An 'Archaeological' Approach to Treating the Polychrome Sleigh *The Turtle*

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Introduction

At Versailles, our general approach to treating horse-drawn vehicles is perhaps as significant as the specific treatment details. I begin by discussing this approach, and relate it to recent developments in the field of conservation in France, in which WAG members have expressed much interest.

Since the establishment of conservation training programs at the Masters level in France in the 1980s, the approach to the treatment of decorative arts has become more scientific and analytical. This trend has recently been reinforced by the requirements that conservation training programs in France must meet in order to be accredited and to be on a par with the best of such institutions in the European Union. Such accredited programs emphasize modern analyses of the object and conservation ideals such as reversibility as much as they emphasize traditional handcraft skills. The trend may be further reinforced by the French Senate's mandate that as of this year all conservators working for French public museums must either have a degree from such an accredited institution or pass a certification process regulated by the Direction of Museums of the Ministry of Culture and Communication.

A more careful study of objects and their finishes has been emphasized especially in the conservation of horse-drawn vehicles, under the influence of the director of the French National Museum of Vehicles and Tourism, Jean-Dennys Devauges, who has a background in archaeology. For vehicles in French museums, original materials are preserved, often with traces of their use, to aid in their study and interpretation. Repaints, modifications and elements added or removed to repair or modify the vehicles with changing times can allow us to trace each vehicle's history. In many cases it is very important to conserve the evidence of these transformations as a part of that history. Removing later, historic layers to arrive at an "original" state is not the goal in such a case. When Louis XVIII reclaimed the coaches of Napoleon I, he apparently ordered the arms to be repainted with his own (Augerson et al., 2002). Generations later, Napoleon III ordered them redecorated, as with the Coronation Coach of Charles X (fig. 1), in The Coach Museum at Versailles. When this Coronation Coach was redecorated, pigmented glazes were applied locally, even over areas of some of the ormolu, and Imperial emblems were added. With such transformations, the head of a new Regime was not merely responding to changes in taste: he was demonstrating his authority and supplanting that of his predecessor. In the conservation of *The Skaters*, which I discussed at the 2000 WAG meeting, the traces of all the successive polychrome schemes were retained, and the sleigh was made to appear much as it did at the time of its last historic use (Augerson, 2000)[1]. The historic varnish was thinned

Figure 1: The coronation coach of Charles X (1825), decor modified under Napoleon III (The Coach Museum, Versailles).

rather than removed, to preserve historic material, and also because removing it would not have left the object looking more as it did originally: the protective varnishes of horse-drawn vehicles enhanced the color schemes with their yellowish hues.

Over several years, I have been studying the polychromed surfaces of the marvelous Louis XV sleighs in the collection at Versailles, a study that may prove important to understanding the techniques employed by painter-varnishers of 18th-century France. Many of these tradesmen—including Dagly, De Neumaison and the Martin brothers, also decorated lacquer furniture and likely used some of the same techniques they employed on vehicles. Jean-Felix Watin made varnishes for the Martin brothers in the 1760s (Wolvesperges, 2001) and after their deaths published his techniques. Watin observed that previous authors on the subject had little if any real experience in making lacquers and varnishes, and their publications can be very misleading. His first and lesser-known book published in 1772 provided scathing critiques of most of the recipes published up until then and described the disastrous results to which they led in his experiments. The most in-depth, modern analytical study of French 18th-century lacquer focused on furniture from the Criard, Deforge and Dubois ateliers (Koller et al., 2000). We are contributing to this growing body of research with studies of the finishes of sleighs at Versailles, conducted in collaboration with analytical chemists at the Research Laboratory of Historic Monuments (Champs-sur-Marne), the Center for the Evaluation of Photo-protection (Clermont-Ferrand), the English and German laboratories Cascade Scientific and the Winterthur Museum. Our preliminary results indicate that these have been decorated with paints and metal leaf using a variety

of techniques: drying oils, spirit varnishes, oil-resin mixtures, and one sleigh having layers of an emulsion binder that might be egg (white and yolk).

The sleigh *The Turtle*

Of the many sleighs made for Louis XV, *The Turtle* is one of six that are in the collection of the Coach Museum of the Château of Versailles (figs. 2 & 3). Snowy weather permitting, these fantastic vehicles raced across the snow-covered paths in the park of Versailles, or on the ice of its frozen Great Canal, a thrilling diversion and grand spectacle (Saule, 1997). This one has a giant turtle at its base and carved reeds, acanthus and other leaves decorating its case in relief, and a sculpted dolphin surrounded by cattails at the back, under the coachman's seat. It was purchased in 1732 with two other sleighs for the impressive sum of 13,368 French pounds, including the price of velvet or silk trimming (long lost but recently replaced), as well as the harness and feather decorations that are missing. The expense book of the Petites Ecuries (today in the privately-owned Hermès

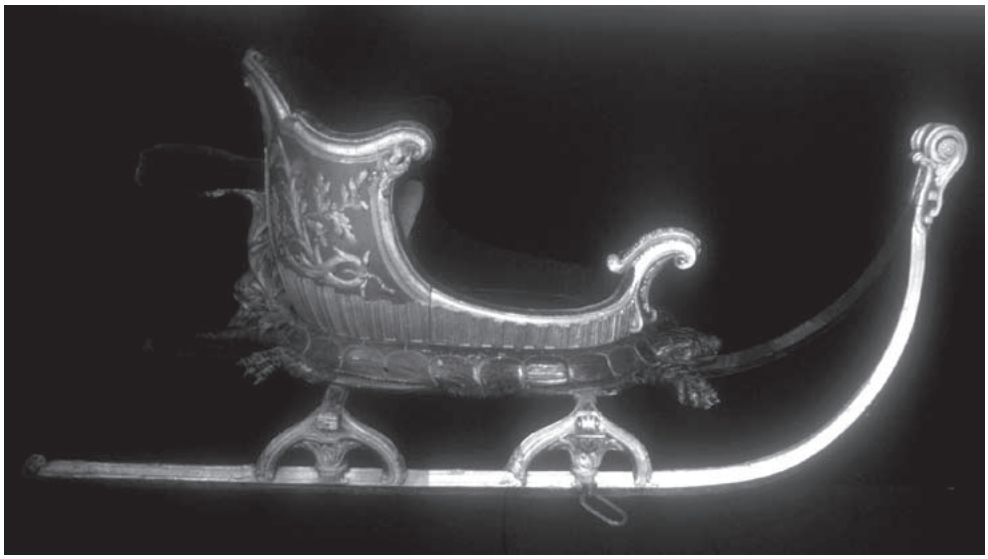

Figure 2. The sleigh,* The Turtle *(1732, The Coach Museum, Château of Versailles), during treatment (the front part after cleaning).

Figure 3. Detail of* The Turtle *during treatment, with the proper right side having been cleaned.

museum in Paris) indicates that the harness was covered in fine cloth, with bells, sleigh-bells and bits that were all variously fire-gilt or silvered. The expense book also indicates the name of *The Turtle*'s highly-skilled carver: Renier, paid 1,137 pounds in the 3rd quarter of 1732.

Prior to treatment, the sleigh was in relatively stable condition, but needed cleaning of centuries of grime and a non-original varnish that had been previously applied unevenly over the surface, more thickly over losses to hide them, and which had darkened with aging and accumulation of grime. After a discussion of the preliminary analysis of the sleigh's polychrome layers, I will describe their ongoing treatment, emphasizing the use of azeotropes in their consolidation and cleaning.

Analysis of Paint and Gilding

To determine their stratigraphy, visible and fluorescence microscopy were performed on cross-sections of samples of the finishes with the assistance of Deborah Bigelow, proprietor of American Burnish in New York. Further information concerning the binders and pigments was revealed by FTIR micro-spectrometry, conducted by Dominique Fromageot at the National Center for the Evaluation of Photo-protection in Clermont-Ferrand.[2] Tiny grains were lifted from individual

Figure 4. Blue and gold decoration on the side of the passenger seat of* The Turtle *during cleaning.

Figure 5. The gilt cattails at the rear (during cleaning) show the evidence of colored glazes: red distinguishing the cattail heads, blue in the shadows of their leaves.

layers and analyzed one at a time. Scientists of Cascade Scientific in Uxbridge (United Kingdom) utilized SEM-EDS to determine the elements in the metal leaf, and to test for the presence of vermilion and other inorganic pigments that go undetected by the FTIR spectrometer due to their transparency to the wavelengths of infrared light employed.[3]

Further analysis must be conducted to confirm certain preliminary data. FTIR analysis indicated that the wood was covered with an ivory-colored, encaustic or wax-based preparation, containing lead white and a pale earth pigment; however, a paint layer on another Versailles sleigh, having a similar FTIR spectrum, was subsequently determind by GC-MS analysis to conatin a mixture of resin and oil, and no wax (Augerson 2005). This hypothesis is supported by similar appearances of encaustic on two other 18th-century vehicles.

Upon the ivory-colored preparation layer, silver leaf was applied using shellac as a mordant on the sides of the vehicle in both the areas now painted blue and on the leaves carved in relief (fig. 4). Gold leaf was applied to the moldings around the sides and to the sculpted cattails at the rear of the vehicle. Another shellac layer was applied over the metal leaf. Careful cleaning of the gilt cattail motifs (discussed below) has revealed that their heads were covered with a red glaze, and shadows on their leaves were indicated with a dark blue glaze (fig. 5).

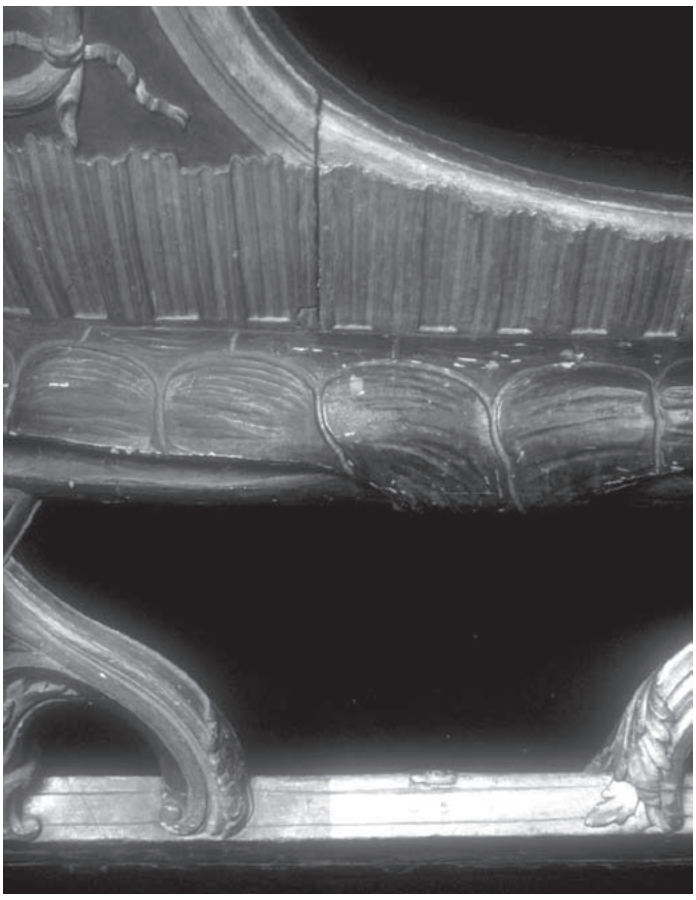

Figure 6. Detail during cleaning; the turtle's shell was done with varied red glazes over brass leaf, which originally may have created an effect like Boulle work.

Figure 7. A scale on the turtle's leg with the later, dark coatings removed to reveal its original polychromy: a light green glaze with dark blue shadowing.

The turtle's shell received brass leaf (on a gray mordant that has not been analyzed), glazed with two to three coats of pigmented shellac, and patterned like a tortoise shell, which originally must have created an effect like the Boulle work of tortoise shell over brass (fig. 6). The first shellac layer was tinted with red ochre in very low concentration, the second with traces of white lead, the third with traces of lead white and a different ochre pigment. This appears to have been covered with one or more layers of another spirit varnish, whose FTIR spectra indicates that it is from a class of natural resins that includes mastic.

The turtle's limbs require further investigation (fig. 7). The initial application of silver leaf still exists in most of these areas, covered with a layer containing ochre, lead white and black iron oxide pigments that seems to have served as an initial green glaze over the silver leaf. A second, light green glaze applied thereafter may be contemporary or of later date; this second glaze contains shellac, terre verte and Prussian blue, with traces of calcium sulfate and calcium carbonate.[4] The presence of copper in this layer, detected by SEM-EDS, may be due to a trace of copper carbonate pigment. This layer was seen after solvent cleaning and lifting of later, darker layers with a scalpel. The sculptured relief of scales on the turtle's skin was shaded with a darker glaze that has not been analyzed but most likely employs more Prussian blue. A varnish that is probably mastic was next applied; its craquelure followed that of the layers found under it, indicating that it was contemporary with them. The craquelure of three succeeding, darker layers is different, indicating a later date for them. These darker layers contain spirit varnish, perhaps mastic; determination of whether there are pigments in them is incomplete, and it is not certain whether they are additional colored glazes or simply coats of varnish.

The question of their nature is important to the treatment. If they contain pigments they will be necessarily kept and not removed, even if discolored; the "windows" made on two of the turtle's scales will suffice to illustrate the earlier polychromy. A reminder of how one can easily be fooled by the aging and degradation of colorants that renders them unrecognizable is the case of the red paint on another vehicle, the coach of the Dauphin, first son of Marie-Antoinette and Louis XVI. Its late 18th-century red paint had tiny traces of a red-brown varnish which, when analyzed with HPLC, was seen to contain traces of a blue-violet tinting agent from Brazilian logwood, *Hematoxylum campechianum L.*, long since discolored (Augerson et al., 2002). Caution would be needed so as to not remove any colored glazes on the gilding of *The Turtle*.

It is difficult to say how the runners were initially decorated. An ivory-colored preparation was seen on the sculpted decor at the front of the runners, similar in appearance to the initial layer found elsewhere that might be encaustic. This has not been detected along the lengths of the runners, but these might have been sanded at one time, removing the original polychrome layers. A white or pale yellow oil paint found on the runners containing a pale earth pigment (aluminosilicate) and some lead white might be a paint layer or an additional preparation, either original or dating to the later 18th century. This layer might be an oil-based preparation of the kind that was typically polished with powdered pumice, to create a perfectly flat surface for applying gold leaf using an oil-based mordant— thereby achieving a brilliance somewhat closer to burnished water gilding than the matte appearance associated with typical oil gilding (Watin, 1778).

The current color scheme was added in the late 18th century, as the blue-painted sides and runners with gold relief are described in the inventory of the Revolutionary government, and the inventory number corresponding to that period, "15," can be seen on the underside of one of the runners at the front. A sample from the gilt relief on the side of the vehicle indicates that it was again applied with shellac as a mordant, but this time coated with a different spirit varnish, perhaps mastic. Those areas painted blue first received a yellow preparation containing drying oil, yellow ochre, some calcium carbonate and a little white lead. The blue paint that followed was done in oil, mixed with some calcium carbonate, a lesser amount of white lead, and very small amount of Prussian blue, then varnished with shellac. At some point a second, similar layer of blue paint was applied over these areas on the sides of the vehicle, followed by another shellac varnish (whereas only a single blue paint layer was found on the painted parts of the runners).

At some more recent date, local losses of gilding were re-gilt and re-varnished (as on an area of damage to the sculpted dolphin at the rear of the vehicle).

Consolidation of Flaking Paint and Gilding

In the consolidation of the paint and gilding, the various solubilities of the different layers were considered, including the preparation that appeared to be encaustic. A fast-evaporating azeotrope was chosen for the consolidant's delivery system, to

limit the exposure time of the paint to solvents. BEVA 371® film (Conservator's Products Co.) was employed at a 5% concentration, dissolved in an azeotrope of 20% 2-propanol (isopropanol) in hexane by volume, having solubility parameters similar to xylenes (but evaporating even faster than hexane). This was applied with a tiny brush to the edges of losses. Fortunately the paint was neither tented nor cupped and held well to the wood in most other areas, making the consolidation procedure relatively easy.

Cleaning the Polychromy

Cleaning of the areas of gold leaf and blue paint began with grime removal. Deionized water was first used in these areas, applied with cotton swabs. This was followed by the azeotrope of 4.8% isopropanol in pentane by volume (6% by weight), which had proven to be good for removal of waxy grime on the sleigh *The Skaters*, treated previously (Augerson, 2000). Where the later-applied varnish was very thick, it was instead thinned with ethanol.

Varnishes over the gold leaf were next thinned with an azeotrope of isopropanol in hexane—the same azeotrope used in the consolidating with BEVA 371®. This mixture was previously seen to have an activity similar to toluene (Augerson, 2000). The cleaning was done over large areas that were allowed to dry after each passing with cotton swabs, so as to avoid softening of the mordant for the gold. Nonetheless, the quick evaporation of the azeotrope permitted the return to the same area again after only an hour for further reduction of the varnish. This mixture enabled the cleaning to progress slowly, so that differences in hue of applied glazes were gradually revealed on areas such as the cattails at the rear of the vehicle, and the colored glazes could be preserved (fig. 8).

Either water or the azeotrope of isopropanol and pentane blanched the glazes and varnishes on the turtle's shell and limbs. For this reason the cleaning of the limbs began with ethanol, followed by the azeotrope of isopropanol in hexane. The finishes on the turtle's shell were also disturbed by ethanol, and only the azeotrope of isopropanol in hexane was effective there for cleaning.

Though I have advocated the use of the azeotrope of 2-propanol in hexane for its rapid evaporation and lower toxicity relative to toluene, it is important to recognize the neurological and testicular damage that hexane can nonetheless cause with prolonged or acute exposure (WHO Working Group, 1991; Becker et al., 2004). The use of a mask that filters organic vapors is necessary, and gloves also reduce the amount that can enter the bloodstream (Cardona et al., 1996); nitrile gloves are recommended. The toxicity of n-hexane can be increased by simultaneous exposure to other solvents such as acetone (Cardona et al., 1996). Protective measures are likewise advised when using pentane or mixtures containing it. Proper ventilation is necessary to avoid the fire hazards associated with these and other highly volatile organic solvents, especially when working in small- or moderate-sized rooms, or when working with more than very tiny quantities of solvent.

Final Retouches

In painting was done with dry pigments in Golden acrylic gloss varnish medium (containing a mixture of iso-butyl and n-butyl methacrylate), diluted to 10% in Lascaux 100/140°C mineral spirits, a solvent of low-aromatic content that is free of impurities and has a good drying rate. Golden acrylic medium contains a stabilizer to prevent crosslinking (Golden Artists' Colors).

Lastly, I used the same protective varnish that I previously employed over another sleigh, *The Leopard* (fig. 8). Its varnish consisted of a mixture of 30 grams Regalrez 1094®, a hydrogenated hydrocarbon of small molecular weight, plus 3.0 grams of micro-crystalline wax (C.T.S. France), with .60 grams Tinuvin 292 UV light absorber, in 330 grams odorless thinner (Royal Talens, Holland). A similar varnish was recommended by Jill Whitten and Rob Proctor in a course given at the Hamilton Kerr Institute of the Fitzwilliam Museum of Cambridge University (UK). This mixture produces a semi-gloss surface with an "aged" look. To obtain a glossier surface, half as much wax should be used. If brushed on instead of sprayed, at least three applications of this varnish are necessary to obtain an even sheen; the last should be applied with hardly any on the brush, with feather-light brushstrokes to even out any imperfections. This particular mixture does not seem to attract dust, even in the relatively dusty gallery of The Coach Museum.[5]

Figure 8. The sleigh* The Leopard *(ca. 1730, The Coach Museum, Château of Versailles), after its recent conservation treatment.

Acknowledgements

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Endnotes

1. In the postprints of the WAG 2000 meeting, I misquoted Lilian Masschelein-Kleiner (1981, p. 27) by stating that the azeotrope of ethanol and water contains 68 % ethanol. In fact, it contains 95% ethanol. It is the azeotrope of ethanol and toluene that she lists as containing 68% ethanol.

2. CNEP Analytical report DF NP 2001-208.

3. Report ETC18127 for the metal leaf and report JCSSEP0317 for the analysis of bright red paint.

4. Perhaps this contains a pale Antwerp blue, having Prussian blue precipitated on the sulfate or carbonate of calcium.

5. Piena (2001) observed that dust stuck to certain varnishes containing Regalrez 1094®. Perhaps the long retention time of the traces of aromatic solvents in his mixtures led to stickiness, or perhaps either the large quantity of wax he employed or the Kraton® elastomer (which I have omitted). It is also possible that the attraction of dust could be due more to electrostatic properties than the varnish's softness. In any case, the varnish on *The Leopard* was observed to collect less dust than nearby vehicles varnished with Acryloid B72®, and the dust did not stick to *The Leopard* but could be easily removed with a soft brush.