Great Moravian provenance at sites characterised by standardised smooth pottery indicates that these culturally alien objects were sufficiently attractive to reach native communities in the upper Oder river basin as imports. One may ask whether they arrived in Lower Silesia directly from Great Moravia or Bohemia, or whether the stronghold at Gilów served as a centre redistributing these southern products. The latter possibility appears to be highly plausible. The artefacts found during the excavations at this stronghold included stone whetstones made of quartz-sericite schist (also known as the Jegłowa schist), quarried on the eastern slopes of Mount Gromnik (Jaworski, Wójcik 1997, pp. 121, 138, Figs. 3: d, 9; Lisowska 2013, p. 207, Fig. 84: 3). At the same time, as indicated above, several spectacular artefacts of the Great Moravian type were discovered at the stronghold on Mount Gromnik and in its immediate vicinity.

Can the small cross from Stary Książ be considered an object pointing to Moravian–Silesian trade relations, too? So far, all the Great Moravian artefacts discovered in Silesia are either elements of weaponry, tools, or ornaments. The find from Stary Książ would be the first object of a cultic, Christian character. Its symbolic significance is even greater if it is interpreted not as a cross in itself, i.e., an isolated cult object, but as a presumed fitting of a wooden reliquary, an item of decidedly higher status among Christian devotional objects. In the latter case, the appearance of such an artefact in Lower Silesia would represent not only a movement of a single object into a new territory, but above all, evidence the transmission of an idea that cannot be separated from the movement of people who propagated it. However, at the present stage of research on the Stary Książ site, it is unquestionably too early to search for a proof of a Great Moravian mission operating in the upper Oder river basin. Among other reasons, this is due to the fact that the early medieval date has been associated with the gilded copper cross based almost exclusively on two analogies for this object. Moreover, these analogies come from the most important Great Moravian agglomerations, for which the stronghold at Stary Książ constituted

a deep peripheral hinterland and was therefore in no way comparable to them in scale. In addition, the hypothesis relies on the discovery of a single artefact of Great Moravian provenance at the site, namely, a *bradatica*-type axe.

Therefore, it seems that apart from resuming excavations at Stary Książ, the only step in the scholarly procedure that may allow one to verify the hypothesis linking the artefact with Great Moravian Christianity and yield new insights is metallurgical analysis. Although the crosses from Staré Město and Mikulčice are not currently accessible to the authors of this paper for such analyses to be conducted, there has been a relatively recent published study concerning six gilded copper plaques decorated with Christian motifs. They were discovered at the Great Moravian stronghold of Bojná in the Inovec Mountains, part of the Carpathian range in Slovakia, and the study itself includes metallurgical analyses of these artefacts (Mehofer, Leusch 2007, p. 79 *ff.*). Research on the chronology of the Bojná stronghold indicates that it was operating concurrently with the stronghold at Stary Książ, albeit in a completely different part of Western Slavic territory, namely, in the 9th century and the beginning of the 10th century (Pieta, Robak 2023, p. 95 *ff.*). In the present article, the results of archaeometric analyses of the Stary Książ cross are compared with the findings pertaining to the artefacts from Bojná.

Metal analyses of the cross from the Stary Książ site: method, interpretation, and discussion

Non-destructive analytical studies[9] were carried out twice, i.e., before and after the re-conservation treatments. The analyses included both the upper and lower surfaces, as well as a prepared cross-section, cleaned thoroughly to the metallic phase prior to the conservation work. The results obtained from the analysis of the prepared cross-section indicated that the strongest analytical signals originated from copper, while the remaining elements produced a distinctly weaker response to excitation. Semi-quantitative analysis established that the copper content amounted to 97–98%, whereas the proportions of iron, zinc, tin, antimony and silver did not exceed 0.5% by weight and were usually around 0.2% by weight. Arsenic is an exception, as its level reaches 0.5–0.6% (Fig. 8: a, b). A similar set of results was obtained from the examination of one of the surfaces of the cross, fairly

[9] The cross was examined using two analytical techniques commonly applied in the study of artefacts. The first method was energy-dispersive X-ray fluorescence spectrometry (ED–XRF), carried out with a Spectro Midex IV generation microspectrometer, using a 0.5 mm collimator, Midex II software, measurement time of 180 s, excitation energy of 45 kV and current of 0.50 mA. Subsequently, the artefact was analysed using a scanning electron microscope coupled with energy-dispersive spectrometer Hitachi Table Top TM4000 SEM with an Oxford Instruments spectrometer. Measurements were performed in Standard (M) mode, using a BSE detector, with a measurement time of 60 s in sensitive mode, an accelerating voltage of 15 kV, a beam current of 99,000 nA and a working distance of 7–10 mm.

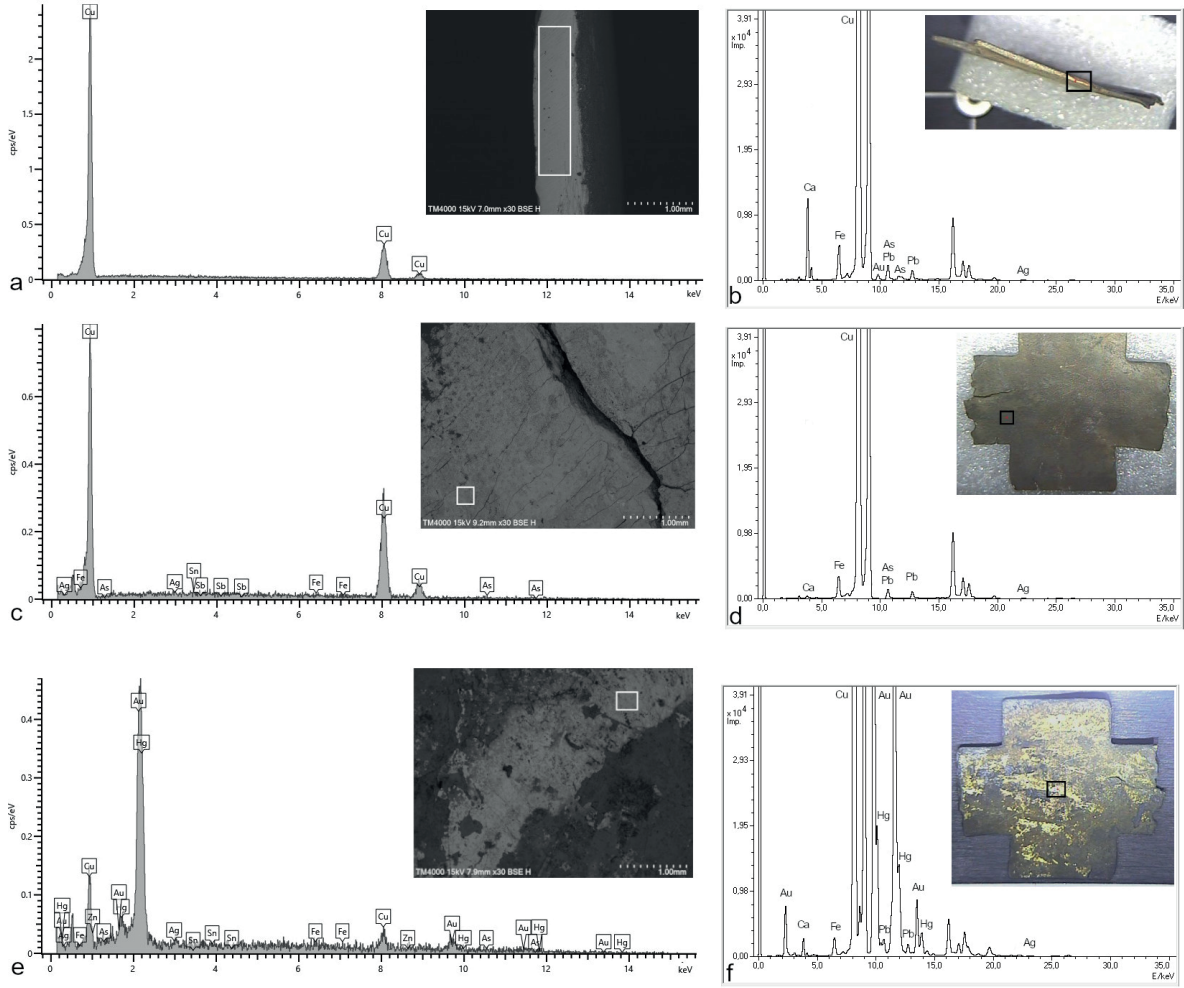


Fig. 8.
XRF and SEM-EDS spectra and images of areas selected for analysis: cross section, reverse and obverse of the cross (developed by B. Miazga)

strongly oxidized and identified as the reverse side of the object. Here too, copper content was dominant, and the concentrations of other identified elements did not exceed 0.3% (Fig. 8: c, d).

The most distinctive analytical area is the front surface, which bears traces of golden layer. Examination using both analytical techniques confirmed the presence of copper signals, as well as much weaker signals attributable to gold. Other peaks were also identified, indicating the presence of mercury. Signals from the remaining elements are clearly less intense (Fig. 8: e, f). The gilding layer present on the front surface is not preserved in its entirety. In many areas it is not only outlined and cracked (Fig. 9: a, c), but also heavily damaged or completely absent, being covered by copper corrosion products and mineral impurities (Fig. 9: b). Its thickness is small and amounts to approximately 1.5–2 μm (Fig. 9: d).

The use of a raw material based on almost pure copper is a very practical solution. Apart from the high nobility of this metallic element and thus its considerable resistance to corrosion, copper is also soft, malleable and ductile (Bielański 1976, p. 632). These properties can be successfully exploited for relatively easy shaping of an object, especially one of such a simple, flat form as a cross. In addition, the use of "pure" copper rather than bronze is more advantageous when later gilding

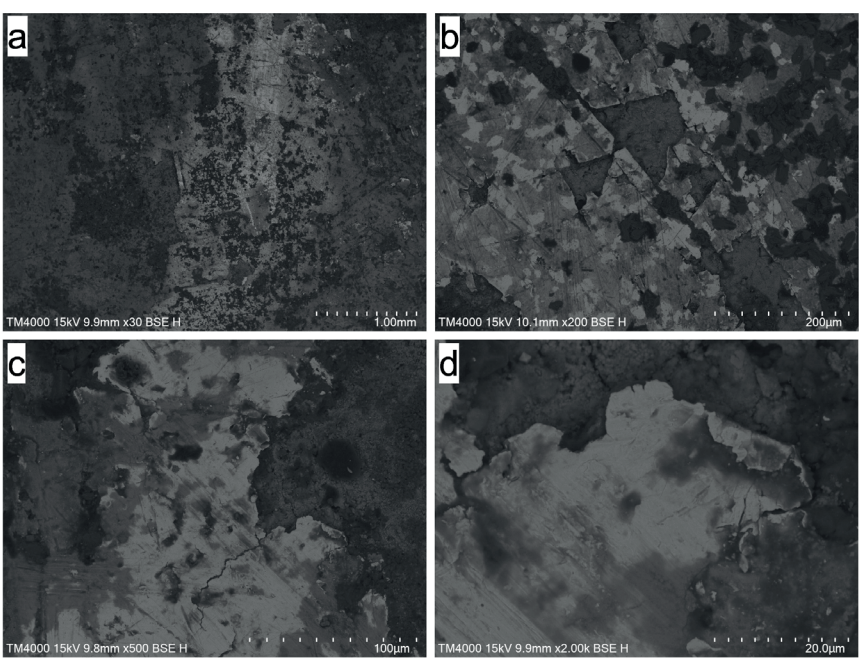


Fig. 9. Cross surface with preserved gilding, showing varied states of preservation. Scanning electron microscopy, magnification 30–2000× (developed by B. Miazga)

of one side of the cross is taken into account (Oddy 2004, p. 254 *ff.*; Aufderhaar 2009, p. 244 *ff.*; Bayley *et al.* 2009; Darque-Ceretti *et al.* 2011; Masi *et al.* 2016; Rychter, Strzyż 2019; Ma *et al.* 2023). For this purpose, fire gilding was employed, a technique widely used in the Middle Ages (*Teofil Prezbiter* 1998, p. 80 *ff.*; Ottenwelter *et al.* 2020). Identification of the gilding method was made possible by analysis of energy spectra from various areas of the cross surface. The detection of mercury signals alongside those of gold provides clear evidence for the use of a gold amalgam applied with considerable precision to one side of the cross. On the opposite surface, no traces of mercury or gold were identified. The gilding of objects made of copper or silver is not a rare practice in the early Middle Ages. Estelle Ottenwelter et al. report finds of gilded *gombik* buttons from the territory of the Czech Republic, occurring in Bohemia and Moravia from the first half of the 9th century. Advanced surface studies of the raw material and technology of these artefacts have demonstrated fire gilding of the examined objects, which were also most often made of nearly pure copper.

The studies conducted on other Great Moravian finds of crosses fail not provide much comparative data concerning raw materials and technology. One of the more noteworthy examples is the information on an enkolpion discovered in Želiezovce in southern Slovakia, described as being made of bronze, although without publication of detailed analytical data (Robak 2018). Slovakia is the area that yet another cross comes from, specifically from Dolní Orešiany, described as bronze, along with a Greek cross measuring 2.5 by 2.5 cm from Zlaté Moravce, described as gold (Hanuliak, Pieta 2014). Slovak researchers also refer to six plaques from the Bojná I site, described as gilded copper, which will be discussed in more detail further in this section. A completely different technological context is presented by 21 rhomboid cross pendants found within the territory of the former Great Moravian state, including sites such as Mikulčice, Čejč, Dolní Věstonice, Gars-Thunau, Maissau, Mutěnice, Pohansko near Břeclav, Prušánky, Brno-Líšeň-Staré Zámky and Velké Bílovice, which have been identified as lead artefacts[10] (Kouřil 2023). In turn, the cross-pendant reliquary found in Zagórze in the Świętokrzyskie region was made of gold (Kubica-Grygiel, Grygiel 2018). The authors also cite other early medieval finds of crosses from Central Europe, pointing to raw materials such as amber, gold, silver, bronze, tin, lead, or reused Arabic dirhams, as well as fairly frequent decoration in the form of filigree or relief depictions of Christ Crucified. Other additions to crosses are also mentioned, including gemstones. Against this background, the find from Stary Książ represents a different type of cross, with a very simple form, without decoration or additional elements. This clearly illustrates how wide a range

[10] The author reports that the cross found in Mikulčice contains 99.6% lead, and that two finds from Maissau are made of the same lead-based material, as indicated by the results of XRF analyses.

of raw materials was used in the early phases of Christianity for the production of objects of religious cult, including crosses.

Pursuing the technological line of inquiry further and focusing on other artefacts of similar chronology or construction, the study of six plaques from Bojná, examined by Mathias Mehofer and Verena Leusch (2007) using scanning electron microscopy coupled with EDX spectroscopy seems to be of particular importance. The results of analyses of the front surfaces of all plaques indicate that they were gilded using the fire-gilding technique. Very high proportions of gold (from 74 to 94% Au) are accompanied by silver (on average 1 to 2% Ag), copper (usually a few per cent Cu), and mercury (reaching up to 11% Hg). Such a relatively wide spread of results is natural for spot or micro-area analyses of archaeological artefacts, which are often oxidized and may also have been subjected to post-discovery treatments such as cleaning. Spot analyses of several areas on the fronts of the plaques revealed a marked dominance of copper, reaching up to 99% Cu. The authors attribute this to corrosion processes, although a simpler explanation seems to be that in these points signals from the base material were recorded, that is, from the metallic substrate beneath the gilding. This interpretation is supported by the SEM images published by the researchers, which show discontinuities in the gilding layer on the plaque surfaces and exposed metallic bases (Mehofer, Leusch 2007, Plate 4, Photos 2–5). The substrate in this case is copper[11], as M. Mehofer and V. Leusch indicate later in their text when presenting the results of analyses of the reverse sides of the plaques. The copper present there is already somewhat oxidized and contaminated, as evidenced by significant proportions of carbon, oxygen and silicon. Importantly, however, tin is absent at a level that would allow these plaques to be classified as bronze artefacts (Mehofer, Leusch 2007, Table 2).

In summary, the data concerning the plaques from Bojná indicate that they were made of copper fire-gilded, most probably on one side only, although occasional "splashes" of gold and mercury also occur on the reverse surfaces. A similar set of data emerges from the study of four fragments of Late Carolingian plaques from Rétközberencs-Parom-domb, analysed using the XRF method. The results showed that the plaques were made of nearly pure copper, with an average of 98.4% Cu, and that one surface was fire-gilded. In this case, a copper content of almost 48% was accompanied by 46% gold and 4.7% silver (Bollók 2015). In the case of the cross from Stary Książ examined here, the results obtained for both the gilded layer and the copper base are very close to those reported for the artefacts from present-day Slovakia and Hungary discussed above.

[11] The researchers analyzing the plaques Bojná concluded that the presence of tin in the uncleaned fragments of plaques 3, 4 and 5 should rather be attributed to contamination of the copper raw material, resulting from repeated use of crucibles or material recycling, rather than to the intentional use of bronze, especially given that the data derive from point analyses of archaeological objects (Mehofer, Leusch 2007, Table 3, Plates 7: 3, 8: 1–2).

Summary

The copper crossgilded on one side discovered in 1992 at the Stary Książ hillfort near Walbrzych was made of nearly pure copper (97–98%), with a small addition of arsenic (0.5–0.6%) and even smaller amounts of iron, zinc, tin, antimony and silver (on average about 0.2%). One surface of the object was covered with a 1.5–2 μm thick gold layer. The process employed the fire-gilding technique, using mercury. The detection of mercury signals indicates the use of a gold amalgam, which was applied with considerable care to the upper surface of the cross.

Elemental analyses carried out on the gilded copper cross from Stary Książ have not undermined the hypothesis of its early medieval date. In light of the results obtained, such an interpretation remains fully justified. The object was made of a raw material known and used in the manufacture of analogous artefacts in the 9th century in the territory of Great Moravia, from where it most probably reached what is now Lower Silesia. The same gilding techniques were applied in its production as those used in the Danubian regions. Formal analogies (Staré Město, Mikulčice) and technological parallels (Bojná, Rétközberencs-Parom-domb) seem to point in this interpretative direction with regard to the cross from Stary Książ, unique in the context of present-day Polish territory. At the very least, they do not invalidate this hypothesis.

It is possible that a decisive step in research on the chronology and cultural significance of this artefact will be taken not in Lower Silesia and not in Lower Silesian laboratories, but in the Czech Republic, Moravia or Slovakia, at one of the research institutions located there. It would be worthwhile to carry out parallel specialist analyses of the Stary Książ artefact and the analogous objects cited in this article, discovered in the core area of the former Great Moravian state, under identical laboratory conditions, using the same equipment and the same research methods. The authors of the present study are prepared to make the artefact available for laboratory analyses outside the borders of Poland. Such research may ultimately determine whether the gilded copper cross from Stary Książ reached the upper Oder basin from the territory of the Great Moravian state and whether it can be regarded as the earliest evidence of Christian practices on the present territory of Poland.

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