



ZEISS Microscopes in Restoration and Conservation The Imperial Carriage Museum in Vienna, Austria



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The Imperial Carriage Museum is located on the grounds of Schönbrunn Palace in the Hietzing district of Vienna and houses over 30,000 objects. Of the roughly 200 conveyances in the Carriage Museum, 101 used to form part of the Viennese court's fleet, while the others belonged to families that were members of the courtly nobility. The museum, which is part of the Kunsthistorisches Museum, represents one of the most important collections worldwide. The work conservators do with ZEISS microscopes behind the scenes is the foundation that allows museum visitors to admire the carriages, clothing, and other items on display.

The Imperial Carriage Museum in Vienna

The Imperial Carriage Museum in Vienna is located on the grounds of Schönbrunn Palace in the Hietzing district of Vienna (Image 1). The museum is home to over 30,000 objects, including around 200 conveyances and numerous textiles from the imperial household.

Taking care of the Imperial Carriage Museum's collection requires the full range of specialist restoration and conservation expertise. The work conservators do behind the scenes is the foundation that allows museum visitors to admire the carriages, clothes, and other items on display.



Image 1 The grounds of Schönbrunn Palace are open to visitors all year round.



Image 2 The imperial fleet comprised over 600 conveyances ranging from ornately decorated state coaches to children's buggies, as well as around 350 horses.

The day-to-day work of a conservator

If an object – such as a carriage – is due to be restored, an extensive examination and inventory is carried out first. Microscopic analyses play a big part in this. When carrying out a restoration, conservators work with a wide variety of materials (Image 7). Textiles, varnish, wood, and metal all require very different analysis and treatment methods. The layers of the craquelure-covered paint surface on one of Franz Joseph I of Austria's coaches – dating back to 1895 (Image 8) – become visible under UV or stereoscopic grazing light as well as with different microscope contrasts. The metal composition (Image 9) of the wheels is determined using electron microscopy and an EDX detector, while fabric fibers (Image 10) are best analyzed using a polarization contrast on a light microscope.

The details of various layers can be seen in the transverse sections (Image 3). To create a section, a sample of just a few micrometers (μm) of material is taken with a scalpel. It is then set in epoxy resin, ground, and analyzed using a light microscope. Up to 37 different layers have already been identified using this method.

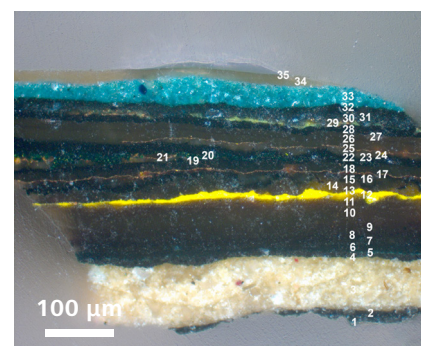
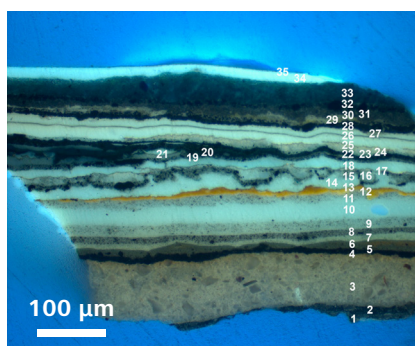
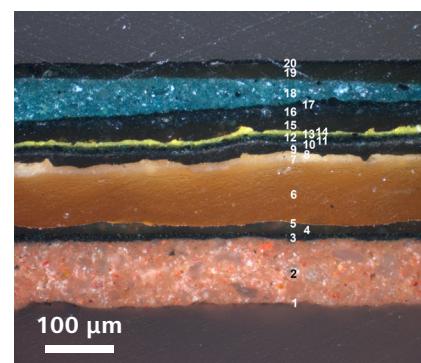
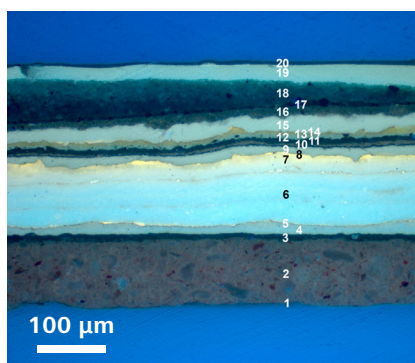


Image 3 Transverse sections from the outer hoop of a wheel and the outer carriage body. Both under UV light and using differential interference contrast (DIC) it is clear that the wheels and outer carriage body have been painted and gold-plated multiple times. Images at 200 \times magnification kindly provided by S. Stanek of the scientific laboratory at the Kunsthistorisches Museum in Vienna

In the lab, the material sample is analyzed using a scanning electron microscope with an EDX detector to determine the chemical composition of the individual layers. A reddish layer is identified as having traces of iron (Fe) and becomes

a clear indicator of rust under the lacquer. The conservators document all their findings carefully. They need to consider how to carry out any restorations and what consequences may be expected to result from an intervention.



Image 4 Testing suitable solvents using a UV lamp.





Image 8 Small cracks and fissures can be easily discerned on the painted surface. These may be caused by aging or by the conflicting movements of different layers. These cracks are also known as craquelure.



Images 5 & 6 The ZEISS SteREO Discovery.V8 stereo microscope with a floor stand enables conservators to work sitting down comfortably even with larger objects.

Once a detailed conservation or restoration plan has been created, the real work begins. Step by step, layers are removed using solvents and mechanical removal techniques. More than anything else, this requires patience – time pressure being the enemy of any restoration project. The conservators use a ZEISS SteREO Discovery.V8 stereo microscope with a floor stand (Images 5 & 6). This allows them to work comfortably on large objects like this carriage while sitting

down. The microscope can be accurately adjusted to the exact angle required to direct light to the area being worked on. The conservator uses the ZEISS Axiolab light microscope with polarization contrast to analyze fibers, assess the condition of the material by age, and to document any damage to the clothing caused, for example, by moths. Using the contrast, the conservator is able to differentiate between linen and flax and to pin down the age of a garment.



Image 7 Gilded wooden structures, glass windows, padded interiors, embroideries, metal traction elements, paintings on the wooden elements – a carriage represents the interaction of a wide variety of materials.



Image 9 The width of the stripes on the wheels indicated the rank of the carriage's passengers.

Microscope equipment used

ZEISS SteREO Discovery.V8



A ZEISS SteREO Discovery.V8 stereo microscope with a floor stand is used for surface analysis of the conveyances at the Imperial Carriage Museum in Vienna. The microscope offers a variety of lighting options, a long working distance, and large depth of field. Structures can be analyzed in 3D using low levels of magnification. Thanks to the variable zoom positions, it is possible to visualize individual details such as craquelure, painting techniques, brush strokes, and layers. Stereo microscopes help determine the condition of the object and draw conclusions about its age and origin. With the help of floor stands it is possible to analyze even large objects directly on site.

ZEISS Axiolab 5 with polarization contrast

Microscope-based investigations also play an important role in fabric and fiber analysis. For example, it is possible to identify which materials and techniques were used during production and to make a decision about what should



Image 10 Conservators use stereo microscopes to carry out minor restorations, interventions, and cleaning tasks.

consequently be taken into account during the restoration. Ideally, this process is carried out using light microscopes featuring polarization contrast. The smallest units of fibers – elementary fibers – are used for this kind of analysis. It is possible to determine the type of fiber on the basis of different optical characteristics. The color of the fiber changes when the microscope stage on the polarized-light microscope is rotated (Herzog test). An elementary fiber may, for example, have a bluish color when viewed from a horizontal position but become a reddish orange when rotated 90°. This is a way of distinguishing synthetic from natural fibers and classifying them.



ZEISS EVO with EDX

Digital scanning microscopes with EDX detectors are used to analyze the morphology of artwork at a high resolution and to determine the chemical composition of individual layers. Electron microscopes like the ZEISS EVO enable greater magnifications and resolutions than light microscopes.



Image 11 Conservators need a comprehensive understanding of all the equipment associated with the artifact.

Being a conservator is both a profession and a vocation

A conservator's main job is to protect art and heritage artifacts, preserving them authentically and sustainably for future generations. Almost all the items a conservator works on are irreplaceable originals, witnesses to human history. Clearly, these paintings, statues, and similar objects can't simply be altered without due care and attention. Restoration involves a combination of science and craftsmanship. Good conservators need practical skills, artistic sensitivity, theoretical knowledge concerning the fields of art and culture, and technical know-how. They need to be able to identify the age of an object and trace its history. And on top of that, they need a solid expert understanding of chemistry, physics, and microbiology (Image 11).

With plenty to do every day, the conservators have no time to be bored. There are donations to be assessed and existing collections to be conserved. Temporary exhibitions on exciting topics such as the Congress of Vienna, the Empress Sisi, and the Napoleonic Era bring staff into contact with new artifacts – posing new challenges – every day.



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