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Cover Illustration
Quadrangular bottle with faceted corners and gilded decoration; 18th/19th century; H. 29.2 cm, W. 11.6 cm; Palácio Nacional de Queluz, Portugal; accession no. PNQ 1653/1

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CHARACTERISTICS OF THE METAL-LEAF GLASS TESSERAE PRODUCED BY PUHL & WAGNER FOR THE MOSAICS IN THE DITTRICH CRYPT IN KRÁSNÁ LÍPA, CZECH REPUBLIC

Brigitta Maria Kürtösi, Jan Vojtechovsky, Karol Bayer

ABSTRACT

This paper concerns the study of the various types of metal-leaf glass tesserae which compose the mosaic in the 100-year-old underground crypt in Krásná Lípa/Schönlinde. This prestigious burial building was designed by architect Julius Carl Raschdorff in 1888–89, and the interior decoration is connected to August Frind. The survey performed as part of an international cooperation project aimed to detect the general condition, damage and special features of the mosaic before a possible future conservation project. It was feasible to sample and investigate the main characteristics of the metal-leaf glass tesserae, which revealed that they were made by the German company Puhl & Wagner. This paper presents the study findings based on in-situ analysis. Some of the results reveal that the glass tesserae were probably made in Berlin using Italian methods but with more individual details. The study analysed a variety of glass types ranging from translucent yellow, blue and green to a variety of opaque pieces. Various tints of *cartellina* were also detected, which can modify the hue of the metal and thus the complete appearance of the tesserae. Based on our analyses, the chemical composition of the glass and metal layers and the visible surface character of the tesserae were identified. This paper provides an insight into research conducted at a lesser-known site using non-traditional techniques.

Keywords: metal-leaf tesserae, gold, mosaic, Puhl & Wagner, Krásná Lípa

INTRODUCTION

This paper concerns the study of the various types of metal-leaf glass tesserae which compose the mosaics in the underground crypt in Krásná Lípa, formerly Schönlinde, in the North Bohemia region of the Czech Republic. The prestigious burial building was designed by Berlin architect Julius Carl Raschdorff in 1888–89. The interior decoration, linked to the local artist August Frind (1852–1924), was finished in 1897.[1] The building complex has been a protected monument since 2006 (ref. no. 102404).

CONTEXT

The crypt of the Dittrich family, which was designed in the form of a Greek cross, is unusual for its architectural complexity, modern heating and electrical system, interior decoration and dedication. This huge burial complex was designed and executed for the family of the textile industrialist and businessman Carl August Dittrich (1819–1886). The interior of the building has two levels. Wall paintings decorate the ground floor and approximately 150 square metres of glass mosaics cover the walls and vaults (Figure 1). The inner space is naturally illuminated via a large, round horizontal opening between the two levels that provides a view into the crypt. This opening is more than three metres in diameter and is centrally located just above the sarcophagus. To enhance the lighting, six additional lamps were installed in 1894.[2]

After the death of Carl August Jr., Dittrich's only son, some modifications were made to the building structure in 1919–1920 by the company Lossow & Kühne from Dresden and to the mosaics by the company Puhl & Wagner from Berlin.[3] In contrast to the luxurious gold-decorated walls of the crypt, the mosaic decoration in the east and west chambers is restrained, revealing an imitation silver surface

[1] VĚTROVSKÁ 2020.
[2] VÁGNER 2015.
[3] VĚTROVSKÁ 2020.

Fig. 1: Interior of the Dittrich crypt decorated with glass mosaics in 1921. Krásná Lípa, Czech Republic, 2018. Photo: J. Vojtechovsky

using opaque coloured tesserae without metal foil. Metal-leaf mosaic tesserae cover the six spherically concave surfaces designed directly for use with the electric lights, which is important for dating of the mosaic. Although Carl August Dittrich was already dead by 1886, the mosaic, as mentioned above, was not created until 1894, eight years later.

ICONOGRAPHY

The iconographical programme is both eternal and personal, with four larger and four smaller tondos visible against the gold and silver-grey background. The larger expanses depict allegorical angel figures with the symbols of the passage of time. They are composed in light colours with brown silhouettes on a blue background. The smaller tondos in the side chambers display the stages in the life of a silkworm, reflecting the cycle of life and the fleeting nature of time, and imply the family's connection to textiles. There are two hidden niches in the north and south walls with ceilings depicted as star-studded blue skies.

AIMS

The survey performed as part of the international cooperation project aimed to detect the general condition, damage and special features of the mosaic prior to a possible future conservation project. The paper is intended to provide an insight into the ongoing investigation of a lesser-known site and the use of a slightly unusual mosaic production technology. It was hoped to analyse the chemical composition of the glass and metal layers and to identify the visible surface character of the tesserae. The intention was also to examine the stratigraphy of the mortar layers and the original mounting procedure to be able to draw conclusions about the workshop technology.

PROVENANCE OF THE MOSAIC TESSERAE

The Puhl & Wagner glass factory and mosaic workshop in Berlin was founded in 1889 by Friedrich Puhl and August Wagner as 'Deutsche Glas- und Mosaikgesellschaft Puhl & Wagner' in Berlin-Rixdorf. The firm merged in 1914 with the smaller

company belonging to the glass painter and mosaic artist Gottfried Heinersdorff (1883–1941) who was probably active until 1926. From 1918 onwards, the firm was called 'Vereinigte Werkstätten für Mosaik und Glasmalerei Puhl & Wagner, Gottfried Heinersdorff'.[4]

As the patent disclosure reveals,[5] Puhl & Wagner invented a method in 1905 to produce its own metal-leaf tesserae. The description emphasises the visually advantageous effects of the translucent glass support for the metallic tesserae. The mosaics on the crypt vault show a huge variety of metal-leaf tesserae made of both translucent and opaque glass with many differences in terms of colour, thickness and surface character compared to ancient and medieval styles. Heinersdorff mentions that the Puhl & Wagner Company managed to produce gold glass that could be used to decorate darker spaces.[6] He also notes that by using the metal-leaf glass, the glass paintings and mosaics do not lose their magical shine after sunset.

Traditional metal-leaf tesserae were made by the hot fusion of three layers: two of glass and a metal one in between.[7] The support consists of a poured glass base made from either translucent or opaque glass depending on the historical time and location. The metal layer is then placed on top of the glass support and covered by the *cartellina*, a thin blown glass layer which not only protects the metal leaf but also contributes to the overall colour and adds a glittering effect.[8]

EXPERIMENTAL

It was possible to sample and study the main characteristics of several of the metal-leaf glass tesserae based on in-situ microscopic analysis, from which it was concluded that they were made by Puhl & Wagner. The samples studied were labelled from A to N and with the letters KL for Krásná Lípa. In the first part of the research, six tesserae (KL_A–F) derived from a detached fragment of mortar that had fallen from the central part of the vault near the south-west corner (Figure 2) were examined. The other eight samples (KL_G–N) comprised detached tesserae lying on the floor near the south-east corner that were collected in February 2020.

Optical microscopy was carried out on raw fragments and polished cross-sections with a Nikon SMZ800 stereo microscope equipped with a Canon EOS 1000D camera and a Nikon Eclipse LV100 polarised light microscope coupled with a Canon EOS 1100D camera. The examination was combined with scanning electron microscopy/energy-dispersive X-ray (SEM/EDS) spectroscopy (Tescan Mira 3 LMU) performed on polished cross-sections.

RESULTS

The results of this research reveal that the glass tesserae were probably produced in Berlin using Italian methods but with individual details. The Puhl & Wagner company followed the methods of Salviati & Co., founded by Antonio Salviati, a lawyer from Vicenza, and Lorenzo Radi, a Muranese glass maker, in 1859.[9] Puhl & Wagner, like the Róth workshop[10] in Austria-Hungary, used the so-called indirect method[11] of mosaic production. Miksa Róth mentioned the mosaic art of Salviati in Italy and that of the Puhl & Wagner company in Germany in his memoirs.[12]

During the in-situ work, the boundaries of the studio-prepared mosaic sections could be defined, as the interstices were easy to recognise. It was possible to see that the mosaicists handled and juxtaposed mosaic sections of approximately 30 × 55 cm while working on site. To create a rich golden appearance

4 Berlinische Galerie 2020.

5 Kaiserliches Patentamt 1907.

6 Heirnersdorf 1914, 32–34.

7 Neri and Veritá 2013, 4596.

8 There are cases when the chemical changes in the covering glass occur as tone alteration. The original colourless transparency of the glass can turn into a pale purplish transparency by the oxidation of manganese ions as a consequence of so-called solarisation, which also can lead to a change in the mechanical properties. In the early 20th century, glass made not only with manganese dioxide (MnO_2) but selenium (Se) or cerium (Ce) as a decolouriser could undergo this process and the photo-oxidation could induce yellowish, amber hues in the clear glass. In our case, the glass mosaics of the crypt are not exposed to direct sunlight so such alterations could not occur.

9 Salviati Mosaics 2020.

10 Róth 1943, 64.

11 Deutsche Glasmosaik-Gesellschaft Puhl & Wagner 1900, 7.

12 Róth 1943, 62.

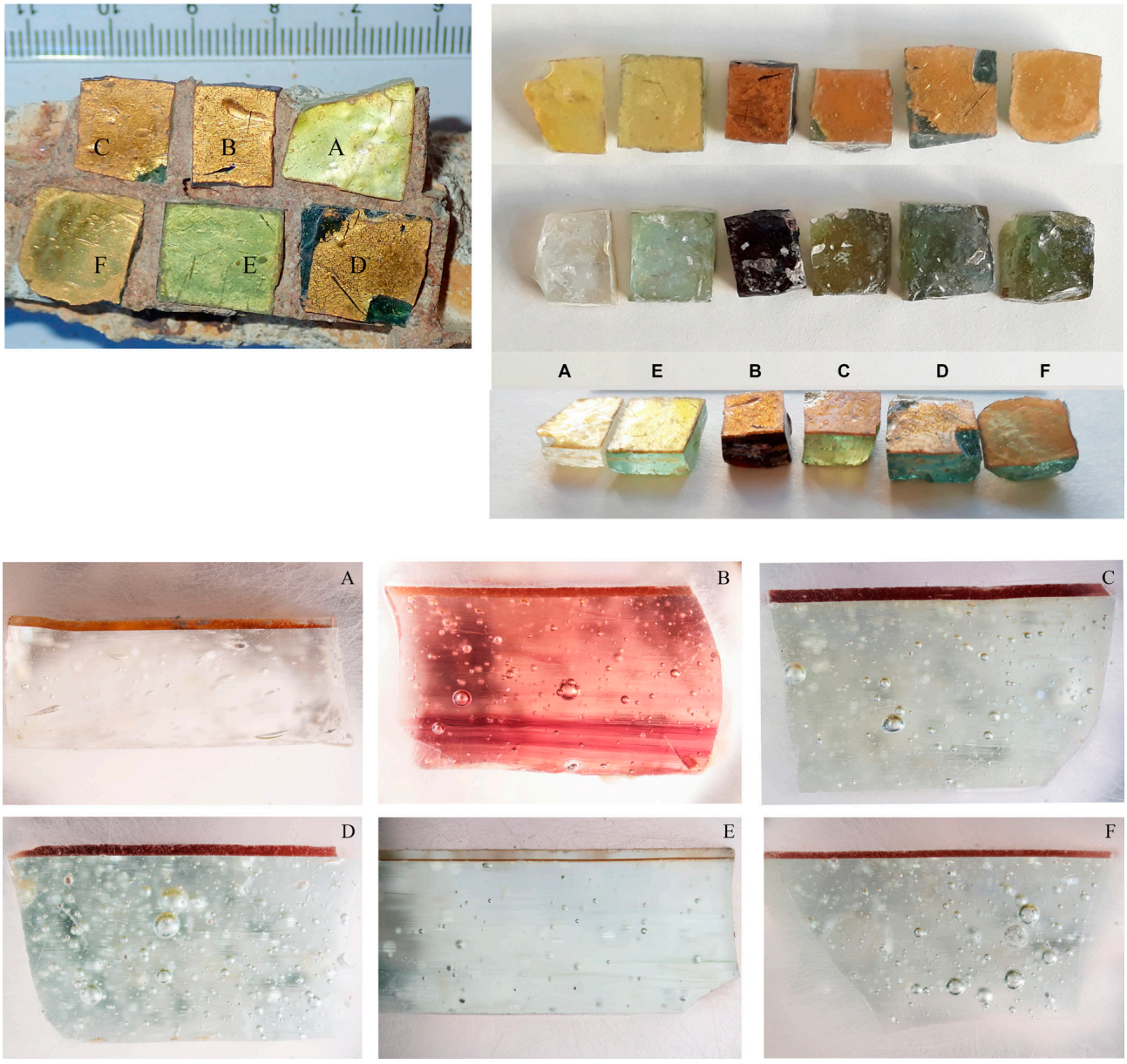

Fig. 2: Views of the metal-leaf glass tesserae (samples KL_A–F) in different examination phases: in a mortar fragment, from the front, from the back, from the side and photomicrographs of the polished cross-sections. Dittrich crypt, Krásná Lípa, Czech Republic, 2020. Photo: B. M. Kürtösi

composed of wavy lines, the mosaicists combined different metal-leaf tesserae that included triangles and other shapes as well as rectangular mosaic pieces. To achieve this special surface, they probably preblended an assortment of tesserae in the workshop to achieve the irregular appearance.

Description of the tesserae

Among the smooth gold tesserae used in the mosaic, there is a remarkable number of pieces with a typical wavy surface (KL_I, J, L, M, N) and alternating thickness (KL_L, M, N) (Figure 3). In the case of the samples examined, the colour of the base glass varies from clear to translucent with a greenish hue, translucent purple, amber, translucent brown, opalescent white, opaque white, opaque light yellow, opaque purplish red, opaque red and translucent blue.

Various tints of cartellina were also detected in the crypt. These tints can modify the hue of the metal and thus the complete appearance of the tesserae. The cartelline appear to have been made by blowing as they exhibit no bubbles.

Glass composition

It is important to note that the attempts to identify the main glass components are semi-quantitative as they were limited to samples A to F. The second phase

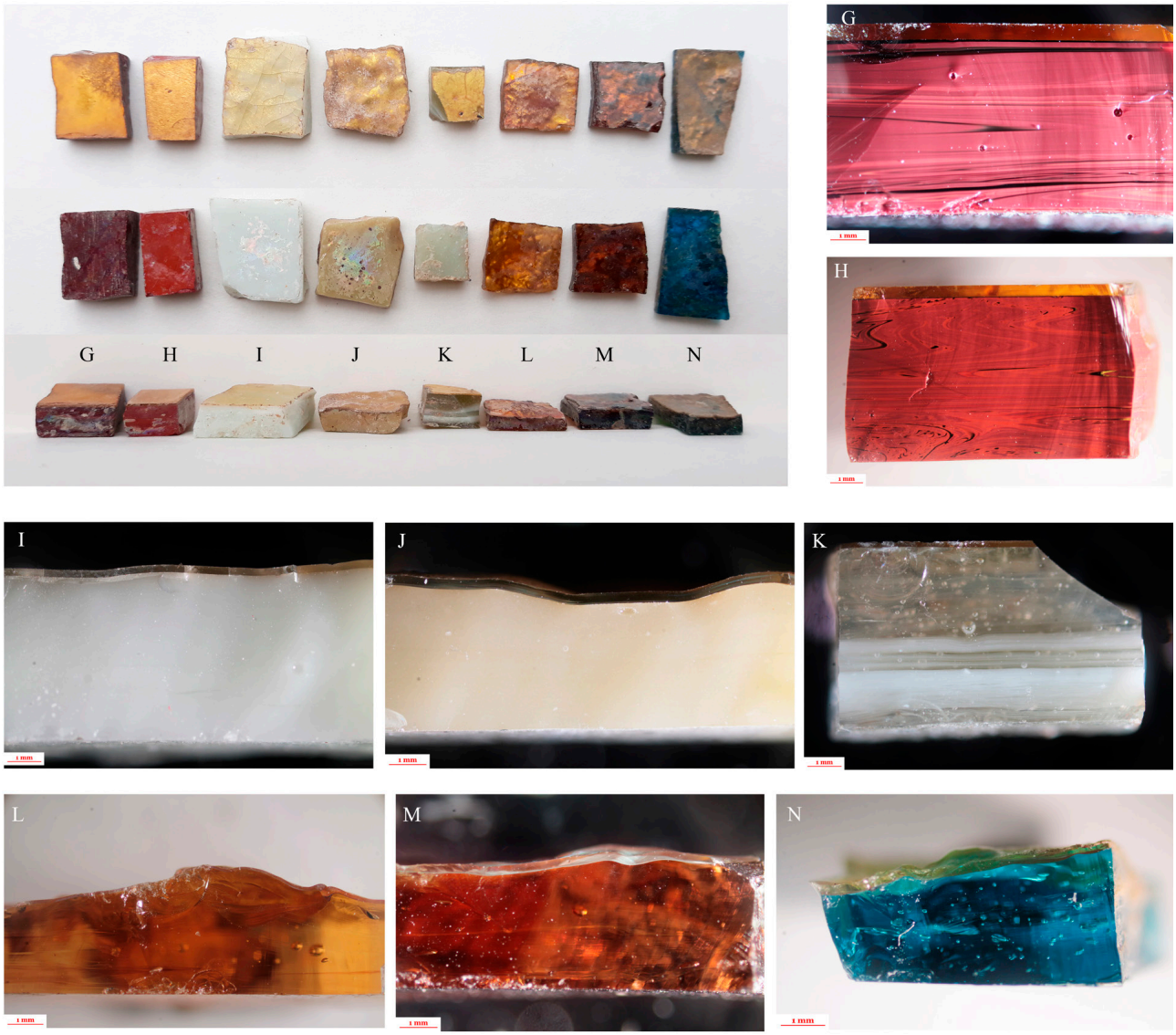

Fig. 3: Views of the metal-leaf glass tesserae (samples KL_G–N) in different examination phases: from the front, from the back, from the side and photomicrographs of the cross-sections. Dittrich crypt, Krásná Lípa, Czech Republic, 2020. Photo: B. M. Kürtösi

of the research will give us further data concerning the composition of the samples G to N.

The general composition of the glass support and cartellina was quite similar despite the evident difference in colour, even though the latter's hue appears more colourful. The origin of this difference was not investigated.

The composition of the glass support and cartellina was similar for each tessera. The SiO_2 content varies between 55 and 60 wt%, the Na_2O content between 11 and 16 wt%, the CaO content between 9 and 16 wt% and the K_2O content between 2 and 6 wt%.[13] All samples contained significant amounts of PbO (3–10 wt%) and the glass was soda–lime–lead–silica.

The chemical analyses revealed that five Krásná Lípa tesserae contained arsenic oxide (As_2O_3) of between 0.2 and 1 wt%.[14]

Arsenic oxide was also used as a raw material to make Muranese artistic glass,[15] mainly as a refining agent during the melting process. In the presence of nitrates,

[13] The concentrations of CaO are particularly high, while K_2O values are lower.

[14] In one sample (KL_A), the As2O3 concentration was as high as 3.8 wt% in the glass support and 3.1 wt% in the cartellina.

[15] FORMENTON et al. 2021.

it helped to remove bubbles and to decrease the colouring effect of other agents.[16] Significant arsenic oxide content also creates good light transparency of between 320 nanometres and 5.3 micrometres.[17]

About the metal layers

The thickness of the metal leaf varies (0.2–0.4 μm) (KL_A-F). It is important to note that Puhl & Wagner also produced imitation gold tesserae by using silver leaf and yellowish cartellina to create a golden appearance. The use of silver leaf and yellow cartellina may have been driven by the desire to enrich the colour palette or for economic reasons.

The company Puhl & Wagner experimented with the production of metal-leaf glass, and they knew how to alter the hue of the silver to achieve a gold look by modifying the firing temperature.[18]

Two of the six samples examined were produced with almost 100% pure silver (KL_A, KL_E). In the case of the other four samples, gold, silver and copper were detected in the following proportions: KL_B: 87.6%/11.9%/0.4%; KL_C: 96.3%/3.5%/0.2%; KL_D: 94.0%/5.8%/0.1%; KL_F: 94.1%/5.6%/0.3%.

CONCLUDING REMARKS

This study looked at just a narrow range of the tesserae. Further investigations will be needed to acquire more nuance on early 20th-century German glass technology. Research on the mosaics in the Krásná Lípa crypt prove that Puhl & Wagner had a perfect command of the technique of producing metal-leaf tesserae. This is reflected by the use of various types of base glass coupled with colourful cartellina, a technique that was completely new to the production of metal-leaf glass tesserae.

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[16] In the 17th century, it was also used as an opacifier in artistic glass to create a white hue (*girasole/opalino*).

[17] VOGEL 2012, 193.

[18] KOVÁCS 1994, 121.

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