The conservation of a lacquered dress sedan chair from the collection of the Marstallmuseum Schloss Nymphenburg in Munich

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Introduction
In the seventeenth and eighteenth centuries, a large number of single-seater sedan chairs were mentioned in the inventories of the Bavarian court. Unfortunately, only two splendidly decorated sedan chairs have survived; they are now housed in the Stables Museum at the Palace of Nymphenburg. Sedan chair were designed as a means of transport without wheels, while protecting against poor weather conditions by being covered from above and often equipped with sliding windows. They were carried by two carriers, or animals using removable carrying poles and straps. Of those two remaining single sedan chairs the older one was ordered by elector Max Emanuel from the master saddler Saillot in Paris on the occasion of his wedding with the electress Maria Antonia in 1685 (figure 1). The gold brocade and embroidered silk adornments are an indication of the high rank of its user. The outside body of this particular sedan chair is lined with a red velvet and covered with gold embroidery in raised technique. This precious style of decoration was especially used in private state carriages and sedan chairs of the seventeenth century. It was inspired by elaborate textile wallcoverings of French apartments, which were used by the carriage and body makers trade as an example. Leading to the assumption that the softly flowing drape of the textile fabrics was less important than the optical effect in different illuminations.

The second remaining dress sedan chair in the possession of the Stables Museum is presumed to have been made sixty years later, about 1745, for Maria Anna, the wife of elector Max III Joseph (figure 2). The upright 'coupé' body shape and its construction are very similar to the sedan chair of Maria Antonia. As its predecessor, the inside is

Figure 1 Private sedan chair of electress Maria Antonia, Paris, c. 1684/1685.

Figure 2 Dress sedan chair of electress Maria Anna, c. 1745.

Figure 3 Dress sedan chair of electress Maria Anna, detail of the inside-trimming.
decorated with richly worked textiles. A blue gros de Tours silk with ‘droguet’ pattern is used for the wall trimming and the cushion with seat fall (figure 3). This characteristic, finely detailed pattern initially came into use in the middle of the eighteenth century and therefore supports the dating of the sedan chair into this time period as with the start of the Rococo period the straight form of the chair was already deemed old-fashioned. The curtains of the three windows consist of blue silk damask with foliage. The colouring and decoration of the chair’s bodywork were made to match the fine trimming and upholstery. Nonetheless, in contrast to the inside the bodywork is not lined with precious and expensive silk fabrics. Instead metal leaf gilding embellishes the frame construction of the sedan chair. Its incised chalk ground mimics the texture of the blue silk damask (figure 4). The fine pattern of the gros de Tours silk is copied onto the panels in lavish lacquer work using lattice-shaped surrounding of the flower sprays, rocailles and floral ornaments (figure 5).

The lining of carriages and sedan chairs with costly textiles was out of fashion. Instead ‘material illusion’ by imitating fabrics, marble, porcelain, tortoiseshell and East Asian lacquerwork using complex polychrome techniques was ‘en vogue’ and executed by specialised painters and lacquer craftsmen. One could compare the great artistic skill of the lacquer technique of the sedan chair to the impressive polychrome painting of the vernis Martin on some furniture manufactured by Mathieu Criard for Madame de Mailly’s chambre bleu in Chateau de Choisy. The lacquer décor of this furniture with Rococo ornaments and flowers was probably made in a workshop of the famous lacquerer of the Martin family. The special light blue Rococo lacquer decoration was made at the same time as the sedan chair in the mid-eighteenth century. At this particular time the decorative motifs and colours of this type of lacquerwork no longer followed the East Asian role models, but changed to western Rococo décor.

Polychrome painting
In view of the upcoming conservation and a better understanding of the special painting techniques the polychrome finish of the lacquered sedan chair was investigated. Following a preliminary examination, cross-sections were prepared to detect and, if possible, categorise the layering of the surface. Microscopic investigation under visible and UV light, complemented by histochemical staining was applied to determine the presence of different types of binding media. Additional samples were taken for further analysis.

Stratigraphy of the blue silk damask imitation
A glue size was applied to the beech frame construction first. The cross-section (figures 6a, b) then shows a multilayered chalk ground which was applied relatively thick since it had to be engraved later. The chalk ground is followed by an orange-red bole and silver leaf. While examining the sample under the microscope using UV light a very fine intermediate layer on top of the metal leaf could be identified as a proteinaceous medium, which is covered with a thin transparent blue layer, probably consisting of Prussian blue. This thin blue layer lays next to a thin transparent clear layer and is hardly visible in the cross-section, leading to
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the assumption that the original metal leaf gilding was not completely coated with the blue glaze. However, the transparent finishing lacquer is presumed to have been applied over the entire area. The first overpaint is a layered coating showing a thick, brittle transparent lacquer under a very thin blue glaze. The following stratigraphy consists of further silver leaf gilding over a reddish mixtion covered with a transparent black-brownish coating. Remnants of different coloured glazes in other areas of the frame construction indicate that some parts were only partially overpainted.

Further examination of the paint layers shows that the metal leaf gilding of the frame construction had been applied before the lacquerwork of the panels was carried out. This can be observed on the protruding metal leaf which was covered with the same blue paint layers that was used on the panels.

**Imitation of the gros de Tours silk**

The thin softwood panels are covered with a lining glued to both sides. Here the cross-section (figures 7a, b) displays the original lacquer buildup consisting of 'double' ground, paint layer, decoration and transparent lacquer layer. The first layer of the multi-layered chalk ground is relatively thin and has a characteristic greyish hue. The following blue layer of azurite and perhaps lead white has probably been applied in two steps. In some parts of the cross-section the upper layer of the blue is darker whereas the lower layer contains more white pigment. Through histochemical staining with Ponceau S a fluorescent thin proteinaceous isolation layer could be made visible on top of the blue azurite application. All paint layers underneath are also bound with a proteinaceous medium. The following lacquer décor consists of a thin grey layer with less fluorescence. With a higher magnification non-fluorescent particles embedded in a brownish matrix are visible. Those particles have been identified as tin. They are likely to be interspersed in the moist, grey-pigmented oil binding medium. The cross-section shows the part of the pattern where the tin particles had been removed with a special tool (figure 8). This mechanical interference changed the colour of the middle dot of the 'droguet' pattern from silver to grey, and was done after the lacquerwork was completed.

**Figure 6** Cross-section from the frame construction (right side, bottom on the right): Paint section showing the thin translucent blue glaze on silver leaf gilding: 1. yellowish-white ground; 2. orange-red bole; 3. silver leaf; 4. blue glaze; 5. thin transparent coating; 6. overpainting. Sample viewed in visible light (a) and UV light (b), photographed at a magnification of 200x.

**Figure 7** Cross-section from the rear panel (bottom): Paint section showing the blue lacquer structure: 1. greyish ground; 2. white ground; 3. blue paint layer; 4. grey metal powder; 5. overpainting. Sample viewed in visible light (a) and UV-light (b), photographed at a magnification of 200x.
The dark blue parts of the lacquer pattern consist of a homogenous layer of Prussian blue. This layer is not visible in the cross-section, neither is the remaining thin layer of the original glossy lacquer. When comparing this to the first overpainting lacquer of the frame construction the overpainting of the panels shows a very thick transparent coat. Non-fluorescent particles indicate that it had been sanded in between applications. In addition and as a result of ageing this lacquer layer has undergone substantial changes in structure and colouration. The cross-section also shows the distinctive brittleness of this layer and highlights further thin coatings of overpaint composed of a transparent layer, followed by a sparse black pigmented coating.

**Overpainting and condition before treatment**

At least two later polychrome phases can be identified in the cross-sections of the sedan chair. In some areas of the frame construction additional paint layers could be observed. Obviously, the original thin transparent finishing lacquer was damaged or destroyed by the formation of cracks and flaking, leading to the removal of almost the complete transparent lacquer of the panels during the first restoration period. Thus the slightly raised décor of tin particles and parts of the oil-based paint layer had been severely reduced. At the same time, the silver leaf gilding of the frame construction was overpainted too. Large areas were given a new chalk ground and new engravings, which did not derive from the floral pattern of the silk damask but from the geometric forms of the borders (see figures 3, 9).

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**Figure 8** Detail of the lacquerwork: Incised tin powder decoration.

**Figure 9** Panel at the top of the right side, detail: Reduced lacquer decoration and renewed chalk ground at the frame construction with overpainting.

**Figure 10** Panel at the top of the left side, detail: Sanded surface with remains of the overpainting lacquer.

**Figure 11** Panel at the top of the left side, detail: Non-fluorescent parts of the exposed azurite layer are clearly visible under UV light.
Moreover, the overpainting revealed serious alterations due to ageing. In some areas the greenish blue surface colour had turned more yellow. The brittleness of the coating as well as the corrosion of the silver leaves is clearly recognisable. This was most likely the reason for overworking the surface twice at some later stage, which included the sanding and reduction of the thick, discoloured lacquer coating (figure 10).

UV light examination revealed extended parts of exposed azurite layer with no fluorescence (figure 11). The now unprotected azurite ground was exposed to humidity fluctuations causing the sensitive protein bound layer to form blisters raising the ground layer (figure 12). In addition, some of the degraded and cracked yellow coating had not been completely removed, leaving a patchy surface while hiding some of the fine details of the original painting and metal powder decoration underneath (figure 13).

Finally, the patchy appearance of the paint surface, the exposure of different paint layers, and the misinterpretation of the historical colour scheme led to further alterations of the polychrome surface. As a consequence the aspired visual effect of the original polychrome coating could not be ascertained anymore. Thus the décor of the panels was described in some publications as ‘white flowers and rocaille ornaments’ or ‘gold painted flowers and rocailles’. 9

Reconstruction of the painting techniques

The restoration concept included a reconstruction of the textile imitation using mockups to recreate the layered structure of this particular surface décor. The selection of the materials and methods to recreate those textile imitations was based on the findings of the preliminary examination and analysis, as well as recipes from contemporary sources. The goal was to use those mockups to evaluate conservation materials and retouching methods and to envision the original surface appearance and colour scheme of the sedan chair.

Reconstruction of the blue silk damask imitation

To reconstruct the silver leaf gilding with the blue glaze of the frame construction a multi-layered chalk ground was applied on a well prepared and sized wooden surface (figure 14). After drying, the contours and details of the pattern were carved into the chalk ground using special engraving tools. Next, a red bole was spread over the chalk ground, followed by the silver leaf gilding. Then the embossed parts were burnished with an agate,
although, due to the overpainted and fragmentary condition of the original silver leaf gilding, neither cross-section analysis nor close-up inspection of the polychrome areas had revealed burnished and non-burnished parts on the original surface.

After burnishing the surface was sized using isinglass. The use of glue as an intermediate layer on metal leaf before lacquer application is frequently mentioned in technical sources. It increases the wetting properties on the metal and prevents bleaching and tarnishing which sometimes occur when a highly diluted lacquer or glaze in highly volatile solvents is applied. At last, a glaze of Prussian blue, an ideal and often referred to pigment for transparent glazes on silver leaf gilding was brushed on the silver surface and covered with a thin white spirit lacquer.

The engraved chalk ground imitates the texture and threads of the blue silk damask used for the curtains of the sedan chair, and the silver leaf gilding acts as a reflective interface for the applied blue glaze. The interchanging glossy and matt surface appearance triggered by the partially burnished silver leaf gilding and the Prussian blue glaze give the sophisticated effect of the shimmering and iridescent silk, strikingly similar to the curtains from inside of the sedan chair (figure 15).

Reconstruction of the gros de Tours silk

Neither the very rare technique of blue lacquerwork based on azurite in an aqueous binding medium nor the decoration with tin powder are described accurately in the painter’s handbooks of the seventeenth and eighteenth centuries. Although it was well-known that azurite in binding media such as drying oils and resins turns greenish or dark, it still was recommended to be used in combination with lacquer. Perhaps if the surface was to remain light blue sometimes the use of an aqueous binding medium was suggested. Therefore most historical blue lacquer recipes do not contain azurite as a main colourant but instead pigments like smalt and Prussian blue.

Based on the results of the preliminary examination the azurite was mixed with different amounts of lead white in a proteinaceous medium. These mixtures were then applied thinly on a multi-layered chalk ground (figure 16). The dark blue lacquer décor was painted with oil-bound Prussian blue on an additional intermediate layer of isinglass. Then the metal powder decoration was carried out by scattering loose tin particles into
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The still moist, grey-pigmented oil paint (figure 17). After drying, the remaining tin powder could be brushed off and the surface of the metal application was burnished with an agate, changing the dull grey surface colour into bright silver. Then some details and contours were accentuated in dark grey oil paint. Finally, the middle dot of the ‘droguet’ pattern was scraped with a spatula, thus partly abrading the tin powder and leaving the surface rough and dull grey. This colour change effect was accentuated by the grey oil paint layer underneath which was exposed by this action.

The unvarnished mockup showed a slightly crystalline luster of the azurite paint layer. But a final coating with a thin lacquer increased both the depth of the blue background and the reflective properties of the white ground. The lustrous effects of the slightly raised tin decoration evoke an impression similar to the gloss of the real silk textile (figure 18).

**Figure 18** Lustrous effects of the gros de Tour silk (a, b, c) and the blue lacquerwork (d, f, g).

**Figure 19** Removal of the yellowed lacquer with an isopropanol-based solvent gel.

**Restoration concept of the clear lacquer**

As already mentioned, the textile imitations of the sedan chair have been overworked and restored several times. During the last session, the removal of the thick transparent lacquer which had been applied during the first renovation was not executed consistently. First it was tried to ‘regenerate’ the brittle lacquer by using liquid solvents or solvent vapour. But various attempts of regeneration failed, probably due to the advanced degree of degradation. After evaporation of the solvents the surface remained crazed, rough and opaque.

Due to the vain restoration attempts the removal of the overpainted lacquer was considered, and as a new finish a historical lacquer was seen as a possibility. Several recipes from the painters’ handbooks for the preparation of ‘white lacquer for light colours’ were tested using the mock-ups. Satisfactory results could be achieved using a smooth but polishable sandarac-based lacquer according to Watin, which contained mastic and turpentine as well as elemi. But a historical lacquer may be subject to yellowing and cracking, leading to a comparable surface effect of the original white spirit lacquer. After discussion with other stakeholders, it was decided that the slightly yellowish natural colour as well as the yellowing and embrittlement of natural resin lacquers were undesired. Then the application of a dammar resin or ketone resin (MS2A) was proposed, but both resins were rejected because of their likewise brittleness and their decreasing reversibility after ageing. In the case of a future varnish removal this would increase the risk of damaging the original lacquer. Finally, because of its extraordinary stability and optical properties the low molecular weight hydrocarbon resin Regalrez 1126 was proposed, in combination with Kraton G1650, a linear triblock copolymer based on styrene and ethylene/butylene, and the hindered amine light stabilizer Tinuvin 292. The resin mixture can be dissolved in low aromatic mineral spirits which avoids interfering...
with the historical paint layers while leaching during application as well as during future removal is unlikely to happen. Furthermore, this solution is less toxic during the working process.

While trying to find a suitable ‘material imitation’ for the original white lacquer this synthetic resin with additives was tested in different solvent systems and with changing application methods to achieve a finish similar to a polished spirit lacquer.

**Treatment**

After the selection of a new varnish and application technique the very thick lacquer varnish from the first restoration period was removed using hydroxypropyl cellulose gel (Klucel E) dissolved in isopropanol (figure 19). The later addition of the dark coating on the frame construction was reduced with different polar solvent systems to closely match the hue of the top silver leaf gilding (figure 20). The Regalrez varnish was dissolved in hydrocarbon solvents of varying boiling range, and applied with a spray gun (figure 21). Irregularities of the surface as well as the tendency of the lacquer to slip from the smooth metal decoration and accumulate on the rougher paint surface areas required the application of many successive thin layers under varying spraying conditions.

Irregularities of the applied Regalrez film could be smoothened by polishing the dried surface several times. Due to a slight orange peel effect an additional coating of a very thin final Regalrez layer was brushed on after the last polishing. No re-dissolving of the underlying coating could be observed due to the use of fast evaporating hydrocarbon solvents. After finishing the new Regalrez surface coating looked a little bit streaky, but very similar to traditional brushed and polished white spirit lacquers.

**Conclusion**

The skilled gilder and lacquerer of the sedan chair achieved an effect that matches the textile fabrics of the sedan chair thanks to complex and sophis-
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ticated textile imitating techniques by coping with the variety of surface textures as well as the reflection of light. The substitution of the degraded secondary lacquer on the sky blue azurite surface from an earlier restoration especially intensified the effect of depth and reflection of the light (figure 22). In fact, although the synthetic Regalrez varnish has a comparable refractive index, the quality and gloss as well as the slight colouring of the eighteenth-century clear lacquer could not be completely obtained with the modern substitute material.

Despite the removal of the disrupting secondary finish the intention of this restoration project was not to regain the original surface condition of the sedan chair but to preserve the aged state of the finish with later changes and additions as a historical document. Weighing up conservation ethics and aesthetic requirements, a meticulous reconstruction of the original colour scheme and the optical effects of this complex textile imitation was aspired (figure 23).

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Notes
1 In this instance, Maria Antonia, the daughter of Emperor Leopold I, was allowed to use gold brocade on the seat of her sedan chair, though in general only items which are associated with the emperor were decorated with golden materials. See R.H. Wackernagel (ed.), Staats- und Galawagen der Wittelsbacher, vol. 1, Stuttgart 2002, p. 81.
3 I would like to thank Dr. Monika Kopplin, Museum für Lackkunst München, for this information.
5 The samples were embedded in Scandiplast polyester resin and examined under a Leica DM RX microscope, equipped with a high-pressure 100 Watt mercury lamp and a 100 Watt halogen lamp. For the fluorescence microscopy the filter set D-violet-excitation (BP 355-425 RKP 455 LP 460) is used.
6 Ponceau S, Ikanna and Sudan black dyes were used as indicators for proteins, resin and oil. See H.P. Schramm, B. Hering, Historische Malmaterialien und ihre Identifizierung.
The pigment analysis with UV-VIS Spectroscopy and µ-RFA was conducted by Dr. Heinrich Piening, Conservation Department, Bavarian Department of State-owned Palaces, Gardens and Lakes.

Prussian blue was probably used as pigmentation for the coloured glaze but could not be identified with absolute certainty by analysis.


See e.g.: J.M. Cröker, Der wohl anführende Mahler, Jena 1736, pp. 242-243; Pater Bonanni, Neuer Tractat von Firnifs, Laquer- und Mahler-Künsten, Breßlau, Leipzig, 1746, 30; J.F. Watin, Der Staffirmaler, oder die Kunst anzustreichen, zu vergolden und zu lackiren, wie solche bey Gebäuden, Meublen, Galanteriewaren, Kutschen, u.s.w. auf die beste, leichteste und einfachste Art anzuwenden ist: sowohl den Künstlern als den Liebhabern zum Unterricht herausgegeben, Leipzig 1779, p. 146.

See e.g.: Watin 1779 (note 10), 157; Bonanni 1746 (note 10), p. 30.


The recipe is entitled: ‘Vernis blanc qu’on peut polir, pour le chambranles, boites des toilette, etc.’.


See e.g.: Bonanni 1746 (note 10), 29; J. Stalker, G. Parker, A Treatise of Japaning and Varnishing, Oxford 1688, p. 23.


Because the original lacquer obviously had been removed due to poor ageing characteristics and durability it was assumed to be less suitable and should not be reconstructed. For the selection of ‘cheap lacquer systems’ with bad ageing characteristics on blue lacquerwork see: U. Baumer, J.K. Koller, ‘Blauer Lacke des 18. Jahrhunderts. Eine naturwissenschaftliche Untersuchung historischer blauer Lackarbeiten’, in: Lacke des Barock und Rokoko, Arbeitshefte des Bayerischen Landesamtes für Denkmalpflege, vol. 112, München 1997, pp. 455-466, 464.

See Watin 1776 (note 12), p. 228.


To the characteristics of MS2A resin and dammar see C.V. Horie, Materials for Conservation, Oxford 1987, pp. 116-117, 146-147.


The removal first was tested with a Carbol 980-isopropanol gel. When applied to the lacquer it was substituted using a Klucel E-based gel. Despite poor working properties it was used to prevent the formation of reactive compounds in the original paint layer. After two minutes application time the 9% gel was swapped together with the dissolved lacquer. Finally, the surface was carefully cleaned with ethanol.