# APPLICATION OF CONTEMPORARY TECHNOLOGY IN THE RESTORATION OF AN 11TH CENTURY BRONZE BOWL

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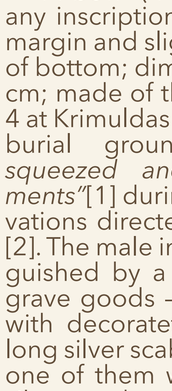
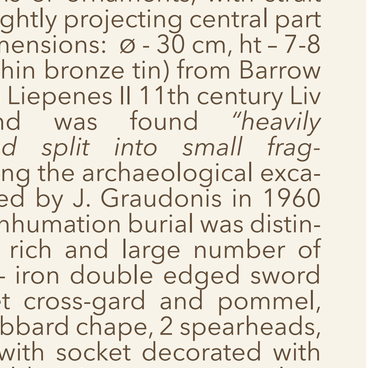
## HISTORY

A bowl ( A 11771:50; round, withaut any inscriptions or ornaments, with strait margin and slightly projecting central part of bottom; dimensions: ø - 30 cm, ht – 7-8 cm; made of thin bronze tin) from Barrow 4 at Krimuldas Liepenes II 11th century Liv burial ground was found *"heavily squeezed and split into small fragments"*[1] during the archaeological excavations directed by J. Graudonis in 1960 [2]. The male inhumation burial was distinguished by a rich and large number of grave goods – iron double edged sword with decoratet cross-gard and pommel, long silver scabbard chape, 2 spearheads, one of them with socket decorated with silver and gold twist ornament, silver bracelet, ring and penannular brooche, iron shears, 3 slate whetstones, iron knive with ornamented silver handle mount, tool with decorated handle, amber pendant, pottery vessel, bronze belt attachments and buckle, 3 bronze spirals and above-mentioned bronze bowl [3]. Part of artefacts have been restored and conserved in 1976 (restorers E.Egle, V.Pavlovs, A.Pravornis)[4] and 2019 (R.Lezdiņa). The bronze bowl from Barrow 4 at Krimuldas Liepenes II along with bowls from Barrow 18 (A 11771:39) at Krimuldas Liepenes I and from Grave 44 (RDM I 48R/CVVM 64876) and Barrow 18 (lost during World War II) at Turaidas Pūteļi burial ground is one of the oldest objects of this type in Latvia [5].



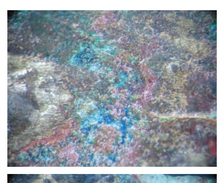
*Bowl in situ*

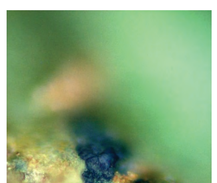


*Location of Krimuldas Liepenes II burial ground*

## RESEARCH

Research of the materials was undertaken by I. Tuņa, the chemist from the Department of Restoration of National History Museum of Latvia.
Results obtained by using stratigrafic, thermal, microchemical/histochemical methods and Raman spectroscopy (*In Via Renishaw*; 478 nm, 532 nm, 782 nm lasers):
- base material – copper (Cu) and tin (Sn) containing bronze;
- red corrosion products – copper (Cu) containing compounds;
- blue – azurite ($Cu_3(CO_3)_2(OH)_2$);
- green – a wide spectrum, brochantite ($Cu_4(SO_4)(OH)_6$) and posnjakite ($Cu_4(SO_4)(OH)_6 \cdot H_2O$) being mostly identified;
- white spots – a layer of tin (Sn) salts [6].





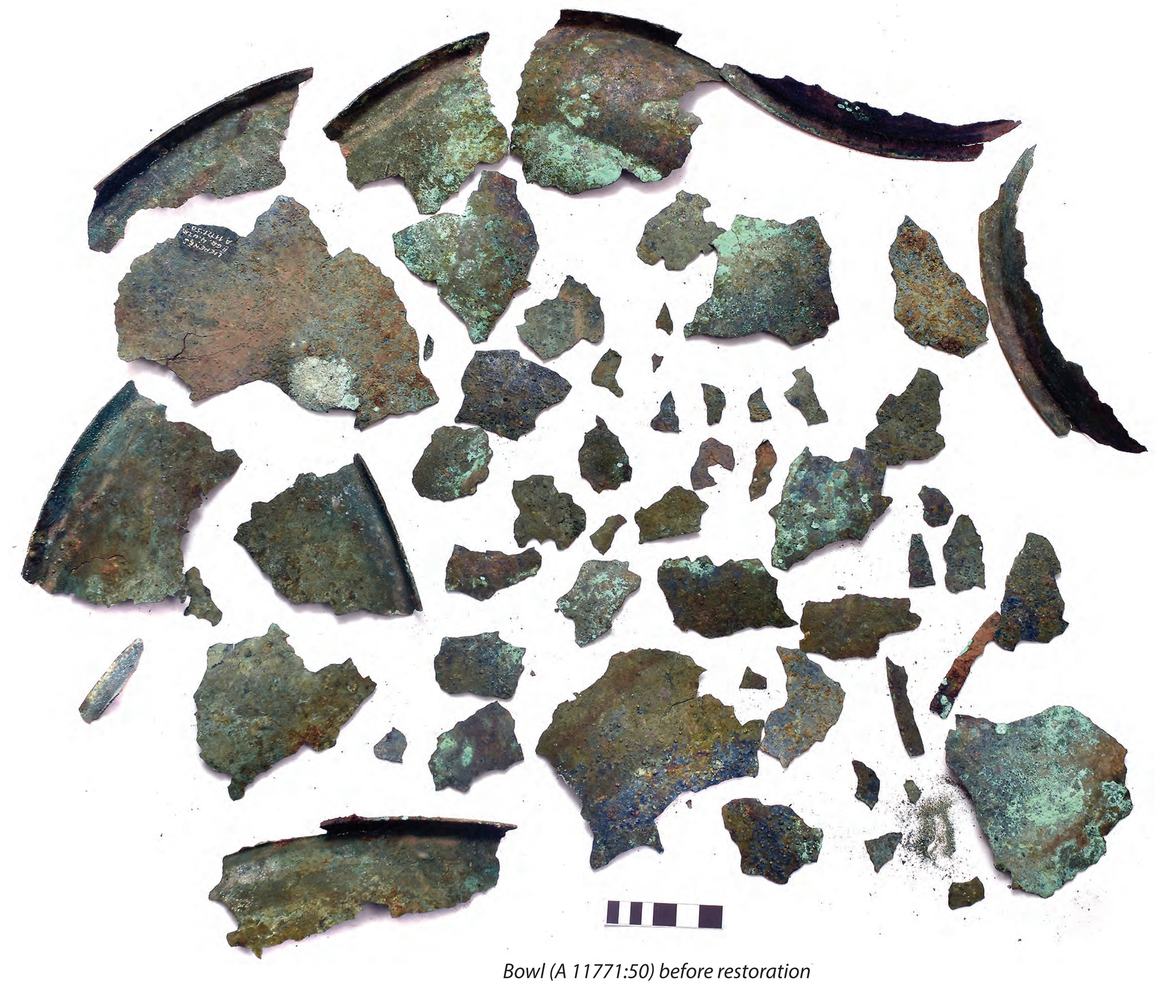
*Bronze corrosion products. Magnification approximately 60x*

*Blue corrosion products – azurite. Magnification approximately 500x*

## CONCLUSIONS

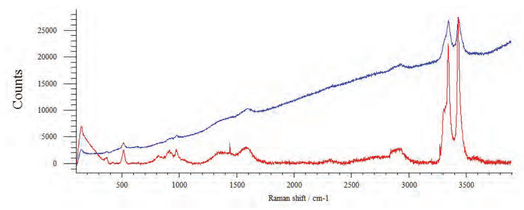
Application of contemporary technology made it possible to:
- obtain a precies form/base of bowl;
- reconstruct original shape of the artefact;
- fix the fragile parts for safe storage, transportation and exhibition;
- look at artefact from inside and outside due to transparency of material.

However, contrary to expectations the 3D scanning did not minimize the need for the handling of the fragile fragments during the process of treatment.

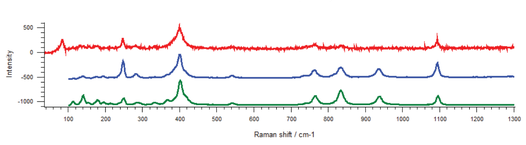


*Bowl (A 11771:50) before restoration*

*Bowl (A 11771:50) after restoration*




*Comparison of Raman spectrum obtained from the green corrosion products (blue) with reference spectrum for brochantite (red)*



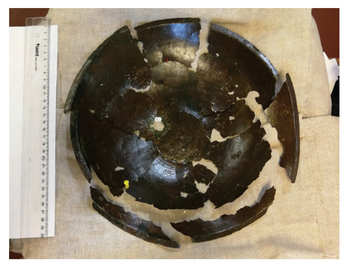

*Comparison of Raman spectrum obtained from the blue corrosion products (red) with reference spectra for azurite (green; blue)*

## RESTORATION

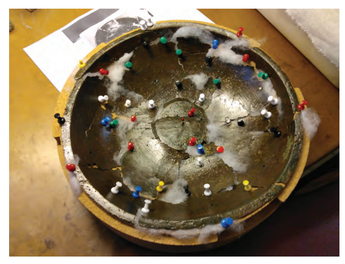
In 2019, before starting the restoration, bowl was split into 55 deformed and cracked fragments of various sizes and shapes. The surface was covered by a layer of bronze corrosion products and soil dirt of various thickness, color and consistency. The metallic core had almost completely mineralized.

The fragments were cleaned mechanically, desalted, passivated in a 3% benzotriazole solution in ethanol, artificially patinated, glued with 30-40% Paraloid B72 in ethanol, creating several larger fragments. To support fragile bronze fragments sand covered with linen canvas was used. Howewer this type of support was found insufficient and in order to reconstruct original shape of bowl, considering the thinness, fragility and deformations of the material, it was decided to use contemporary technology to make a precise form/base in which the original parts could be fixed for safe storage, transportation and exhibition. After the application a protective coating of 7% Paraloid B72 in ethanol and 10% microcrystalline wax Cosmoloid H-80 in white spirit, the fragments were fixed in new-made form/base with bronze plugs.

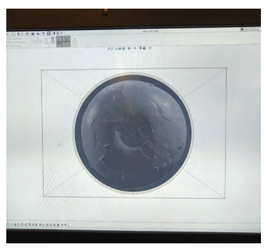
*Fragments of bowl before restoration*

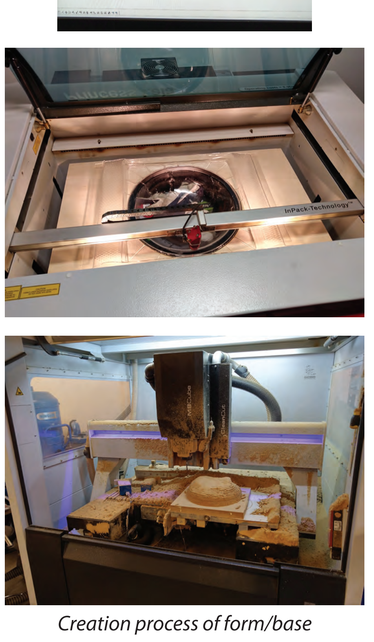


*Bowl during the process of restoration on sand covered with linen canvas*

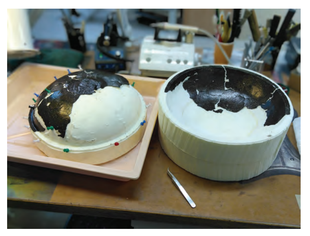


*Bowl during the process of restoration in form of cork*





*Creation process of form/base*



*Bowl during the process of restoration in and on forms of foam plastic*

*Form of foam plastic modified by grinding and shaping with plasticine*

## TECHNOLOGY

During the process of restoration become clear that it is possible to reconstruct original shape of the bowl. It was decided to use contemporary technology to make a precise form/base to fix the original parts for safe storage, transportation and exibition. 3D scanning of the bowl fragments, processing of the file to obtain the profile, modelling and manufacturing of the base with laser cutting were undertaken at the RTU Dizaina Fabrika. Five forms were made, with scanning taking place two more times in between (from inside and outside of bowl, when fragments are in or on the form/base). Each of the made forms (one of cork and three of foam plastic) was modified, grinding them and completing with plasticine. The final version was made of transparent polymethyl methacrylate (PMMA) using thermo-vacuum shaping on wooden shaving particle board (MDF).

**References:** *1. Graudonis J. Pārskats par 1960. gada arheoloģiskajiem izrakumiem Siguldas raj. Krimuldas Liepeņu lībiešu uzkalniņkapos. LNVM AA 398, p. 14.*
*2. Graudonis J. Pārskats par 1960. gada arheoloģiskajiem izrakumiem Siguldas raj. Krimuldas Liepeņu lībiešu uzkalniņkapos. LNVM AA 398, p. 13 – 19; Latvijas arheoloģijas rokasgrāmata, LU Latvijas Vēstures institūts, Rīga, 2021, p. 325- 326.*
*3. LPSR Vēstures muzeja Inventāra grāmata Nr.94, A11768 – 11821; 11825 – 11911; Latvijas arheoloģijas rokasgrāmata…, p.326.*
*4. X Konservējamo priekšmetu saraksts. LNVM AAp 52, Pasūtījums 271 – 46 ç; Latvijas PSR Vēstures muzeja Restaurācijas nodaļa. Pasūtījumu reģistrācijas žurnāls No 1., 1976. g. III cet. 13 R, Akts 417.*
*5. Pāvele T. Latvijas 11. – 13. gs. bronzas bļodas// Arheoloģija un Etnogrāfija VI, LPSR ZA izdevnieciba, Rīga,1964, p. 127 – 134; Graudonis J. Pārskats par 1959. gada arheoloģiskajiem izrakumiem Siguldas raj. Krimuldas Liepeņu lībiešu uzkalniņkapos. LNVM AA 397; Pārskats par arheoloģiskajiem izrakumiem Turaidas Pūteļu kapulaukā. LNVM AA 3.*
*6. LNVM Restaurācijas departamenta izpētes protokols Nr. 2762/19, 2019. g. 18. marts.*

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