Winterthur/University of Delaware
Program in Art Conservation

# Proposal: Technical Study of an 18th-Century British or British-American Giltwood Looking Glass

Jonathan Stevens, Graduate Fellow, Winterthur/ University of Delaware Program in Art Conservation
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## 1. Introduction

ACP 1781 (Loockerman Looking Glass) is a looking glass with a mercury-amalgam glass and carved and gilt wooden frame in the Rococo style. The object was found in the Dover, Delaware house of Vincent Loockerman, Sr. (1722-1785), a prominent merchant, and was likely purchased in Philadelphia during the third quartrer of the 18th century. Looking glass frames inspired by rococo designs (most famously those of Thomas Chippendale), were both imported from Britain to Philadelphia along with their glasses and carved in America to fit glasses imported from Britain (Heckscher 1992, 186-190). Carving and gilding were specialized and often combined trades in both Britain and America during this period, and many sophisticated London-trained craftspeople worked in Philadelphia, making geographic attribution on stylistic grounds difficult in many cases (Prime 1929, 225-226; Campbell 1747, 174-175). The looking glass is currently on long-term loan from the Bradford-Loockerman family to The Biggs Museum of American Art in Dover, Delaware.

**Figure 1.** ACP 1781, Before Treatment

## 2. Literature Review

### *2.1 Wooden Substrate*

Visual inspection of losses to the frame's finish layers reveals a wooden substrate with an absence of vessels (pores), suggesting that the species is a gymnosperm[1] (Hoadley 1990, 1-3) (Bowett 2012, xxvii-xxviii). In 18th-century Britain, deal, the generic name used for imported softwood timber, was favored by frame-makers and carvers for painted or gilded work[2]. Scots pine (Pinus sylvestris L.; native to Eurasia), and Norway spruce (Picea avies (L.) H. Karst.; native to Northern, Central, and Eastern Europe) were by far the most common deals, and both were used for carving and gilding (Bowett 2012, 285, 291-292). In America, the native timbers white pine (Pinus strobus L.) and red pine (Pinus renisosa Aiton) were used in much the same way as British deals, with white pine far more commercially important. An identification of white pine is generally taken to indicate that a Colonial-era object was manufactured in America. This may be likely and can indeed be important evidence in support of a geographic attribution, but it cannot be definitively concluded based solely on wood species. White pine was imported and used in the British furniture trade as early as the 1760s, and its use in British naval applications is documented much earlier (Bowett 2012, 299-302). White pine can usually be distinguished from other pines based on the appearance of cross-field pitting under magnification, but American red pine and Eurasian Scots pine are difficult to separate based on anatomical features. Research by Sharon Zarifian at the University of Massachusetts at Amherst has shown that the two species may be separated by comparing average ray height (Hoadley 1990, 144-149; Zarifian, 1987).

In a paper delivered at the 2018 American Institute for Conservation conference, Corona, Heginbotham and Schilling of The Getty discuss the use of heart-cut pyrolysis gas chromatography to identify wood species. This technique requires a smaller sample and less specialized expertise than anatomical methods of wood identification, and may be able to differentiate between species previously indistinguishable by anatomical means (Corona, Heginbotham, and Schilling 2018). A collaborative project between Yale University, Winterthur/ University of Delaware, and The Getty is underway to establish a reference library of confirmed spectra for the use of this technique.

### *2.2 Finish Stratigraphy*

Cross-section microscopy has been used since the 1930s to analyze the finish stratigraphy of paint and varnish samples. Wolbers, Buck, and Olley discuss the history and practice of this technique in their 2012 chapter "Cross-section microscopy analysis and fluorescent staining" in *The Conservation of Easel Paintings,* including research presented by Wolbers and Landrey in 1987 on the use of fluorescence microscopy and biological fluorochrome staining in the characterization of binding media, and propose techniques to characterize proteins, carbohydrates, and lipids in polyester-resin-mounted cross sections. This technique offers a method for viewing the layer structure of the surface of a painted or varnished object using a small sample (as little as 100 microns) and may serve as a roadmap for further analysis. Fluorochrome staining may also have the advantage of detecting thin layers which would be impossible to isolate for analysis using GC-MS or FTIR (Wolbers, Buck, and Olley 2012, 326-335). The use of cross-section microscopy for furniture is discussed in *Conservation of Furniture* (Rivers and Umney 2013, 390-393), and has been used extensively for the analysis of gilded

[1] Gymnospermae are a class of the phylum Spermatophyta (seed plants) and include the order Coniferales (commonly called conifers or softwoods) (Hoadley 1-2).

[2] Limewood was also favored by carvers for its smooth texture, ease of working, and ability to take detail and was at times gilded, but it was generally reserved for the finest work, although it was sometimes used for carvings in combination with pine (Stevens and Whittington 1983,448; Bowett 2012, 113-115, 292).

surfaces (e.g. Powell 1999; Chao, Heginbotham, Lee, and Chiari 2014; Anderson and Malenka 1991) and may reveal overgilding, restoration layers, or unexpected finish layers. For example, a group of American carved rococo-style looking glasses attributed to Philadelphia carver James Reynolds were painted with a stone-white colored oil paint as their original presentation surface[3] (Heckscher 1992, 187-190**)**.

Scanning electron microscopy with energy-dispersive X-ray analysis (SEM-EDS) has been used since the 1970's to analyze paint and can provide an overall picture of layered stratigraphy through mapping of surface topography, relative atomic density, and elemental composition (Townsend and Boon 2012, 345). SEM-EDS is also commonly used to analyze gilding stratigraphies (eg. Sandu et. al. 2015, 433-434; Chao, Heginbotham, Lee, and Chiari 2014; Cardoso and Pye 2018, 77-84).

***2.3 White Ground Layer***

17$^{th}$- and 18$^{th}$- century British gilding recipes indicate a priming layer for burnish (water) gilding consisting of protein glue and "whiting" or chalk (calcium carbonate) (Stalker and Parker 1688, 57) (Dossie 1764, 433-434) (Campbell 1747, 107-108). Today this layer is commonly referred to as gesso, the Italian word for gypsum (calcium sulphate dihydrate). Italian, English, and French historical sources suggest that gypsum, chalk, lead, clays such as kaolin, or a combination of materials may have been used as fillers for gilding ground layers (Powell 1999, 34; Darque-Ceretti, Felder, and Aucouturier 2013, 149). Isabel Pombo Cardoso & Elizabeth Pye suggest that a two-layered gypsum ground (consisting of coarse and fine gesso) was the norm in Portugal and other Southern European countries during the 16$^{th}$-18$^{th}$ centuries and that a single-structured chalk ground was more usual in some Northern European countries (Cardoso and Pye 2017, 185). Although the British texts cited above (Stalker and Parker, Dossie, and Campbell) all specify whiting as a ground for burnish gilding, foreign-born carvers and gilders were influential in Britain during the 18$^{th}$ century (Mitchell and Roberts 1996, 63) and could possibly have deviated from these recipes in favor of the traditions of their home countries.

In their 2018 study, "Gessoes in Portuguese Baroque Gilding Grounds: Part 2: Analytical Study of Historical Samples and Archaeological Reconstructions," Cardoso and Pye analyzed gesso compositions using optical microscopy to examine the layered stratigraphy, polarized light microscopy (PLM) to characterize mineral particles, μRaman spectroscopy (to identify fillers), scanning electron microscopy with energy-dispersive x-ray spectrometry (SEM-EDX) for elemental identification and mapping and observation of particle morphology. μX-ray diffraction (μXRD) was used to confirm results from other techniques, and in some cases to perform quantitative analysis of samples (Cardoso and Pye 2018, 74). In their 2014 study, "Materials and techniques of gilding on a suite of French eighteenth-century chairs," Chao, Heginbotham, Lee, and Chiari analyzed the white ground layer beneath the gilding on a suite of chairs using ESEM-EDX and found that it contained primarily calcium, carbon, and oxygen, supporting an identification of the filler as chalk ($CaCO_3$) (Chao, Heginbotham, Lee, and Chiari 2014, 105).

As a binder for the priming layer, Stalker and Parker recommend a glue made from parchment (a writing substrate made from untanned animals, usually sheep, calves, and goats). Dossie also recommends parchment and also suggest the leather used by glovers (likely made from similar materials to parchment) as a replacement. Rabbit skin glue, commonly used for gilding grounds in the twentieth century, is not mentioned in the British treatises discussed above, and Leslie

[3] Examples can be found in the collections of The Winterthur Museum (1952.0261), The Metropolitan Museum of Art (1990.18), and Cliveden House in Philadelphia (NT 73.55.22 [1]). Reynolds advertised the sale of imported looking glasses "in carved and white, or carved and gilt frames." In the November 14, 1768 Pennsylvania Chronicle (Heckscher 1992, 189).

Carlisle, in her 2012 article, "Exploring the grammar of oil paint through the use of historically accurate reconstructions," in *Conservation of Easel Paintings,* points to this adhesive's absence from her earlier database of 16th- to 19th-century recipes for painting grounds (Witlox and Carlisle 2005), and suggests that even modern "rabbit skin" glue may in fact be made from generic animal skins[4] (Carlisle 2012, 35). Dallongeville et al. report in their 2011 paper, "Identification of Animal Glue Species in Artworks Using Proteomics: Application to a 18th Century Gilt Sample," that a reference sample of modern "rabbit skin" glue[5] was in reality bovine glue (Dallongeville, Koperska, Garnier, Reille-Taillefert, Rolando, and Tokarski 2011, 9434).

The presence of proteins may be indicated by fluorochrome staining, as discussed above, or by fourier-transform infrared spectroscopy (FTIR) (Townsend and Boon 2012, 352-354), and general classes of animal protein found in artworks (collagen, ovalbumin, and casein) may be distinguished using chromatographic methods combined with mass spectrometry (eg. gas chromatography-mass spectrometry (GC-MS) and high performance liquid chromatography-mass spectrometry (HPLC-MS)) (Dallongeville et al. 2011, 9431; Townsend and Boon 2012, 349-352; Singer and McGuigan 2007). Laser induced fluorescence (Nevin et al. 2007), high-performance liquid chromatography-diode array detector analysis (Fremout et al. 2009), enzyme-linked immunosorbent assay (ELISA) (Keeney 2007; Kučková et al. 2015) high-performance liquid chromatography electrospray ionization tandem mass spectrometry (HPLC-ESI-MS/MS) (Fremout et al. 2010), and other methods have been used to analyze proteins in works of art. Matrix-assisted laser desorption/ ionisation time-of-flight mass spectrometry (MALDI-TOF-MS) has been used to perform genus-specific analysis of animal proteins (Buckley et al. 2009; van der Werf et al. 2012), and this technique has also been applied specifically to the analysis of gilded surfaces (Kučková et al. 2015; Dallongeville et al. 2011).

### *2.4 Bole*

Water or burnish gilding is laid over a clay layer, commonly referred to as bole (it is called size by the period British treatises of Stalker and Parker, Dossie, and Campbell), which consists of a colored clay bound in animal protein glue, often with additional ingredients (Rivers and Umney 2013, 655-677). Stalker and Parker recommend as the "best size" a mixture of English and French Armoniack (likely refers to Armenian bole, also known as bole armoniac, a red clay containing iron oxides, silicates of aluminum, and possibly magnesium, although "Armoniack" may be a generic term for red clays) and candle grease. Another recipe offered by Stalker and Parker contains "sallet-oyl" (salad oil?) white wax, black lead, and "bole Armoniack" (Stalker and Parker 1688, 58-59). Dossie gives a recipe for size which calls for bole armoniac, and purified suet or tallow, noting that some practicioners mix the tallow, melted, with chalk, and others add a few soap suds to the bole, "…which will contribute to its uniting with the tallow." Dossie gives a second recipe which is very similar to Stalker's second recipe. It calls for bole, black lead, olive oil, and beeswax (Dossie 1764, 432-433). Campbell's recipe is similar to the other two and includes pipe clay, red chalk, black lead, sweet oil, and tallow (Campbell 1747, 108). Stalker and Parker and Dossie both suggest that a layer of yellow pigment (likely ocher) in animal protein glue should be applied to carved areas prior to the application of the red bole so that areas missed during gilding will not be as obvious. Dossie advises that a "little vermillion or red lead" should also be added to this coat (Stalker and Parker 1688, 59; Dossie 1764, 435). Rivers and Umney note that "English clay could not be burnished without the addition of graphite," although it is unclear which period they are referring to. They also refer to traditional recipes which use egg white or isinglass rather than parchment or glover's glue as a binder (Rivers and Umney 2013, 655-656).

[4] See also Rivers and Umney 2013, 647-648 for further discussion of parchment vs. rabbit skin size.
[5] Kremer 63028.

As part of their 2014 study, "Materials and techniques of gilding on a suite of French eighteenth-century chairs," Chao et al. have analyzed the mineral composition of gilding bole using optical microscopy, polarized light microscopy (PLM), digital image analysis, SEM-EDX, Raman spectroscopy, and X-ray diffraction (XRD) (Chao et al. 2014). Barata et al. studied gilder's boles from Portuguese baroque altars using SEM-EDX and XRD in their 2015 study, "Synchrotron X-Ray Diffraction of Bole Layers from Portuguese Gilded Baroque Retables." Conestro Sastre et al. have proposed transmission electron microscopy (TEM) as an alternative to SEM for characterizing boles (Conejo Sastre et al. 1999).

The protein binder of a bole may be analyzed using the techniques covered previously for the binder of the white ground layer. Oil and wax additives are commonly characterized using FTIR and chromatographic methods (Townsend and Boon 2012, 349-355).

## 3. Experimental Procedure

### *3.1 Research Objectives*

The purpose of this study is to gain insight into the materials and techniques used to create the ground for gilding on the looking glass's frame. The results will be viewed in light of British 17$^{th}$ and 18$^{th}$ century treatises on gilding and compared to the recipes set forth in these texts (Stalker and Parker 1688; Campbell 1747; Dossie 1764). Identification of the wood species used for the carved frame will also be attempted in an effort to inform questions about the geographic location of manufacture (America or Great Britain).

### *3.2 Methodology*

The object has not undergone any known analysis or study at this date. The removal of four cross-section samples from different elements of the frame, taken adjacent to existing areas of loss if possible, is proposed initially. English frames from this period often had complex surfaces with some areas burnished, some areas unburnished, and some areas with subtle toning or matting layers (Stalker and Parker 1688, 58-60). Removal of samples from different areas of the frame (i.e. carved wood, carved "gesso," flat areas, recessed areas) may therefore provide clues to its original appearance. Initial cross-section microscopy will also serve as a roadmap for further analysis and may necessitate revision of this proposal if results deviate from the expected stratigraphy.

#### *Wooden Substrate*

The wooden substrate will be examined visually at areas of loss or exposure under macro- and microscopic magnification. If possible, a thin section sample (approximately 5mm x 5mm) will be taken from a discrete area (e.g. within the rabbet) for microscopic anatomical identification. An additional small wood sample (approximately 300µg) will also be taken from a discrete area by drilling or removal with scalpel for analysis by HC-Py-GC/MS.

#### *Finish Stratigraphy*

Cross-section samples will be mounted in polyester resin cubes and viewed under normal and ultraviolet light at 10x-60x magnification in order to assess the finish structure's stratigraphy. Fluorochrome staining will also be performed on these samples to characterize and locate potential carbohydrates, lipids, and proteins.
Cross-section samples will also be analyzed using SEM-EDS to map surface topography, relative atomic density, and elemental composition.

***White Ground Layer***
Analysis of mineral elements within the white ground layer will be guided by the results of SEM-EDS elemental mapping. A loose sample may be taken, from and area exposed by existing loss, for analysis by polarized light microscopy to aid in characterization of mineral particles, and may be further analyzed using Raman spectroscopy and XRD to support preceding analysis and to aid in understanding the molecular structure and crystallinity of constituent minerals within the ground layer.

Loose sample of white ground may also be used to aid in characterization of possible binding media within the layer. Analysis by FTIR may be performed to characterize the binding media initially and to guide further study. Chromatographic techniques (e.g. GC-MS or HPLC-MS) may be used to further inform identification of binding media (e.g. lipids and/ or proteins), and MALDI-TOF-MS may be used for genus-specific identification of protein(s) present.

***Bole***
Analysis of mineral elements within the "bole" layer will also be guided by the results of SEM-EDS elemental mapping. A loose sample may be taken, from and area exposed by existing loss, for analysis by polarized light microscopy to aid in characterization of mineral particles, and may be further analyzed using Raman spectroscopy and XRD to support preceding analysis and to aid in understanding the molecular structure and crystallinity of constituent minerals within the "bole" layer. Depending on thickness of "bole" layer, it may require separation under magnification.

Loose sample of "bole" may also be used to aid in characterization of possible binding media within the layer. Analysis by FTIR may be performed to characterize the binding media initially and to guide further study. Chromatographic techniques (e.g. GC-MS or HPLC-MS) may be used to further inform identification of binding media (e.g. lipids and/ or proteins), and MALDI-TOF-MS may be used for genus-specific identification of protein(s) present.

If present, the mineral content and binder of an ocher layer may be analyzed in a similar fashion to the ground and "bole" layers.

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