

Historic Paint Finishes Study:

The original paint finishes of the Carter Mansion 1775-1780
Elizabethton, Tennessee Second Phase Study

The Stair Landing and above, The Second Floor: Passage 201, South Bedchamber 202, West
Bedchamber 203



Tennessee Dept. of Environment and Conservation
Sycamore Shoals State Historic Park

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Introduction

This study was conducted as a continuation of the first historic paint finishes report, of 26 September 2018. Some of the surfaces may overlap, however most of the examination was conducted on woodwork from the landing between the first and second floors and all of the second floor rooms.

Much of the surfaces that are exposed at present are original finishes and while they may have changed in appearance, due to fading and discoloration, they are to remain exposed. Original finishes from the eighteenth century are extraordinarily rare and must be retained.

Some paint removal had been conducted on these surfaces when the Carter Mansion became property of the State of Tennessee in 1972. This study was conducted on the surviving paint finishes as they existed in the Summer of 2020.

General Observations:

There has been a persistent legend that the Carter Mansion was moved from another site. In his book, *Architecture, Men, Women and Money in America, 1600-1860*, Roger Kennedy suggested Tidewater Virginia, based on certain architectural similarities. It was hoped that this might be indicated with the examination of the finishes of the second floor spaces, Rooms: Passage 201, Chamber 202 and Chamber 203, however, no firm evidence can be established. As is the case in so many historic structures, the Carter Mansion shows many inconsistencies, or rather responses to specific conditions in terms of the application and sequence of paint and varnish finishes. Many of the samples showed a dark brown natural resin varnish as the first finish, which may prove to be an aged shellac and some flat surfaces show a clearer yellowish natural resin varnish. The West Chamber 203, however, shows no natural resin varnish under the present marbled finish. The surviving paint finishes at the Carter Mansion cannot be used to indicate that the house was dismantled and moved from another location. Speculation based on the early finishes is inconclusive, because there are simply too many variations possible.

Because of the exposed early paint finishes, the second floor of the Carter Mansion is of the greatest importance. This authenticity is irreplaceable. No actual restoration painting is anticipated. Color standards are provided, however, because the paints generally are consistent with the early finishes on the first floor. In the case of the second floor, the paint colors are for reference only and not for any repainting.

Technical Program

Note: The following is the procedure that is generally followed for museum quality paint finish examination. The identification of the pigment components is among the most important parts of the process.

1. Collection of Materials

Numerous samples were taken from the subject areas to determine the required chromo-chronologies of each surface. For this project, the first, original finish associated with the construction of the building is the focus of this study. The retention of many original finishes some of which are still exposed made the collection challenging in that the sample size was kept as small as possible.

2. Exposure of Finishes:

Most of the surfaces were already exposed in part by paint removal ca. 1972. Small exposures were undertaken on site and in the lab.

3. Stereoscopic and Polarized-light Microscopy, and Micro-chemistry

All samples are examined in cross section and obliquely. When required, the sample may be mounted for thin cutting or polishing. These samples are mounted in Bio-plastic polymer resin, in most cases. The samples are ground and polished for examination using top lighting.

Each significant layer of a sample is identified by comparison to color standards from the Benjamin Moore and Company color lines. The Munsell Color System [standard] proved to be less satisfactory for color matching. Exposure to full-spectrum or part-spectrum light is used to help reduce the yellowing of oil media. Initial stereo-microscopy is accomplished using a Olympus SZ-1145 microscope. Polarized-light microscopy, when necessary, is also undertaken, using the Olympus BMAX-50 microscope. Polarized-light microscopy identifies pigments and media according to the McCrone Research Institute system of particle identification. In many cases the most important function of serious paint research is the identification of the actual pigments and media used through optical and chemical testing. Polarized-light microscopy will be conducted on the original finish and on subsequent finishes where identification of pigment material may be an aid in dating, as required by the specific project. For this project extensive polarized light microscopy was conducted on the first and second paint finishes, in order to confirm the pigments, despite fading.

4. Color Matching

The best surviving surface of the paint finishes were matched under controlled lighting using the Olympus SZ-1145 relating the surviving colors to those on the first floor. The color matching was primarily an academic procedure, since no restoration painting is anticipated.

5. Photomicrographs:

A very important means of recording chromo-chronological data is photomicrography: print photographs taken through the microscope of particularly informative samples. This allows for clear indications of the conditions seen under the microscope, and how the recommendations were achieved. The report includes photomicrographs that are annotated with information in the report. The annotated photomicrographs are the principal feature of the report.

6. Report

The report brings together all the aforementioned material in a comprehensible manner and includes color samples, photomicrographs, color finishes and any additional pertinent

information, such as that from known documents. Spectrophotometric readings of color standards are also executed to provide all standards with CIE LAB and included in the report.

7. Additional examination: Addendum for instrumental examination

The presence of a very dark brown clear natural resin varnish will be subject to instrumental reading to identify the actual resin and the presence of a tinting agent, if any. Because of the Covid pandemic [ongoing since March 2020] the analytical laboratory of Winterthur, which will be doing the instrumental examination will conduct these examinations after 6 October 2020.

Respectfully submitted this date: 24 September 2020

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Note Regarding Photomicrographs

Despite the great advances in color accuracy in digital registration, the appearance of historic paint finishes, particularly in cross section, is not always perfectly accurate. Some dark finishes must be over-illuminated in order to register for the photomicrograph. The color registration of other finishes may be altered as a result. In most cases, cross sections appear lighter or paler than they actually are.

Note regarding John and Landon Carter at the Carter Mansion

The following excerpt is from the Tennessee Historical Society, Tennessee Encyclopedia. The author is Anne-Leslie Owens; originally published 8 October 2017; updated 1 March 2018. The significance for this report is that John Carter, who acquired the land died in 1781, and that his son, Landon Carter inherited the property in 1781. The actual painting may date to Landon's period at the house Landon Carter (1760-1800).

The John and Landon Carter Mansion on the Watauga River at Sycamore Shoals, Elizabethton, is one of the oldest and most architecturally significant houses in Tennessee. Local tradition holds that the house was built by John Carter, an early settler and political leader of the Watauga Association, who died in 1781. Documentary evidence does not refer to such a large house until the 1790s, indicating that his son, Landon Carter, may be responsible for building the house prior to his death in 1800. Based on its architectural styling, typical of the 1780s, either Carter could have been responsible for the house's construction.

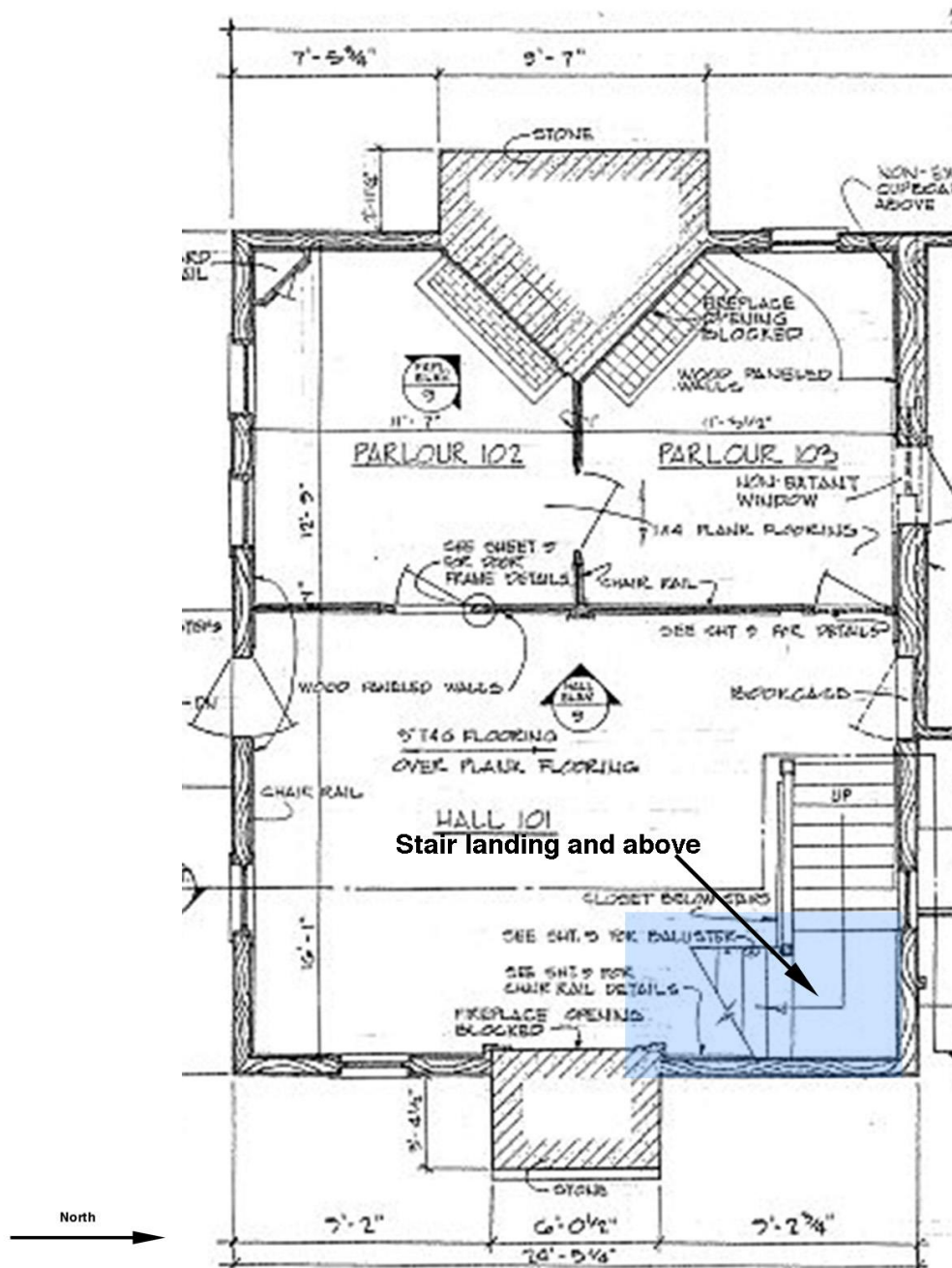
John Carter traveled to Tennessee from Virginia in 1770, and by 1775 he had gained title to the section of land where the mansion stands. John Carter's most famous son, Landon, may have resided with his parents, since he did not marry until 1784. Serving as administrator of his father's estate, Landon inherited the 640-acre home place in 1781. References to such a grand house do not appear until 1796 and 1800, when French botanist Andre Michaux and Governor John Sevier visited the Carters.

The second floor's fine styling is evident in its wainscoting and painted details. The smooth, flat, pine surfaces were painted to simulate marble, wood veneer, and wood paneling. The large second-floor bedroom contains an overmantel painting featuring a hunt scene, with hounds chasing a stag. The unknown artist created a similar country scene for the fireplace of the north parlor on the first floor.

The house remained in the Carter family until 1882. In 1973 the State of Tennessee bought the house and several acres. After restoring the mansion to its original appearance, the state opened it to the public as part of the Sycamore Shoals State Historical Area.

Carter Mansion: Stair landing

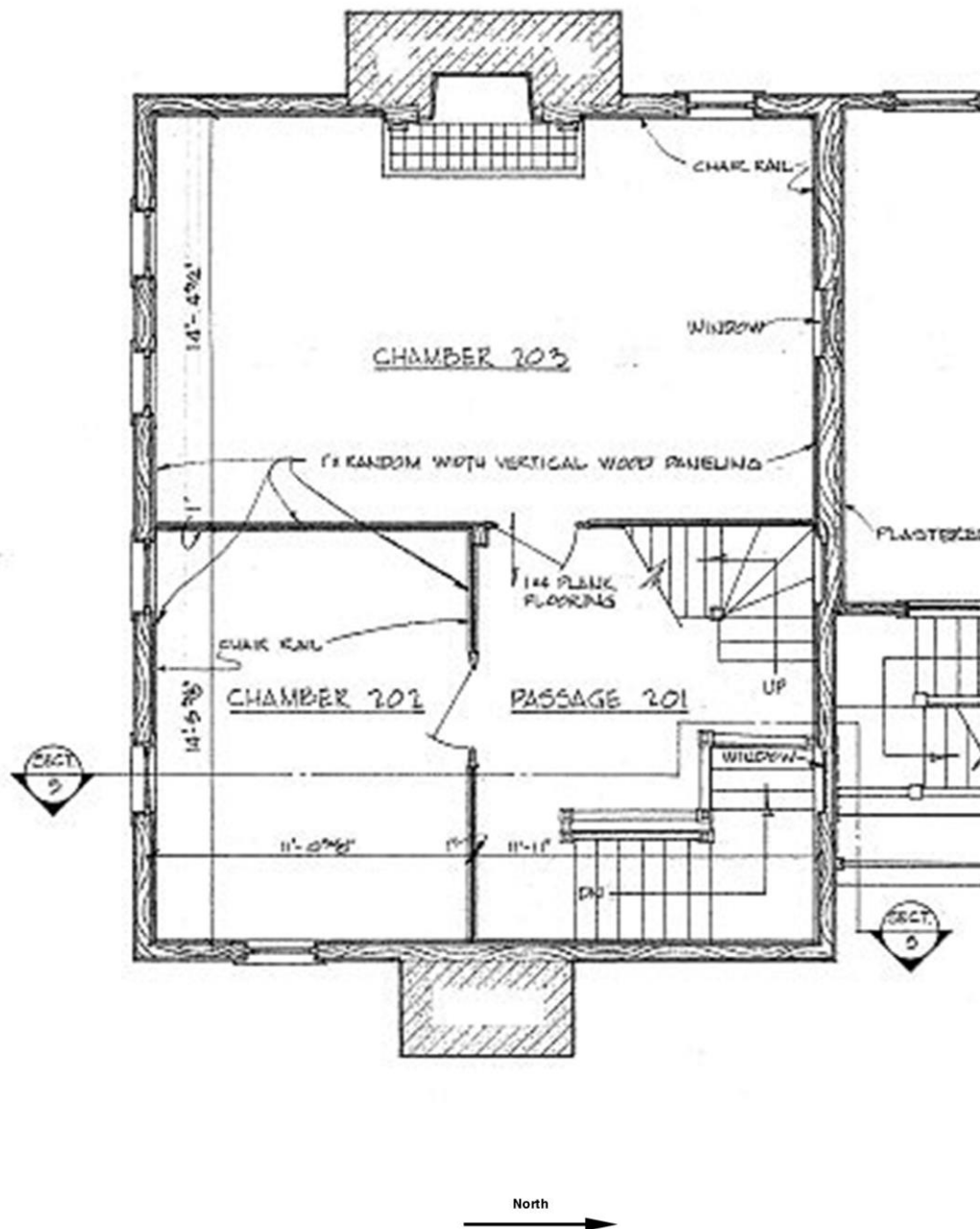
Scope of samples for this study were taken from the stair landing and the second run of the stair case and the floor above.



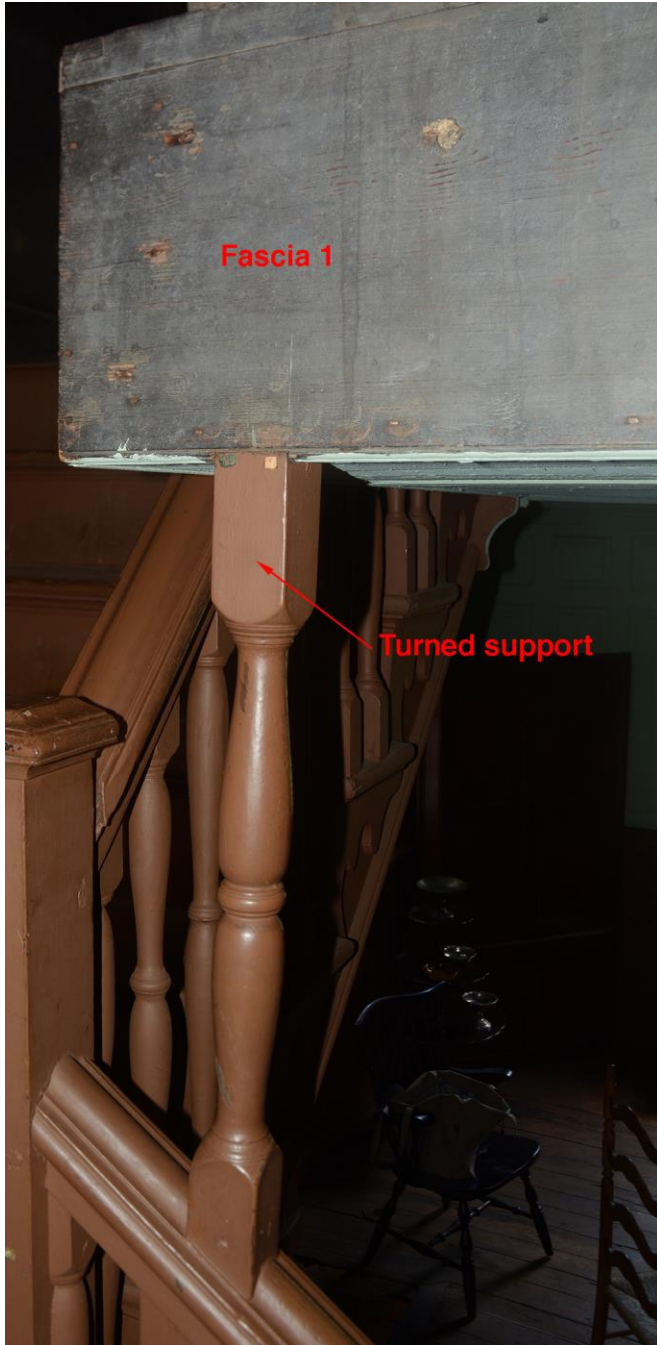
Carter Mansion:

Floor Plan, Second Floor:

All of the second floor was subject of this study.



Samples from the Stair Landing Area: Group 1 [Prefix: SL-]

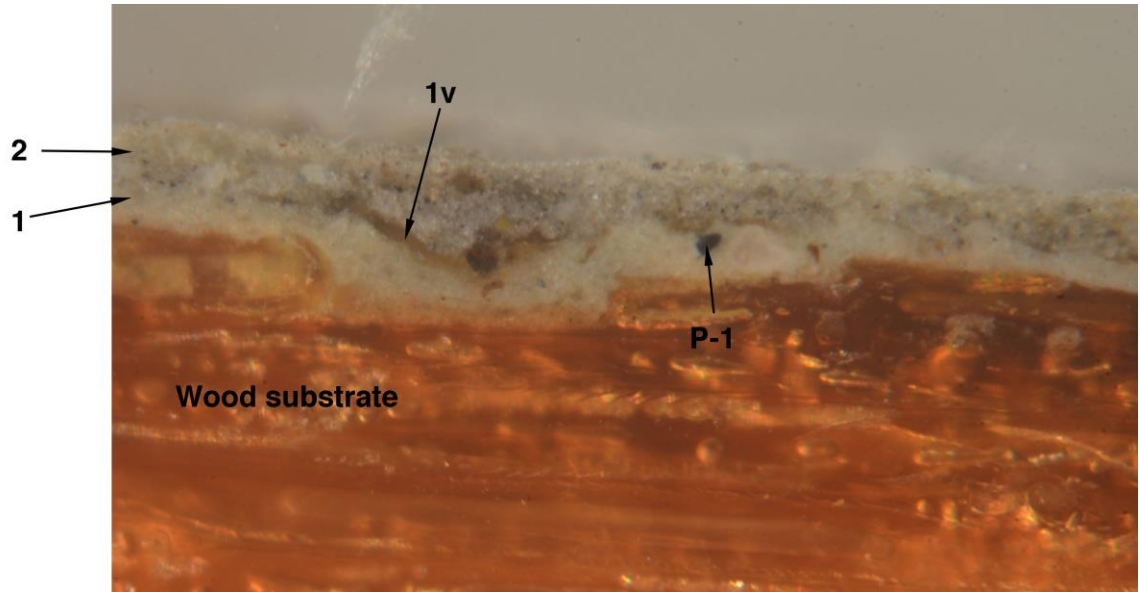


Samples from the Stair Landing Area: Group 1

Examination of the Samples:

Sample SL-1: Fascia 1 [south fascia]

Photomicrograph: Mounted sample, Olympus BMAX-50 polarized light microscope/ 10x objective, (100x total microscopic magnification) with Nikon D7100 digital camera body Lexar Media 1GB flash card Dolan Jenner Fiber optics illuminator, daylight filtering

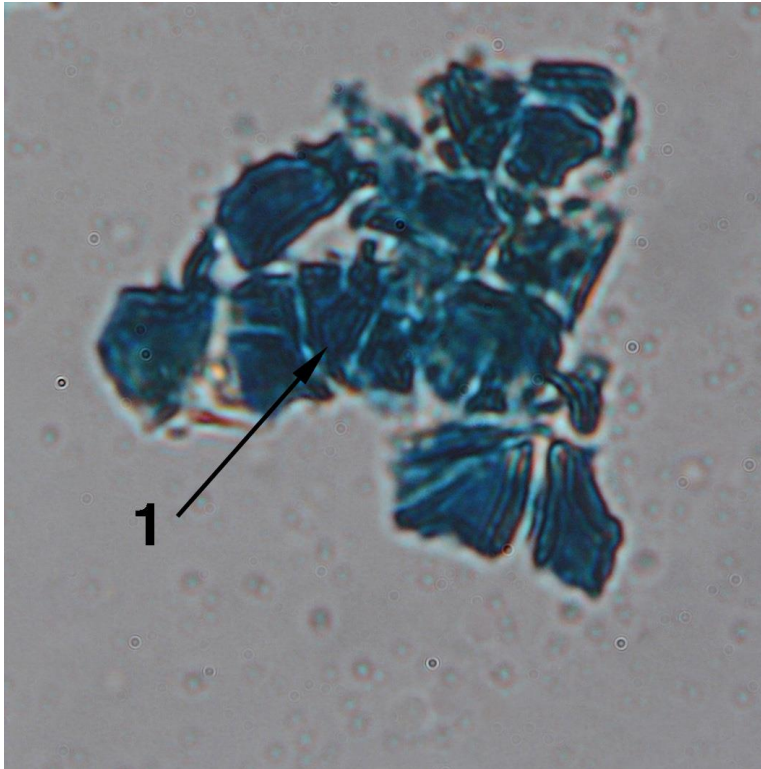


Note: The sample has been mounted in polymer resin, cut and polished to 8000 micron grit polishing cloth. The condition of the first finish is very good on this sample. The first layer, prepared with lead white and Prussian blue and is the first finish. The Prussian blue pigment particle is seen in the matrix [P-1]. What is somewhat surprising is how white the first paint finish appears in cross section; in fact it is a pale greenish blue. Refer to the unmounted photomicrograph, page 13. **Sample 1: Fascia 1 [south fascia]**

Polarized light microscopy:

Extracted Prussian blue pigment particle from Sample 201-1, Fascia 1, [indicated at “P-1”].

Photomicrograph: Slide Mounted sample, Olympus BMAX-50 polarized light microscope/ 40x objective, (400x total microscopic magnification: additional enlargement in computer) with Nikon D7100 digital camera body Lexar Media 1GB flash Uncrossed polars.

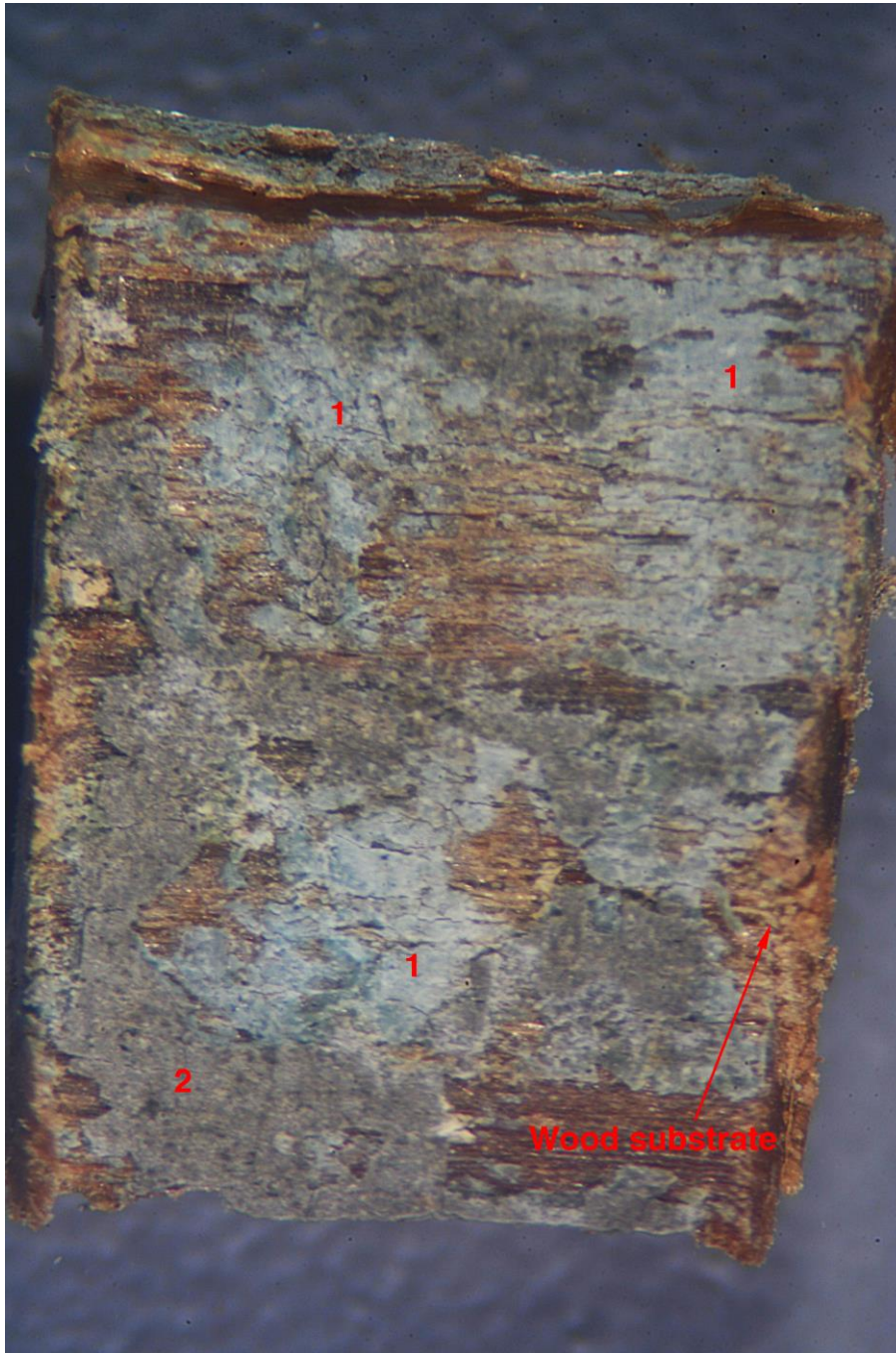


Note: Note: Pigment particles were extracted using a tungsten needle, and mounted on a glass slide in Meltmount Medium 1.662. The illumination is uncrossed polars.

The blue pigment particles are clearly seen (1) this is a Prussian blue pigment, it is isotropic (disappears when the polars are crossed and the background is black) and has a refractive index less than 1.662. This is the “old type” of Prussian blue, not the twentieth century soft blue amorphous particles.

Sample SL-1: Fascia 1 [south fascia]

Photomicrograph: Unmounted sample, Olympus SZ-1145 microscope, with Nikon D7100 digital camera body Lexar Media 1GB flash card Dolan Jenner Fiber optics illuminator, daylight filtering.

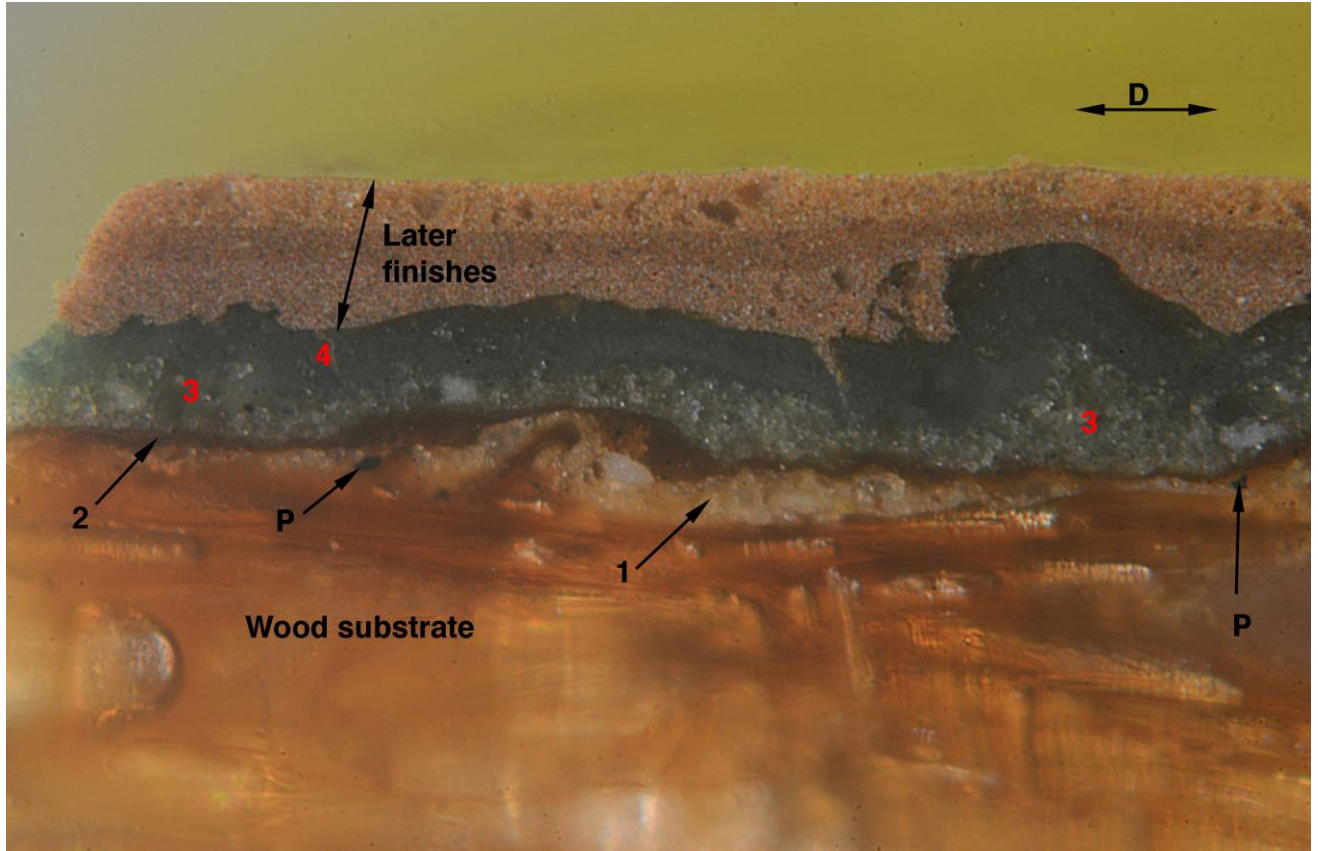


Note: The view of this sample is looking down onto the finish surface. This is a rare example of a light blue finish that has retained the blue coloration. In most cases at Carter Mansion there is marked fading of the color,. Indeed the second finish was also prepared with Prussian blue, an example that did fade to gray. The first finish [1] is a combination of lead white and Prussian blue pigment [potassium ferric ferro cyanide]. There is a second finish prepared in the same manner [2], however, this proved to be less stable and has faded to gray.

Note: The same paint condition and paint layers is seen on:
Sample SL-3: Fascia 2, North Wall

Sample SL-2: Turned Post

Photomicrograph: Mounted sample, Olympus BMAX-50 polarized light microscope/ 10x objective, (100x total microscopic magnification) with Nikon D7100 digital camera body Lexar Media 1GB flash card Dolan Jenner Fiber optics illuminator, daylight filtering



Note: The sample has been mounted in polymer resin, cut and polished to 8000 micron grit polishing cloth for additional examination. The wood substrate is seen at the base of the sample. The first layer is a white lead layer, showing occasional Prussian blue pigment particles [P] which may not have been intentional. The second layer is a brown clear natural resin varnish glaze. Layers 1 and 2 creates the first finish. The third layer is a medium blue finish [3] made of Prussian blue and lead white. The fourth layer is probably twentieth century: a chromium oxide green paint layer. The later finishes are ca. 1972 and post. Note the yellow coloration of the mount medium [D] which is caused by the action of the methyl ethyl ketone solvents of the mounting resin.

Note: The same layering was observed on the following sample:

Sample SL-8, Stair Landing: Newel

Samples from the Stair Landing Area: Group 2



Many of the samples exhibited considerable discoloration, in particular fading of the Prussian Blue pigment [potassium ferric ferrocyanide]. This is the same pigment that was used for the walls of the Parlor, where the blue finish is still exposed. In the parlor, it is a deeper blue finish color.

The photomicrographs of the stair landing area fascia boards noted in the photograph above are very indicative of the very deteriorated condition of the paint layers. These paint layers are now of course, over two-hundred and forty years old.

Sample SL-3: Fascia 2

Sample SL-4: Fascia 3

Sample SL-5: Molding, Location 1

Sample SL-6: Molding, Location 2

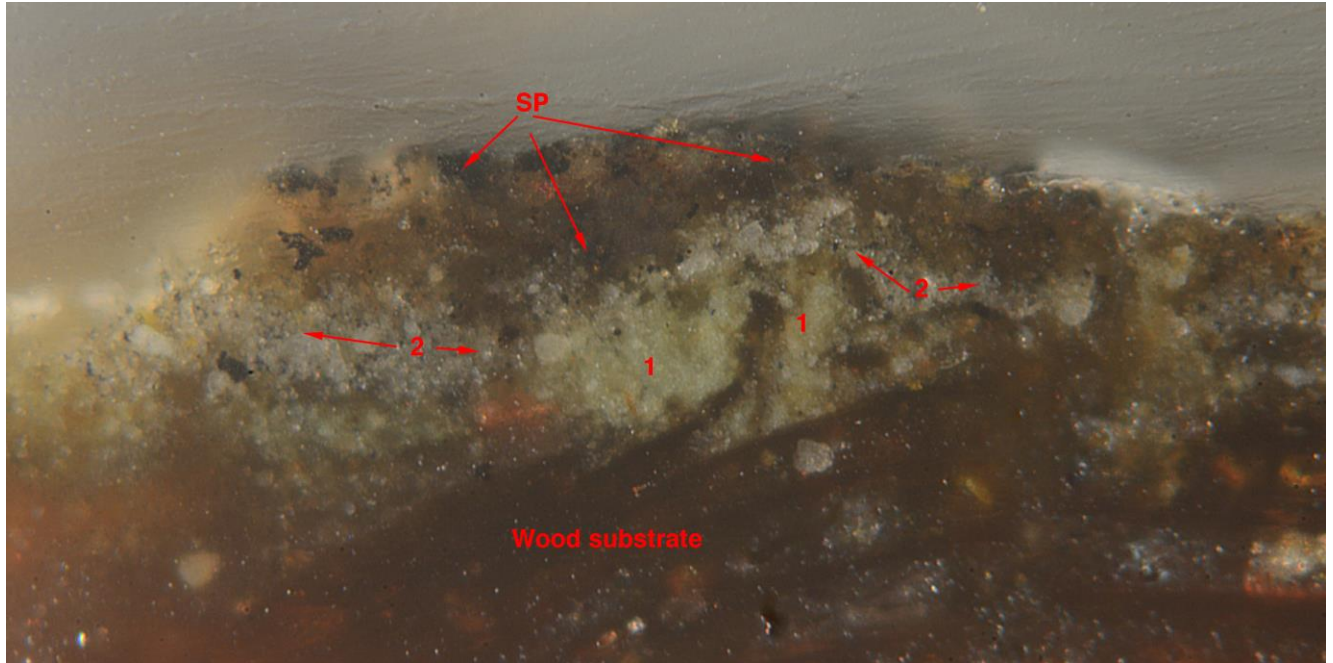
Sample SL-7: Board above window

Samples from the Stair Landing Area: Group 2

Examination of the Samples:

Sample SL-3: Fascia 2 [West]

Photomicrograph: Mounted sample, Olympus BMAX-50 polarized light microscope/ 10x objective, (100x total microscopic magnification) with Nikon D7100 digital camera body Lexar Media 1GB flash card Dolan Jenner Fiber optics illuminator, daylight filtering



Note: The sample has been mounted in polymer resin, cut and polished to 8000 micron grit polishing cloth. This is an example of the extreme poor condition of the paint layers: they are barely recognizable as layers.

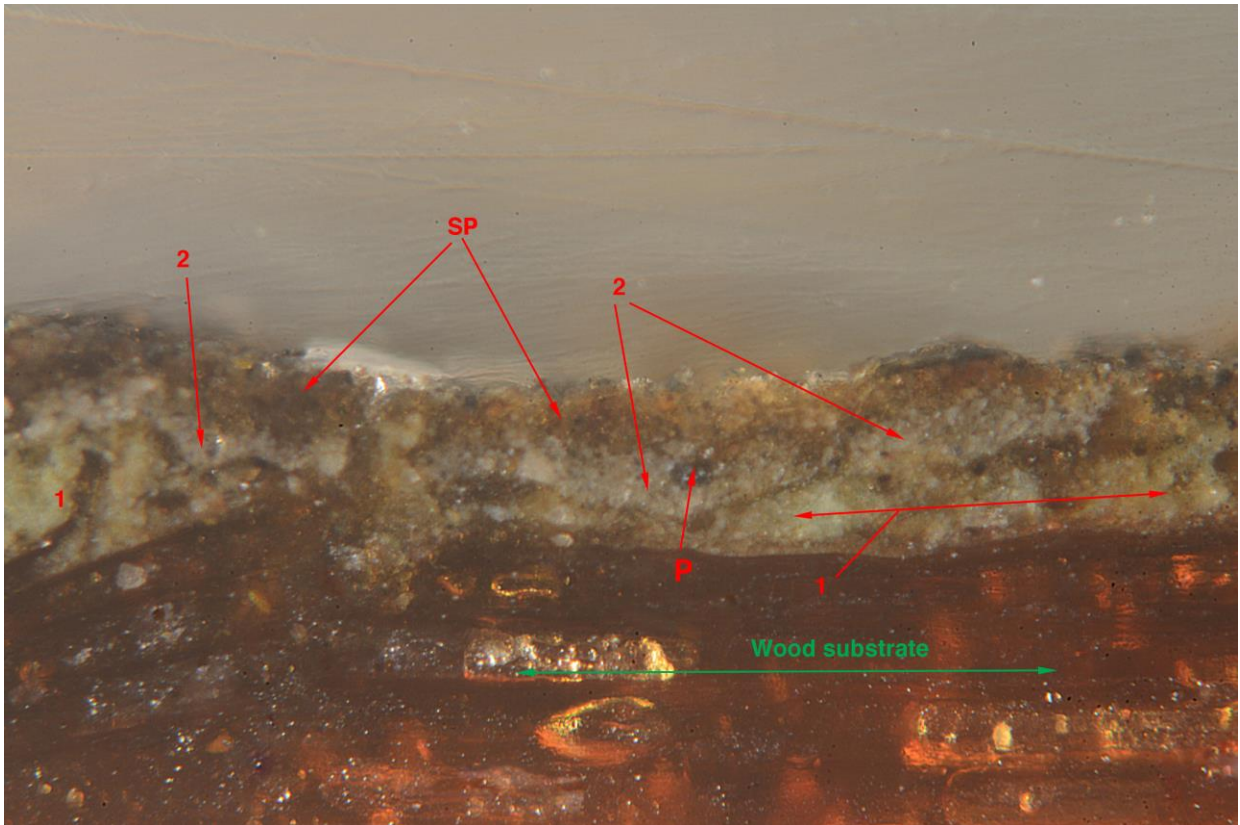
The wood substrate is seen at the base of the sample and is indicated: the surface of the wood is dark. Note remnants of the first finish, [1] a lead white with Prussian blue combination that appears light green due to the yellowing of the linseed oil binder. The second finish [2] is also a combination of lead white and Prussian blue, however, this example has faded and now appears gray. Refer to Photomicrograph: Polarized light microscopy; Stair Landing, Fascia 3.

The surface of the sample is completely covered by a hardened oily grime layer, with surface particulate [SP].

Samples from the Stair Landing Area: Group 2

Sample SL-4: Fascia 3 [North]

Photomicrograph: Mounted sample, Olympus BMAX-50 polarized light microscope/ 10x objective, (100x total microscopic magnification) with Nikon D7100 digital camera body Lexar Media 1GB flash card Dolan Jenner Fiber optics illuminator, daylight filtering



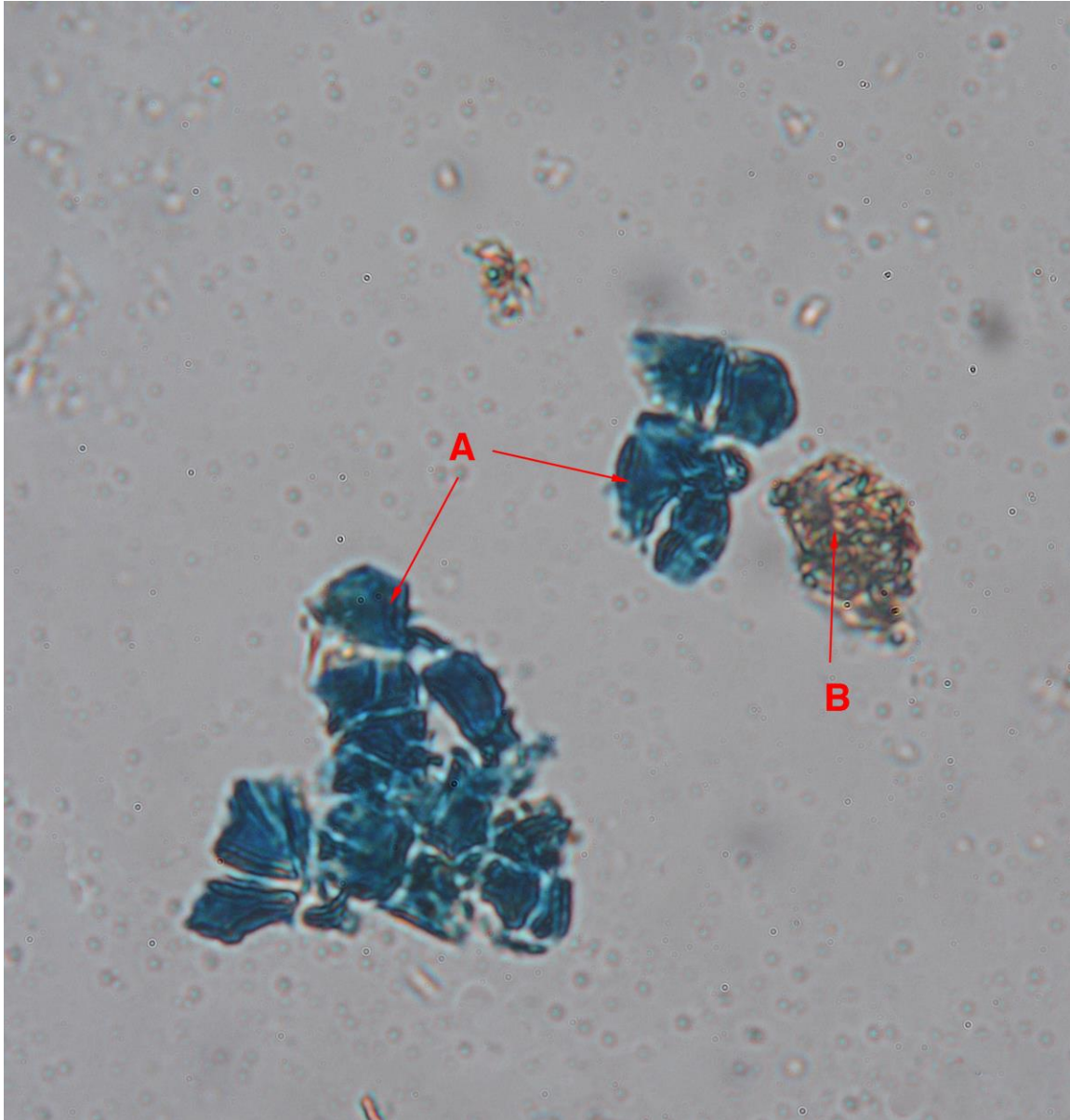
Note: The sample has been mounted in polymer resin, cut and polished to 8000 micron grit polishing cloth. This is an example of the extreme poor condition of the paint layers: they are barely recognizable as layers.

The wood substrate is seen at the base of the sample and is indicated: the surface of the wood is dark. Note remnants of the first finish, [1] a lead white with Prussian blue combination that appears light green due to the use of lead yellow, and also yellowing of the linseed oil binder. The second finish [2] is also a combination of lead white and Prussian blue, however, this example has faded and now appears gray. The large Prussian blue pigment particle [P] is clearly seen, however the color is not perceptible. Refer to Photomicrograph: Polarized light microscopy; Stair Landing, Fascia 3.

Polarized light microscopy:

Extracted Prussian blue pigment particle from Sample SL-4 Fascia 3, [indicated at “P”].

Photomicrograph: Slide Mounted sample, Olympus BMAX-50 polarized light microscope/ 40x objective, (400x total microscopic magnification: additional enlargement in computer) with Nikon D7100 digital camera body Lexar Media 1GB flash Uncrossed polars.



Note: Note: Pigment particles were extracted using a tungsten needle, and mounted on a glass slide in Meltmount Medium 1.662. The illumination is uncrossed polars.

The blue pigment particles are clearly seen (A) this is a Prussian blue pigment, it is isotropic (disappears when the polars are crossed and the background is black) and has a refractive index less than 1.662. This is the “old type” of Prussian blue, not the twentieth century soft blue amorphous particles. There is an agglomeration of lead white and yellow particles also visible [B]. Discoloration of the oil medium may be observed in this agglomeration.

Sample SL-5: Molding, Location 1
Sample SL-6: Molding, Location 2
Sample SL-7: Board above window

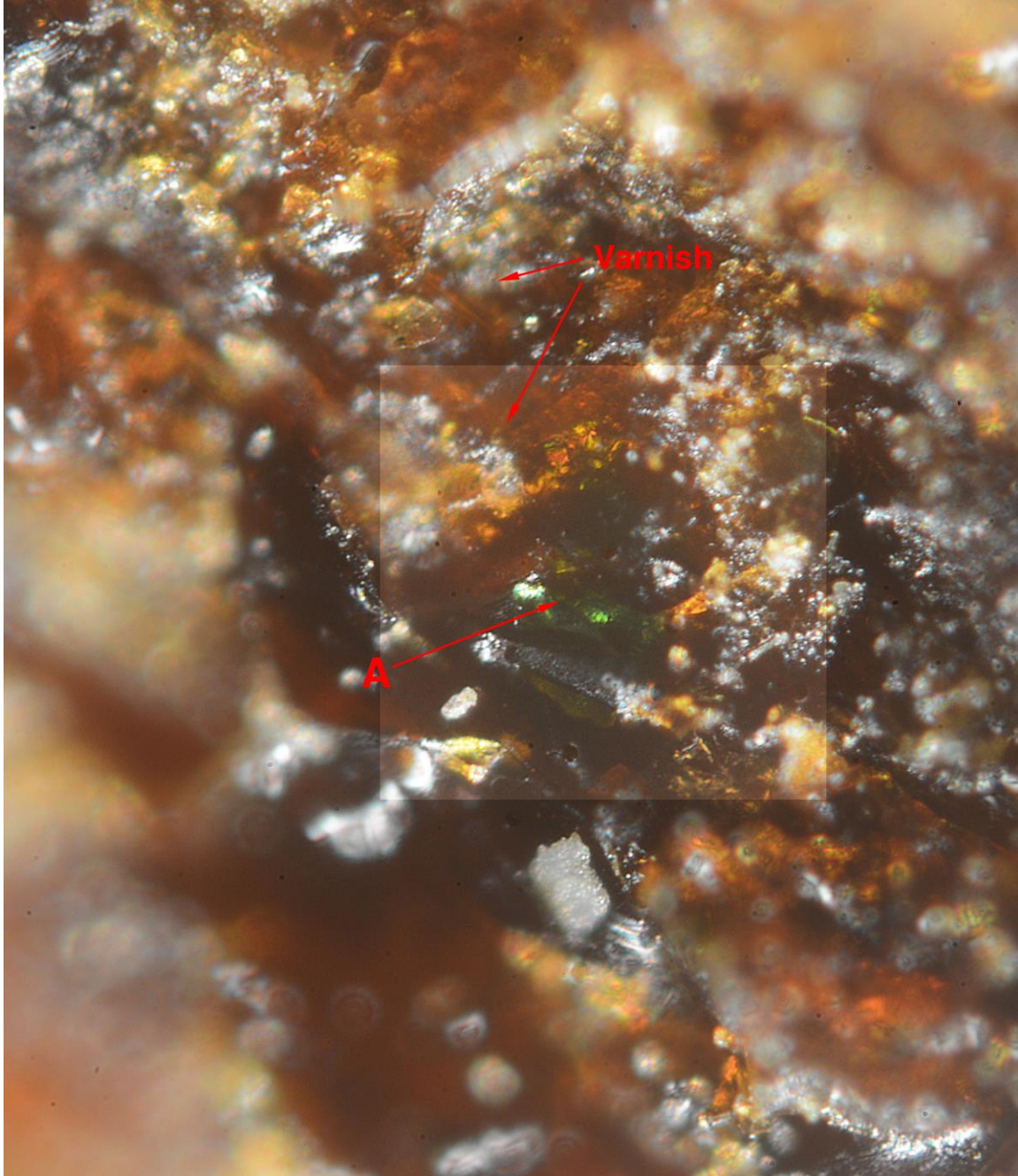


Note: The Molding separates the board above the window and the fascia board on the north wall of the stair landing.

Samples from the Stair Landing Area: Group 2
Examination of the Samples:

Sample SL-5: North wall: Molding, Location 1 and Location 2

Photomicrograph: Unmounted sample, Olympus SZ-1145 Stereo-microscope, with Nikon D7100 digital camera body Lexar Media 1GB flash card Dolan Jenner Fiber optics illuminator, daylight filtering.

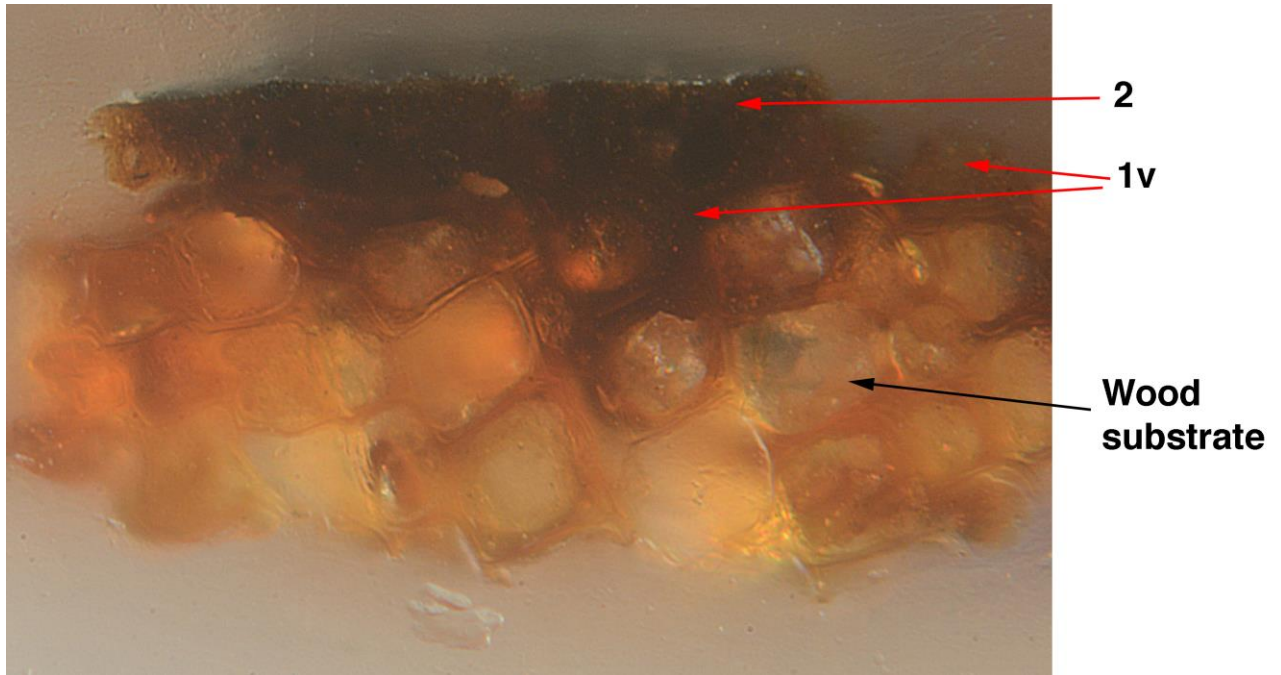


Note: This is an unmounted view showing the remaining green pigment particle [cupric acetate, which has been combined with the natural resin varnish, becoming cupric resinate. There are only minute particles that retain the green coloration.

Sample SL-5: Molding, Location 1 [North Wall]

Sample SL-6: Molding, Location 2 [North Wall]

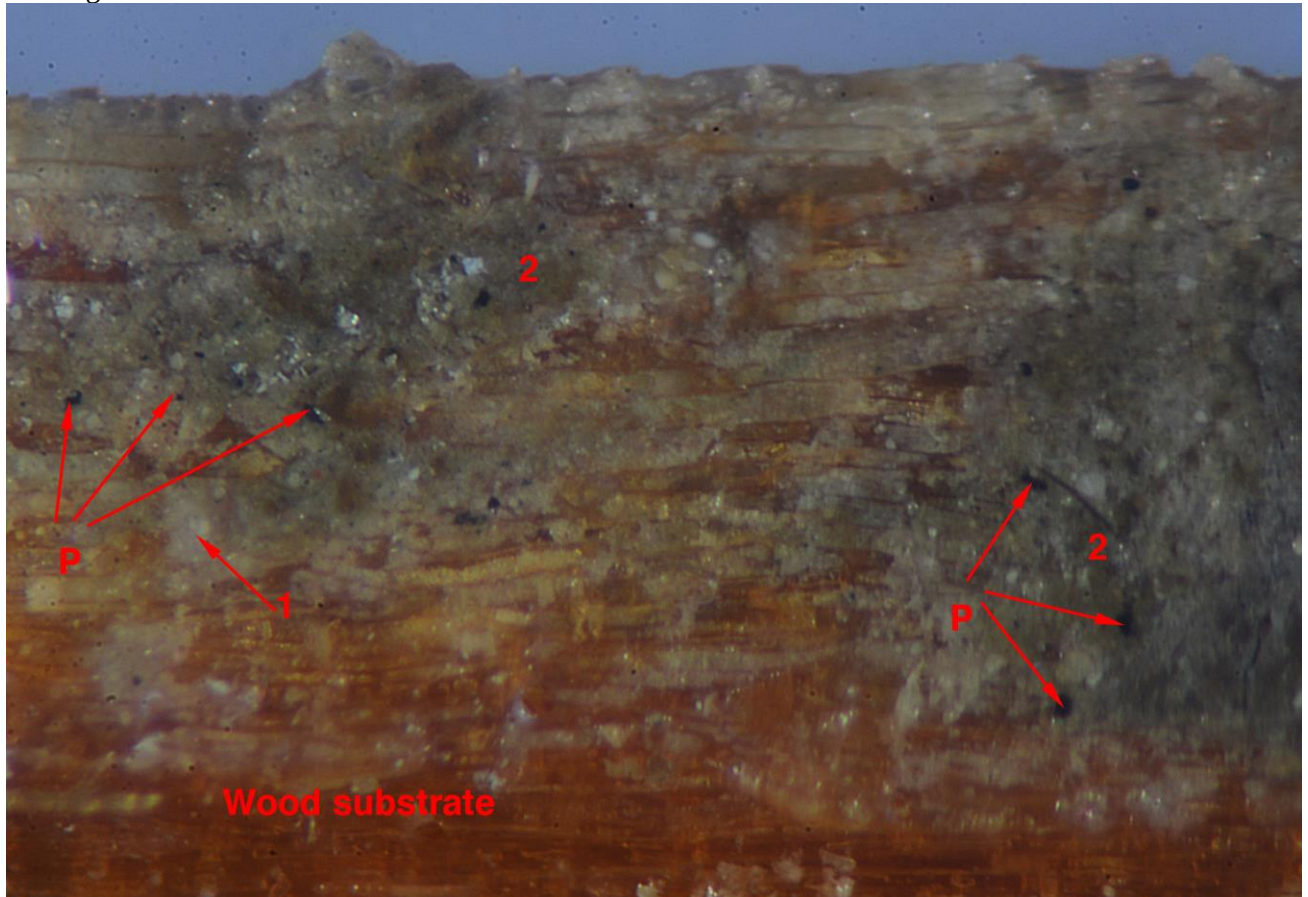
Photomicrograph: Mounted sample, Olympus BMAX-50 polarized light microscope/ 10x objective, (100x total microscopic magnification) with Nikon D7100 digital camera body Lexar Media 1GB flash card Dolan Jenner Fiber optics illuminator, daylight filtering [Additional enlargement in computer]



Note: The sample has been mounted in polymer resin, cut and polished to 8000 micron grit polishing cloth. The wood substrate is clearly seen and indicated: note the cell structure. The first finish is the natural resin varnish coating: this may be a combination of natural resins,[1v] that is seen on the immediate surface but also penetrates into the wood. The second finish [2] is the carbon black finish that is still exposed. This finish would have had some gloss when applied but all gloss has been lost over time.

Sample SL-7: Board above window

Photomicrograph: Unmounted sample, Olympus SZ-1145 microscope, with Nikon D7100 digital camera body Lexar Media 1GB flash card Dolan Jenner Fiber optics illuminator, daylight filtering.

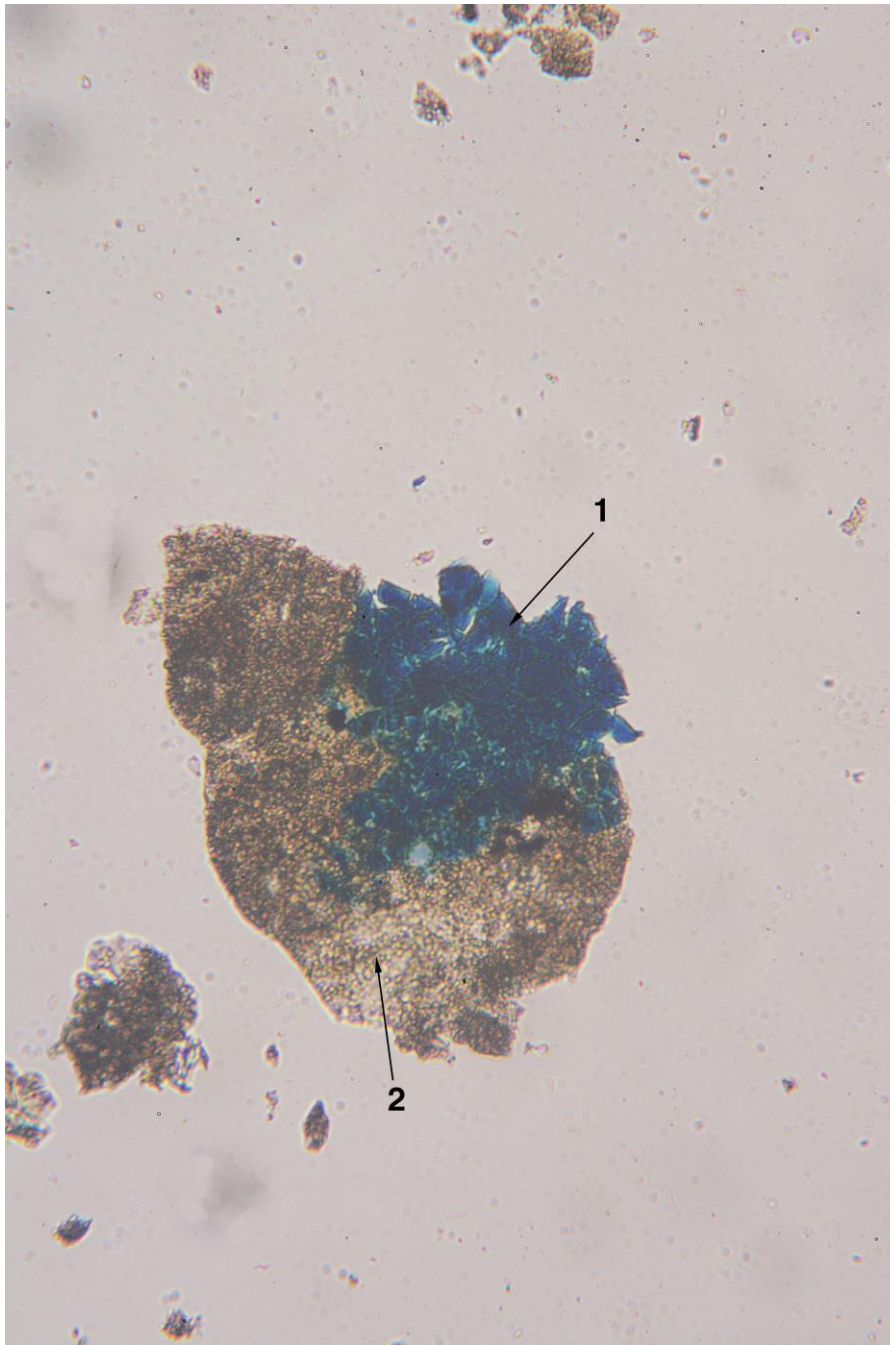


Note: The view of this sample is looking down onto the finish surface, from an angle. The sample was trimmed under the microscope to afford this view. The wood substrate is clearly seen. The pores of the wood show a thinned out white, as a primer. The first finish, 1, a white lead layer [1] and shows yellowing of the linseed oil binder. The second finish is very discolored: the original color could not be ascertained from the surviving paint in its condition. Fortunately remains of the Prussian blue pigment survive [P] The a particle of the pigment was removed for polarized light microscopy. This board was finished with the same Prussian blue finish, which faded and is identified as 2 on the fascia boards 2 and 3.

Polarized light microscopy:

Extracted Prussian blue pigment particle from Sample 201-7: Board above window, [indicated at “P”].

Photomicrograph: Slide Mounted sample, Olympus BMAX-50 polarized light microscope/ 40x objective, (400x total microscopic magnification: additional enlargement in computer) with Nikon D7100 digital camera body Lexar Media 1GB flash Uncrossed polars.



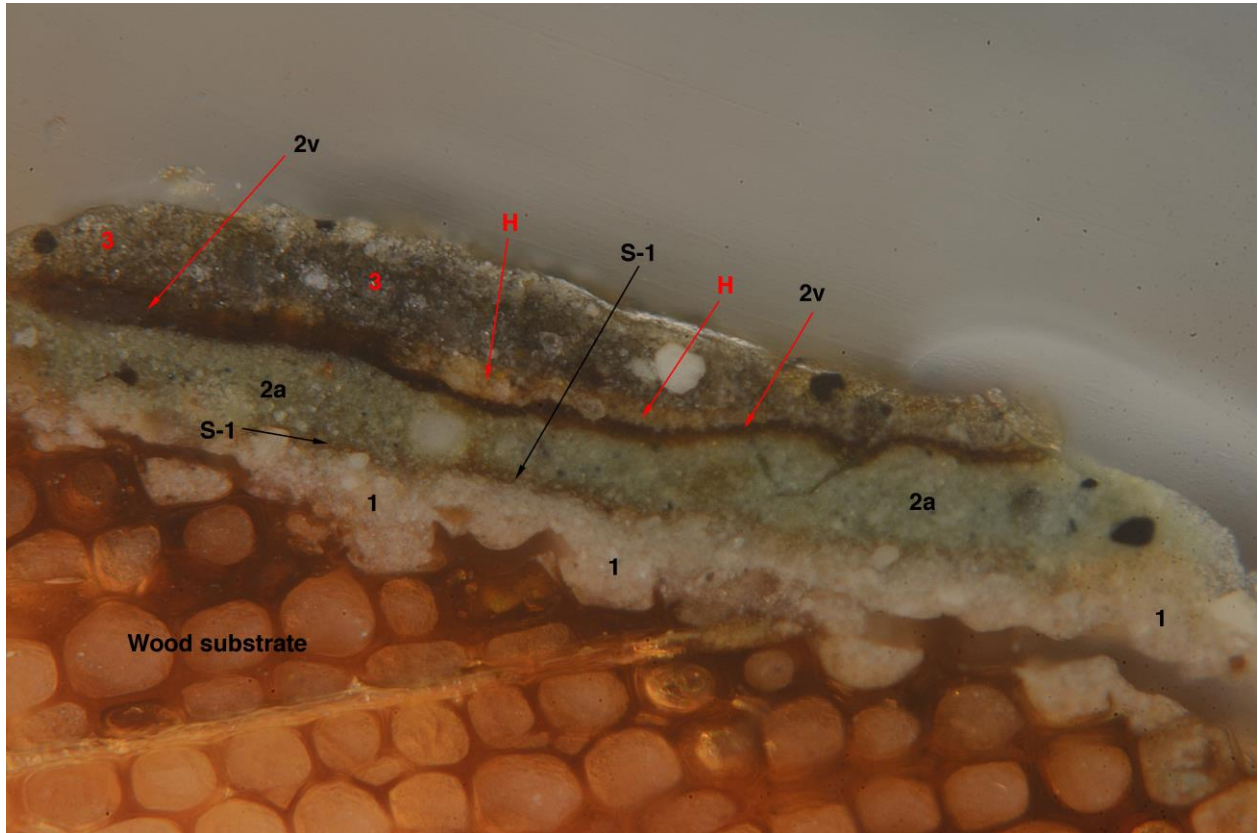
Note: Note:
Pigment particles were extracted using a tungsten needle, and mounted on a glass slide in Meltmount Medium 1.662. The illumination is uncrossed polars. The blue pigment particles are clearly seen (1) this is a Prussian blue pigment, it is isotropic (disappears when the polars are crossed and the background is black) and has a refractive index less than 1.662. This is the “old type” of Prussian blue, not the twentieth century soft blue amorphous particles. There is an agglomeration of lead white particles also visible [2] which was the base of the paint. The discoloration of the oil medium may be observed in this agglomeration.

Stair Landing: Crown molding return
Location of samples:



Sample SL-9: Crown molding return, Location 1:

Photomicrograph: Mounted sample, Olympus BMAX-50 polarized light microscope/ 10x objective, (100x total microscopic magnification) with Nikon D7100 digital camera body Lexar Media 1GB flash card Dolan Jenner Fiber optics illuminator, daylight filtering [Additional enlargement in computer]

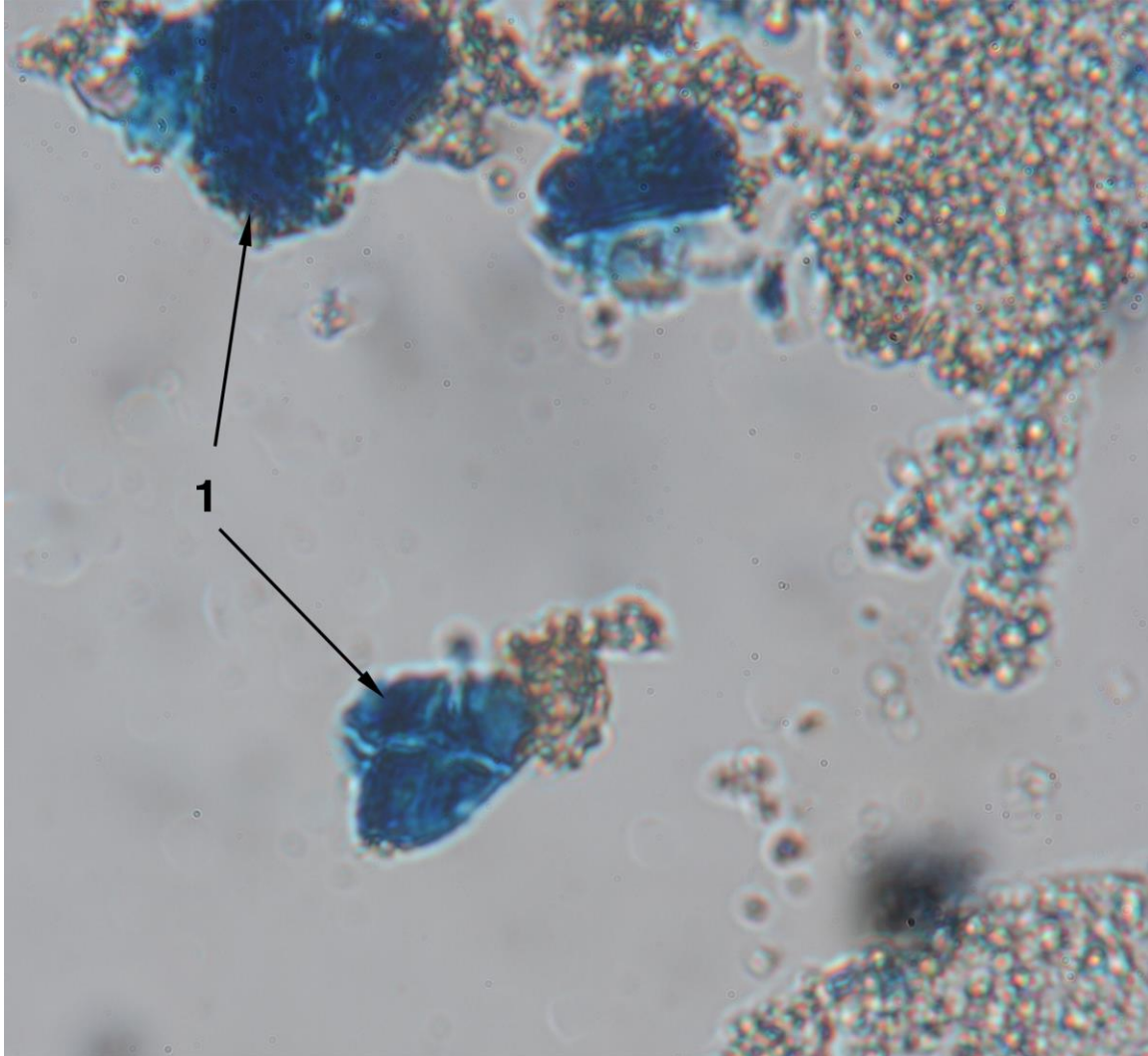


Note: The sample has been mounted in polymer resin cut and polished to 8000 micron grit polishing cloth. The wood substrate is seen at the base of the sample. The first finish is the lead white layer [1] that is clearly seen: note also that this finish has an oily discolored surface [S-1]. The higher oil content of the surface would have imparted a gloss to the paint. The second layer [2a] is prepared with lead white, lead yellow and Prussian blue pigment and has discolored somewhat due to the yellowing of the linseed oil binder and fading. This paint was protected by a varnish coating [2v] that is clearly seen: it has discolored to a brown: this is a natural resin varnish. Finish 3 is a moderate grey, prepared with lead white and lamp black.

There is an additional light tan color [H] that may be an unintended application, as it does not appear elsewhere.

**Polarized light microscopy: Sample SL-9: Crown molding return, Location 1:
Extracted pigment particle from Crown molding return, Location 1 Layer 2a**

Photomicrograph: Slide Mounted sample, Olympus BMAX-50 polarized light microscope/ 20x objective, (200x total microscopic magnification: additional enlargement in computer) with Nikon D7100 digital camera body Lexar Media 1GB flash Uncrossed polars.

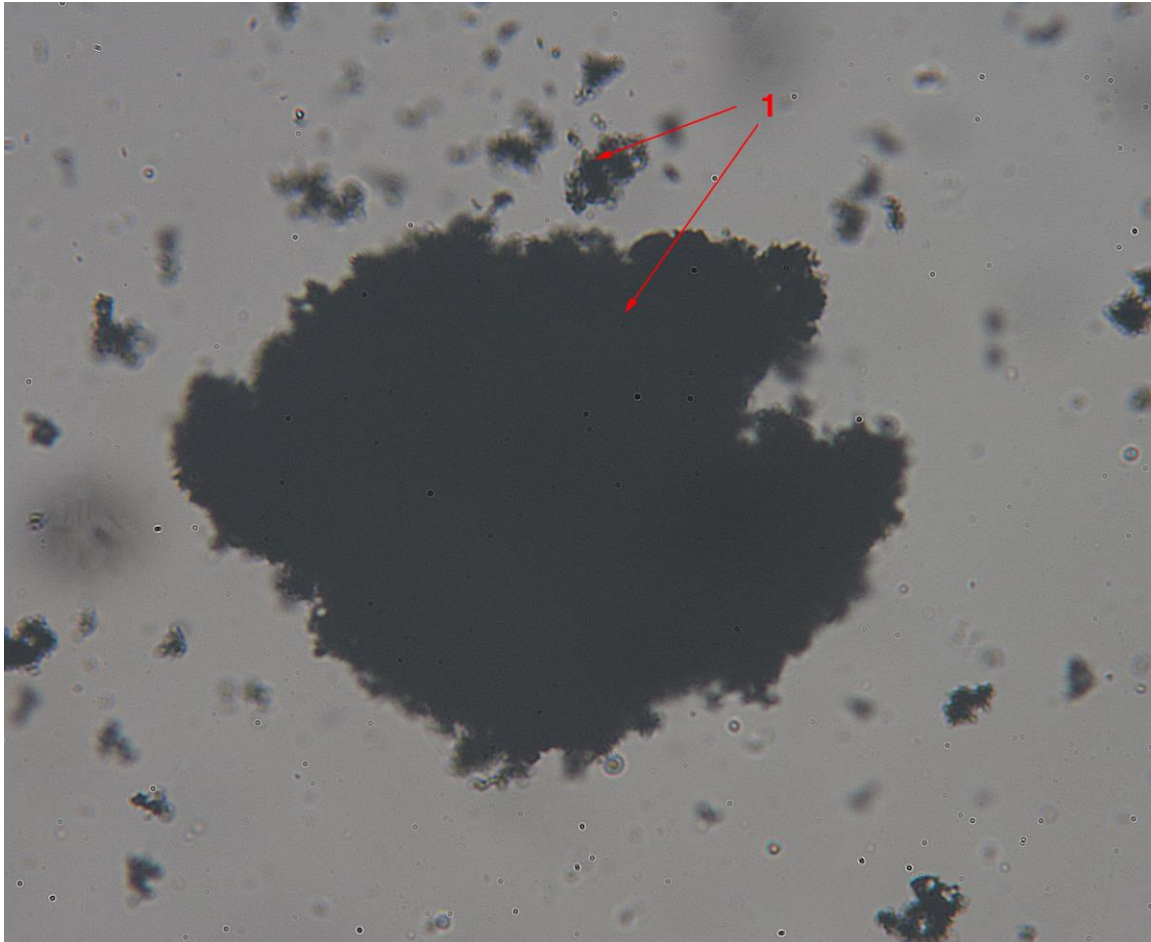


Note: Layer 2 of the cited sample was subject to polarized light examination. A pigment particle was extracted for polarized light microscopy. This layer retained much of the original color when seen in cross section, however, it was thus important to determine the original coloring pigment in this layer, despite the fact that it is the third layer in the sequence. The sample was extracted using a tungsten needle and was mounted in Meltmount medium 1.662. The illumination is uncrossed polars. The blue pigment particles are clearly seen (1) this is a Prussian blue pigment, it is isotropic (disappears when the polars are crossed and the background is black) and has a refractive index less than 1.662. This is the “old type” of Prussian blue, not the twentieth century soft blue amorphous particles. There is an agglomeration of lead white particles also visible [2] which was the base of the paint. The discoloration of the oil medium may be observed in this agglomeration.

Polarized light microscopy: Sample SL-9: Crown molding return, Location 1:

Extracted pigment particle from Crown molding return, Location 1 Layer 3

Photomicrograph: Slide Mounted sample, Olympus BMAX-50 polarized light microscope/ 20x objective, (200x total microscopic magnification: additional enlargement in computer) with Nikon D7100 digital camera body Lexar Media 1GB flash Uncrossed polars.



Note: Layer 3 of the cited sample was subject to polarized light examination. A pigment particle was extracted for polarized light microscopy. Many of the paint layers have declined and blue finishes appear gray. It was thus important to determine the original coloring pigment in this layer, despite the fact that it is the third layer in the sequence. The sample was extracted using a tungsten needle and was mounted in Meltmount medium 1.662. The complete opacity of the pigment particles [1] indicate that this is a carbon black pigment: appears to be lamp black. The third layer on the Crown molding return is thus a gray, having been prepared with lead white and lamp black.

Sample SL-10: Crown molding return, Location 2:

Note: As seen in the photograph on page 24, the lower moldings were painted with a chromium oxide green paint in the nineteenth or early twentieth century. This cross section bears comparison with Crown molding return, Location 1.

Photomicrograph: Mounted sample, Olympus BMAX-50 polarized light microscope/ 10x objective, (100x total microscopic magnification) with Nikon D7100 digital camera body Lexar Media 1GB flash card Dolan Jenner Fiber optics illuminator, daylight filtering [Additional enlargement in computer]

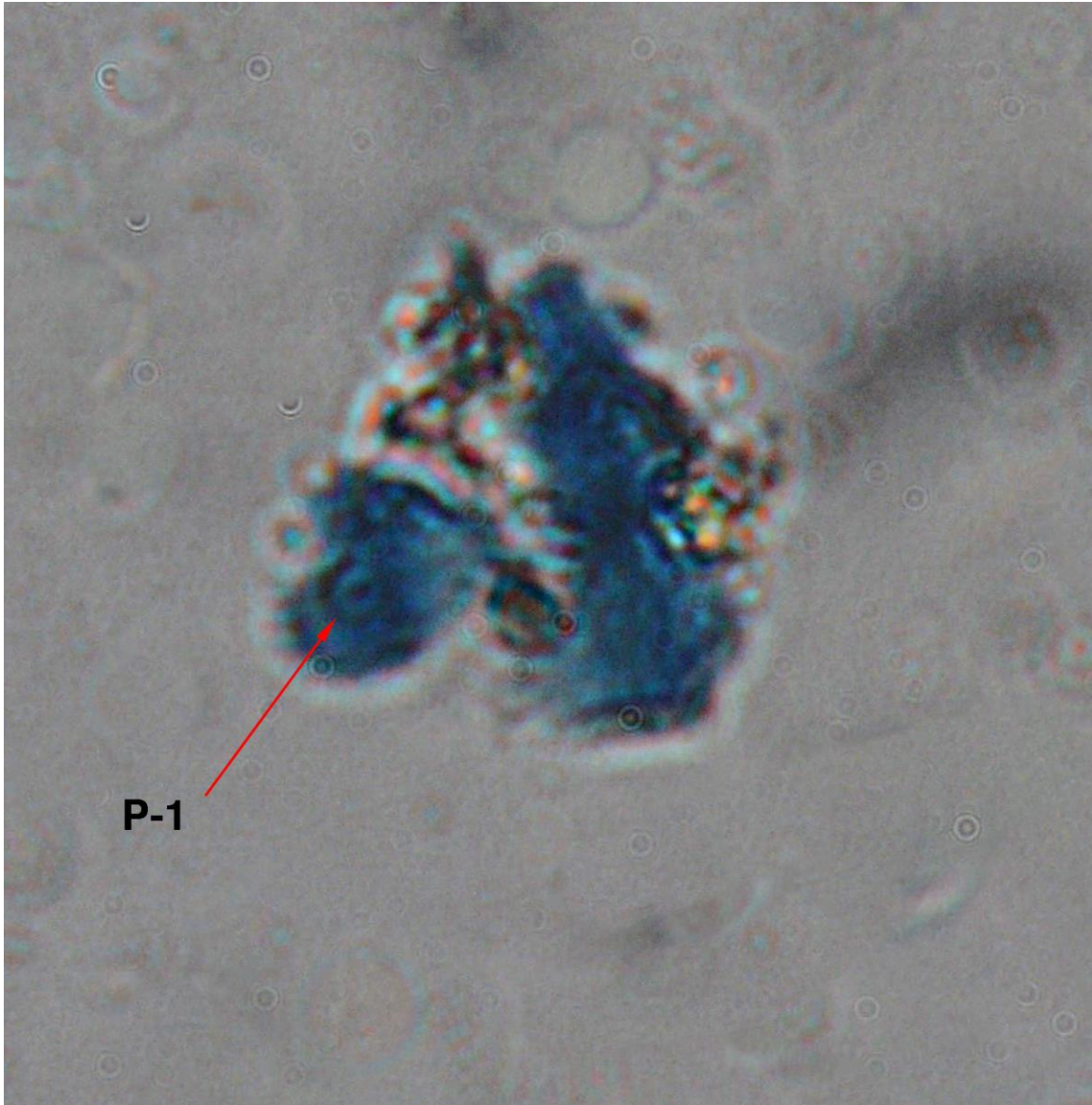


Note: The sample has been mounted in polymer resin cut and polished to 8000 micron grit polishing cloth. The wood substrate is seen at the base of the sample. The first finish is the lead white layer [1] that is clearly seen. The second finish posed a question: this appeared visually to be a paint layer with distilled cupric acetate [verdigris] mixed with lead white [2a], the pigments [P] looked green and the discoloration of the paint layer toward brown is also indicative of cupric acetate. As in the case of Sample: Crown molding return, Location 1, the paint is protected with a varnish coating [2v]. Polarized light microscopy was conducted on pigment particles from layer 2a [indicated: P] and proved that this paint layer was made with **Prussian blue pigment** and lead white. This is another indication of the extreme discoloration of materials at this site. The last layer, Layer 3, is the chromium oxide green paint from the 19th century.

Polarized light microscopy:

Extracted Prussian blue pigment particle from **Crown molding return, Location 2:**
[indicated at “P”].

Photomicrograph: Slide Mounted sample, Olympus BMAX-50 polarized light microscope/ 40x objective, (400x total microscopic magnification: additional enlargement in computer) with Nikon D7100 digital camera body Lexar Media 1GB flash Uncrossed polars.



Note: Pigment particles were extracted using a tungsten needle, and mounted on a glass slide in Meltmount Medium 1.662. The illumination is uncrossed polars.

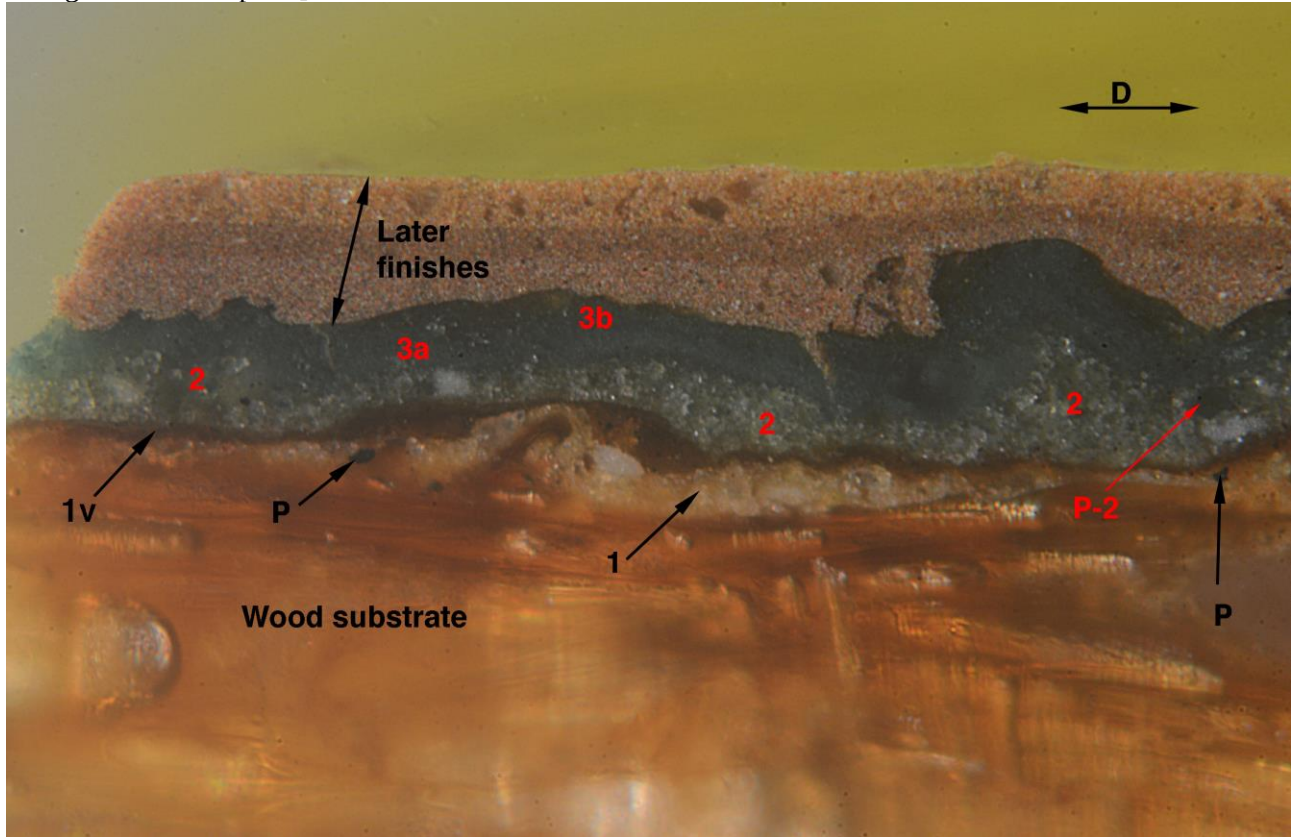
The blue pigment particles are clearly seen (P-1) this is a Prussian blue pigment, it is isotropic (disappears when the polars are crossed and the background is black) and has a refractive index less than 1.662. This is the “old type” of Prussian blue, not the twentieth century soft blue amorphous particles. This particle required additional enlargement in the computer, thus rendering the image less than ideally sharp.

Stair Landing, Newel:



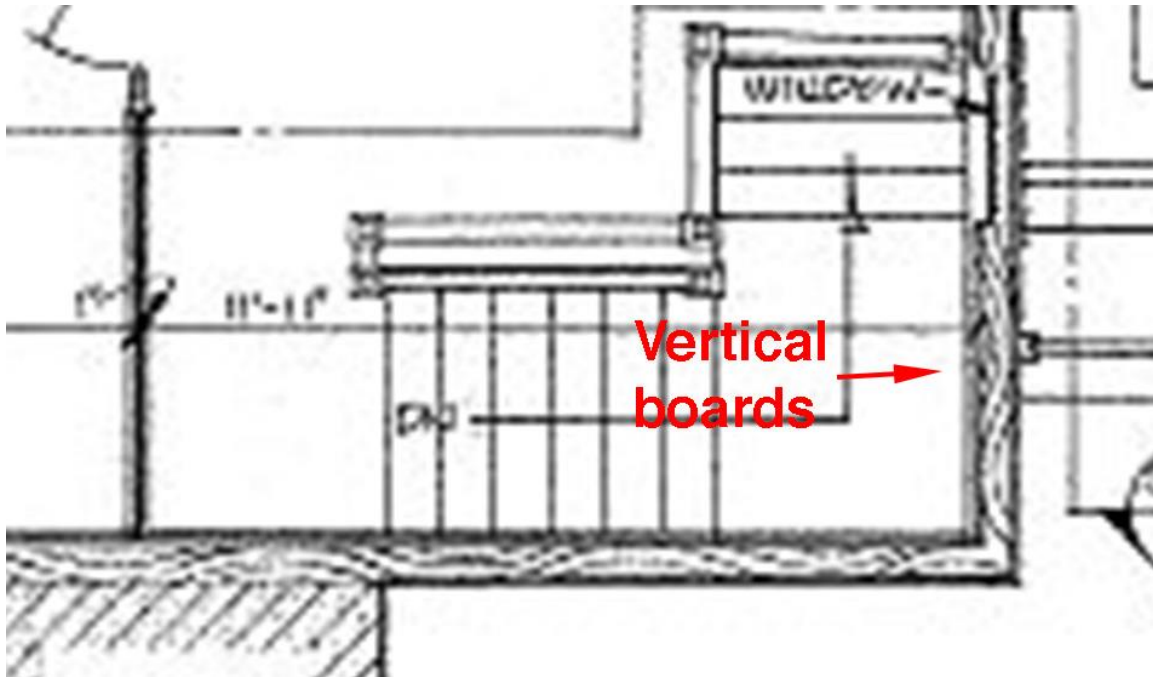
Newel and newel cap at the Stair Landing

Photomicrograph: Mounted sample, Olympus BMAX-50 polarized light microscope/ 10x objective, (100x total microscopic magnification) with Nikon D7100 digital camera body Lexar Media 1GB flash card Dolan Jenner Fiber optics illuminator, daylight filtering [Additional enlargement in computer]



Note: This sample has been mounted in polymer resin, cut and polished to 8000 micron grit polishing cloth for additional examination. The wood substrate is seen at the base of the sample. The first finish is a lead white finish, the occasional Prussian blue particles appear not to have had any bearing on the color [P]. The paint is coated with a natural resin varnish] that has turned brown [1v]The second finish is the lead white and Prussian blue paint finish [2]: note the large pigment particle of Prussian blue [P-2]. The third finish is the chromium oxide green finish of the nineteenth century [3a, 3b]. The later finishes date to ca. 1972 and post.

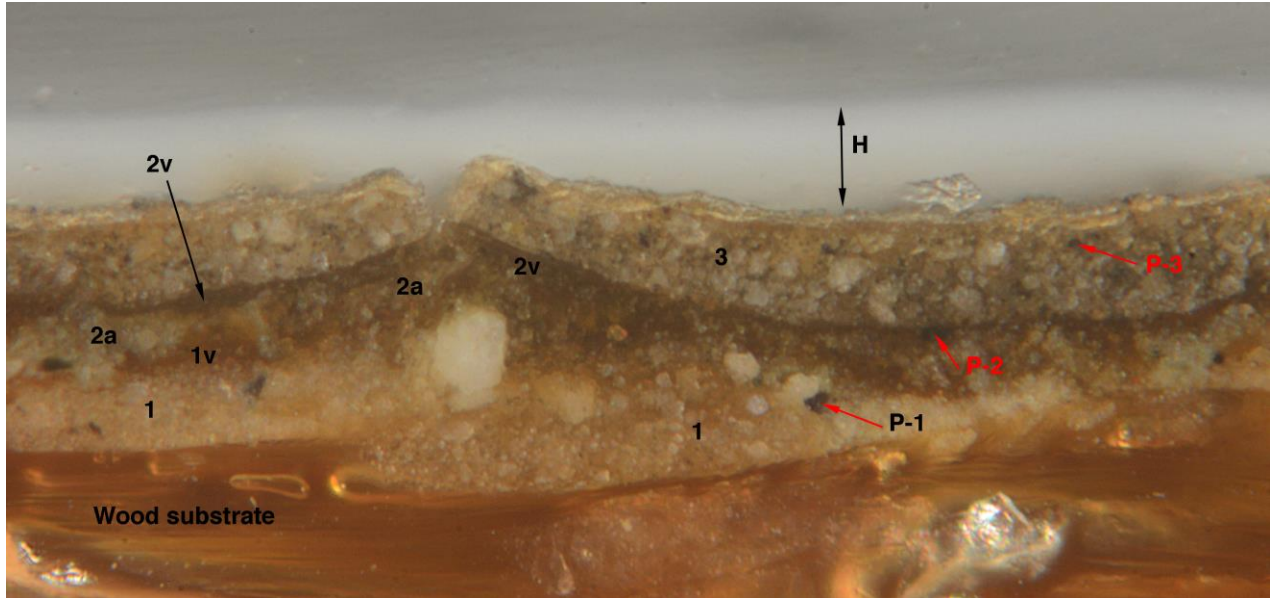
Sample SL-11: Vertical boards, at stair landing: Location, north wall



Note: The vertical board wall proceeds east from the window frame at the level of the landing.

Sample SL-11: Vertical boards, at stair landing: Location, north wall

Photomicrograph: Mounted sample, Olympus BMAX-50 polarized light microscope/ 10x objective, (100x total microscopic magnification) with Nikon D7100 digital camera body Lexar Media 1GB flash card Dolan Jenner Fiber optics illuminator, daylight filtering [Additional enlargement in computer]

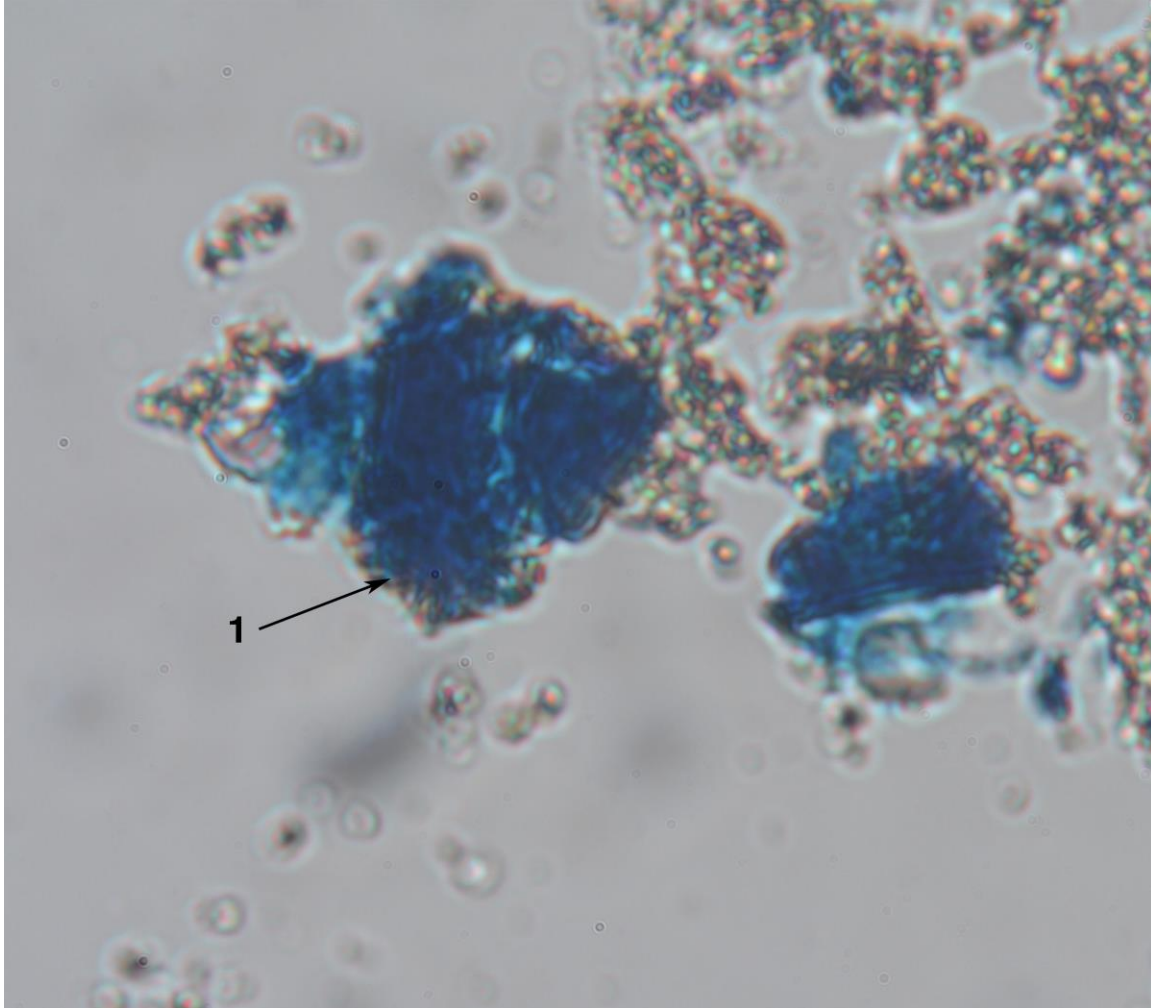


Note: This sample has been mounted in polymer resin, cut and polished for additional examination. The wood substrate is seen at the base of the sample as indicated. The first paint layer is a lead white, with some Prussian blue pigment particles [P-1]; this finish was protected by a layer of the natural resin varnish coating [1v]. This is followed by a light blue color containing Prussian blue pigment [P-2], that in this location is completely unrecognizable, as it has discolored badly [2a]. This paint layer is also coated with a natural resin varnish layer [2v]. The third finish [3] appears to be the light blue that has discolored to gray, as seen on the Fascia boards of the Stair Landing. The white 'halo' [H] is within the resin mount.

Polarized light microscopy:

Extracted Prussian blue pigment particle from **Vertical Boards at Landing, Layer 2a**

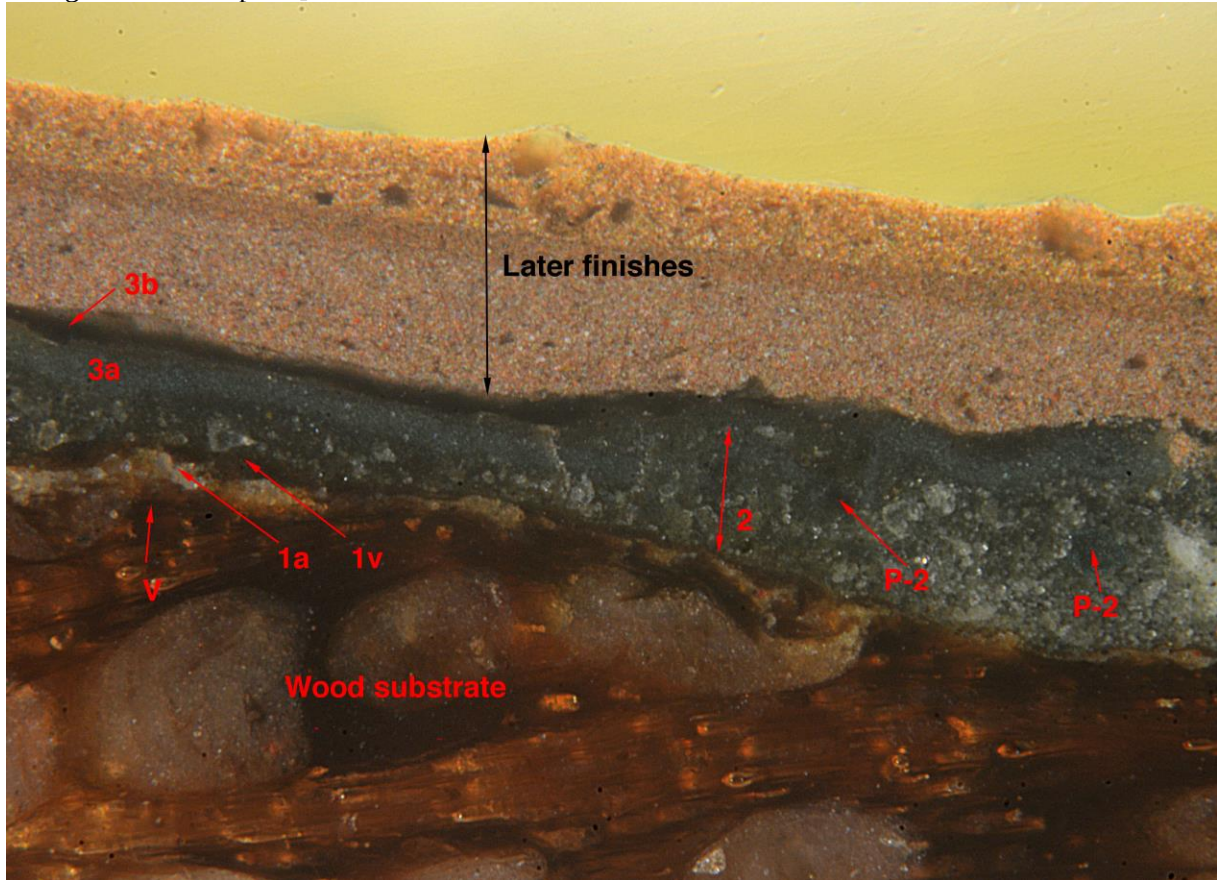
Photomicrograph: Slide Mounted sample, Olympus BMAX-50 polarized light microscope/ 40x objective, (400x total microscopic magnification: additional enlargement in computer) with Nikon D7100 digital camera body Lexar Media 1GB flash Uncrossed polars.



Note: Pigment particles were extracted using a tungsten needle, and mounted on a glass slide in Meltmount Medium 1.662. These pigment particles were removed from layer 2a, and indicated at P-2. The illumination is uncrossed polars. The blue pigment particles are clearly seen (1) this is a Prussian blue pigment, it is isotropic (disappears when the polars are crossed and the background is black) and has a refractive index less than 1.662. This is the “old type” of Prussian blue, not the twentieth century soft blue amorphous particles.

Sample SL-12: Second Run of Stairs, Baluster

Photomicrograph: Mounted sample, Olympus BMAX-50 polarized light microscope/ 10x objective, (100x total microscopic magnification) with Nikon D7100 digital camera body Lexar Media 1GB flash card Dolan Jenner Fiber optics illuminator, daylight filtering [Additional enlargement in computer]



Note: The sample has been mounted in polymer resin, cut and polished to 8000 micron grit polishing cloth for additional examination. The wood substrate is seen at the base of the sample. There is a thin natural resin varnish application on the wood [v] that may have been a finish or a sealer. The first finish appears to be the lead white [1a] which is itself coated with the dark natural resin varnish coating [1v]. this is followed by a prussian blue color, which has faded toward gray, however the Prussian blue pigment particles are clearly discernable [two are indicated, P-2]. The third finish is the chromium oxide green [3a, 3b] finish, from the late nineteenth or early twentieth centuries. The brown finishes are indicated: these would post date the restoration ca. 1972.

Handrail, Second Run of Stairs

Sample SL-13: Cap

Sample SL-14: Apron

The samples from the handrail were in very poor condition, and show evidence of paint removal as well as the normal wear of the surfaces. The following is based on the staining and minute particles

Sample SL-13: Cap

First finish: based on remaining staining of the wood:

Dark brown umber: Benjamin Moore CSP-390

Sample SL-14: Apron

First finish: the first finish has been severely impacted by paint removal, however, the pale gray-lead white appears, and may have been covered with the dark natural resin varnish coating.

The Stair Landing: Earliest finishes

The following is a list of the earliest finishes on each of the surfaces examined. The dark brown natural resin varnish layer that appears on some surfaces will be subject to additional instrumental examination.

All of the early finishes that are exposed at this time are to remain exposed. The following is for reference purposes only.

Sample SL-1: Fascia 1 [south fascia] First Finish: Light Blue: Special Standard BM-800M/1

Sample SL-2: Turned Post First finish: White Benjamin Moore CW-5 [Harwood Putty]
With dark brown natural resin varnish tbd

Sample SL-3: Fascia 2 First Finish: Light Blue: Special Standard BM-800M/1
Sample SL-4: Fascia 3 First Finish: Light Blue: Special Standard BM-800M/1

Sample SL-5: Molding, Location 1 Natural resin varnish coating
Sample SL-6: Molding, Location 2 Natural resin varnish coating

Sample SL-7: Board above window White Benjamin Moore CW-5 [Harwood Putty]

Sample SL-8, Stair Landing: Newel White Benjamin Moore CW-5 [Harwood Putty]
With dark brown natural resin varnish [pigment may be present].

Sample SL-9: Crown molding return, Location 1: White Benjamin Moore CW-5 [Harwood Putty]

Sample SL-10: Crown molding return, Location 2: White Benjamin Moore CW-5 [Harwood Putty]

Sample SL-11: Vertical boards, at stair landing: Location, north wall
White Benjamin Moore CW-5 [Harwood Putty]

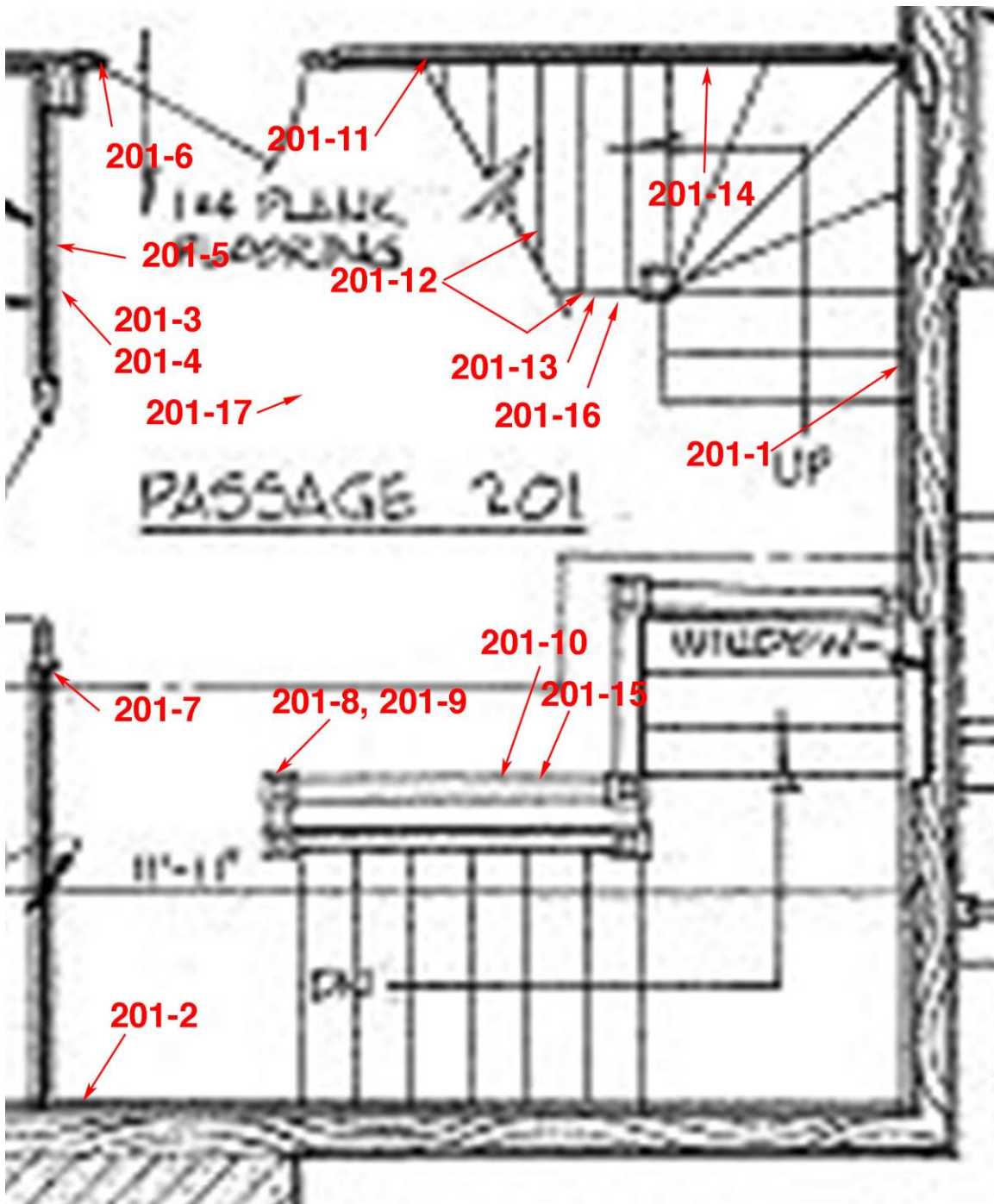
Sample SL-12: Second Run of Stairs, Baluster White Benjamin Moore CW-5 [Harwood Putty]
With dark brown natural resin varnish

Sample SL-13: Handrail Cap: Dark brown Benjamin Moore CSP-390 [based on remnants]

Sample SL-14: Handrail Apron: First finish: the first finish has been severely impacted by paint removal, however, the pale gray-lead white appears, and may have been covered with the dark natural resin varnish coating.

The Passage 201

Second Floor Level: Passage 201 Paint sample locations



Sample Locations:

201-1: Crown molding, proximate to stair to attic

201-2: Baseboard

201-3: Chair rail, Cap

201-4: Chair rail, Apron

Sample Locations, continued

- 201-5: Dado, ground
- 201-6: Door frame to Chamber 203 [West Chamber]
- 201-7: Door frame, to Chamber 202 [South Chamber]
- 201-8: Stair newel
- 201-9: Stair newel flutes
- 201-10: Stair railing, Baluster
- 201-11: Wall field
- 201-12: Stair, underside and Ceiling
- 201-13: Stair Bracket
- 201-14: Stair to attic, vertical boards

Second Floor Level: Passage 201

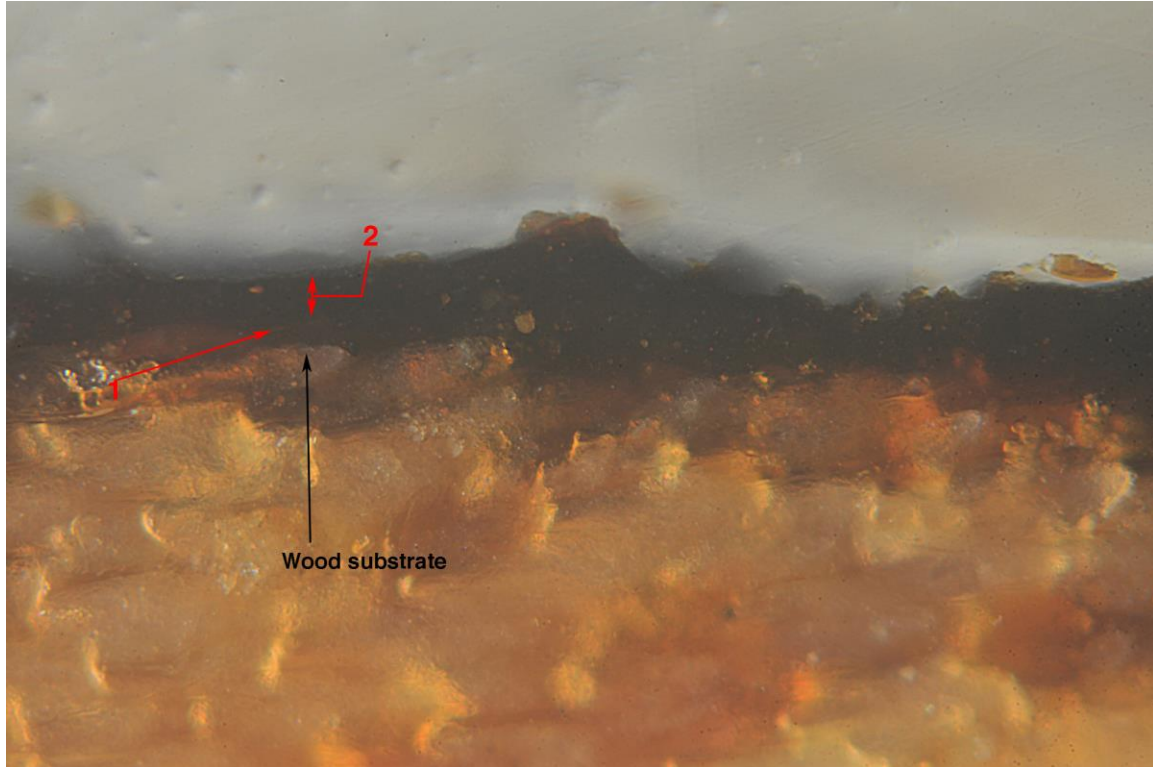


Note: The Second Floor Hall was finished in the same manner as the West Bedroom and the South Bedroom. Note the same panel trompe-l'oeil effect on the dado, carried out with the same colors, using a dark natural brown, a carbon black and white. The wall field and ceiling are nearly unrecognizable, but would have had the marbling effect carried out in white and pink. The best example of this is found in the West Bedroom.

Second Floor Level: Passage 201
Examination of the Samples:

Sample 201-1: Second Floor Hall, Crown molding, proximate to stair to attic

Photomicrograph: Mounted sample, Olympus BMAX-50 polarized light microscope/ 10x objective, (100x total microscopic magnification) with Nikon D7100 digital camera body Lexar Media 1GB flash card Dolan Jenner Fiber optics illuminator, daylight filtering [Additional enlargement in computer]



Note: The sample has been mounted in polymer resin, cut and polished to 8000 micron grit polishing cloth for additional examination. The wood substrate is clearly seen and indicated. The first layer, which is presumed to be a finish is the natural resin varnish coating [1]. The second finish is the black finish [2], which is still exposed and in place.

Sample 201-2: Baseboard, east wall

Photomicrograph: Unmounted sample, Olympus SZ-1145 Stereo-microscope, with Nikon D7100 digital camera body Lexar Media 1GB flash card Dolan Jenner Fiber optics illuminator, daylight filtering.



Note: The view of this sample is looking down onto the finish surface. The wood substrate is clearly seen and indicated. Note that the first finish appears to be a dark varnish (1[v]). The thickness of this natural resin coating strongly suggests that this was a finish that was exposed. This surface is coated with a black finish [2].

Note: The same paint layering is seen on the following samples:

Sample 201-3: Chair rail cap

Sample 201-4: Chair rail, apron

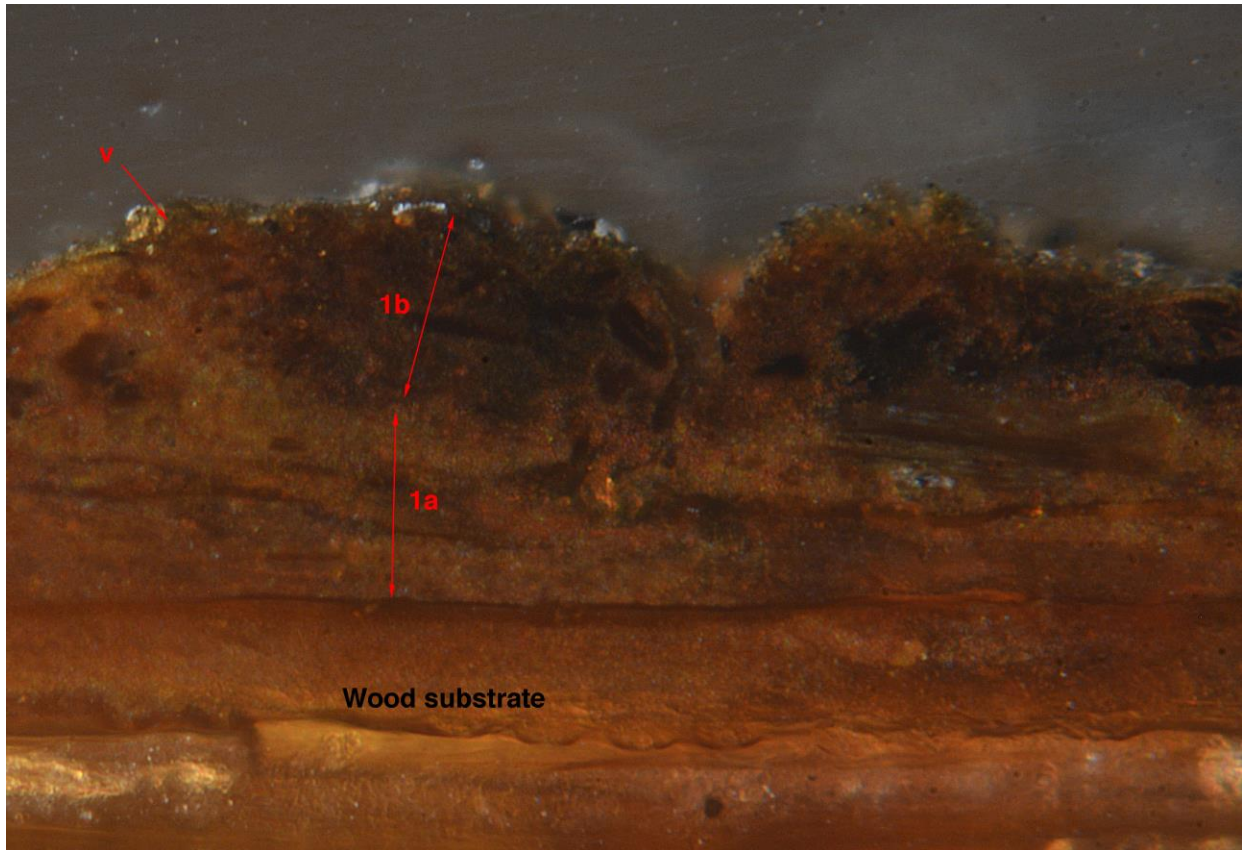
Second Floor Level, Passage 201: Dado



Note: The Dado of the Second Floor Hall shows the same trompe-l'oeil panel design as seen in the South Bedroom and the West Bedroom. As in the rooms, this surface is the original from the eighteenth century.

Sample 201-5: Dado, ground

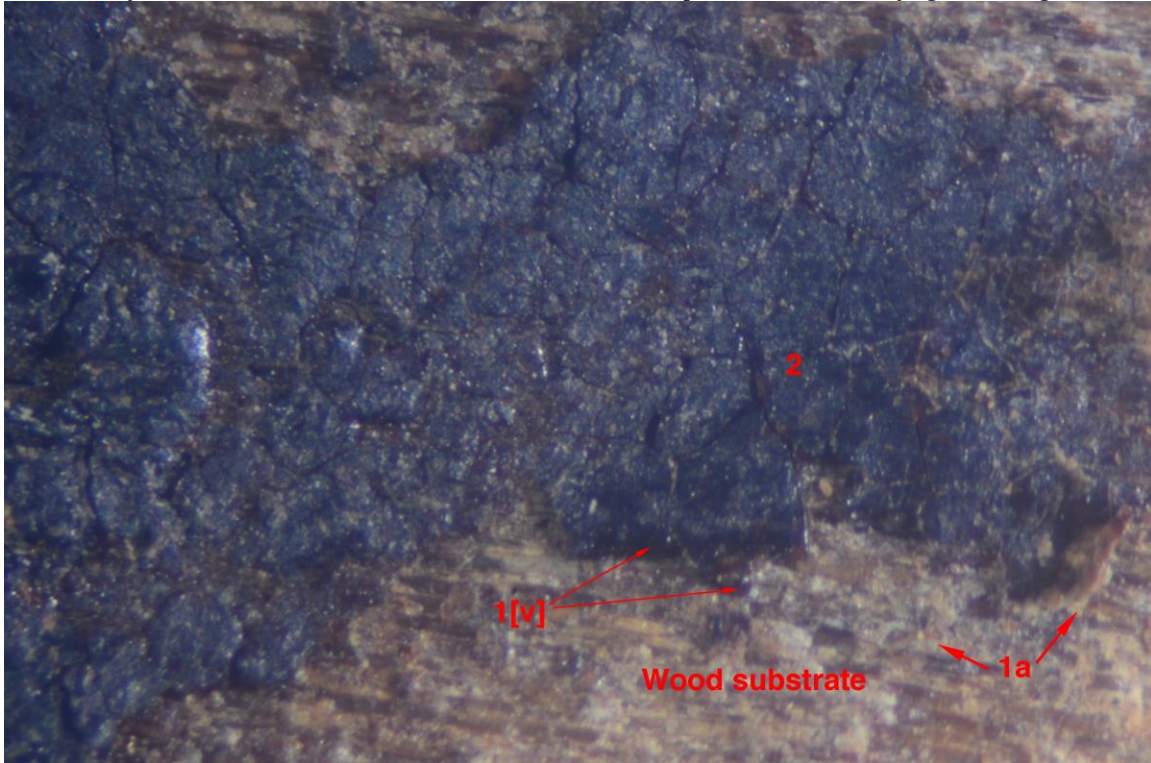
Photomicrograph: Mounted sample, Olympus BMAX-50 polarized light microscope/ 10x objective, (100x total microscopic magnification) with Nikon D7100 digital camera body Lexar Media 1GB flash card Dolan Jenner Fiber optics illuminator, daylight filtering [Additional enlargement in computer]



Note: The sample has been mounted in polymer resin, cut and polished to 8000 micron grit polishing cloth for additional examination. The wood substrate is seen at the base of the sample and is indicated. The present finish appears to be the only finish on the wood: there is a brownish red initial paint layer [1a] produced with a red ochre that probably would have been marketed as *Spanish brown*, and a darker natural brown umber finish [1b] that creates the dark brown finish. At some point later the surface was coated with the natural resin varnish, indicated [v]. The natural resin varnish maybe a combination of specific resins.

Sample 201-6: Door frame to Chamber 203 [West Chamber]

Photomicrograph: Unmounted sample, Olympus SZ-1145 Stereo-microscope, with Nikon D7100 digital camera body Lexar Media 1GB flash card Dolan Jenner Fiber optics illuminator, daylight filtering.

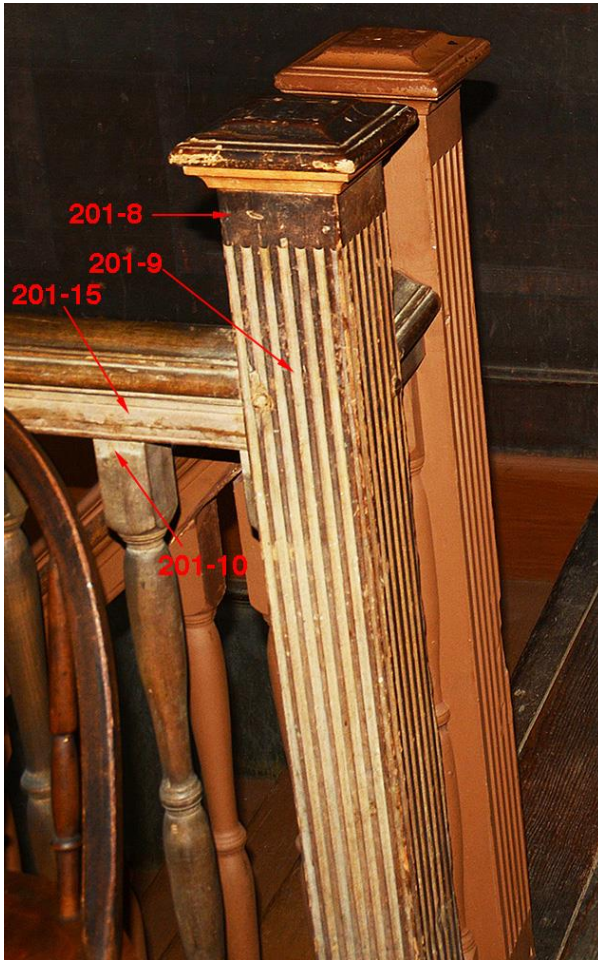


Note: the view of the sample is looking down onto the finish surface. The first finish is prepared with the lead white ground color [1a] followed by the dark brown natural resin varnish [1v]. The surface was then overpainted with the black opaque finish [2], which remains exposed.

Note: the same finish is found on samples:

Sample 201-7: Door frame, to Chamber 202 [South Chamber]

Second Floor Hall, 201: Newel and Railing



Sample 201-8: Stair newel

Note: the surface of the stair newel was stripped during the restoration of 1972, however, the “staining” of the wood with the dark umber brown pigment is clearly seen.

Sample: 201-9: Stair newel flutes

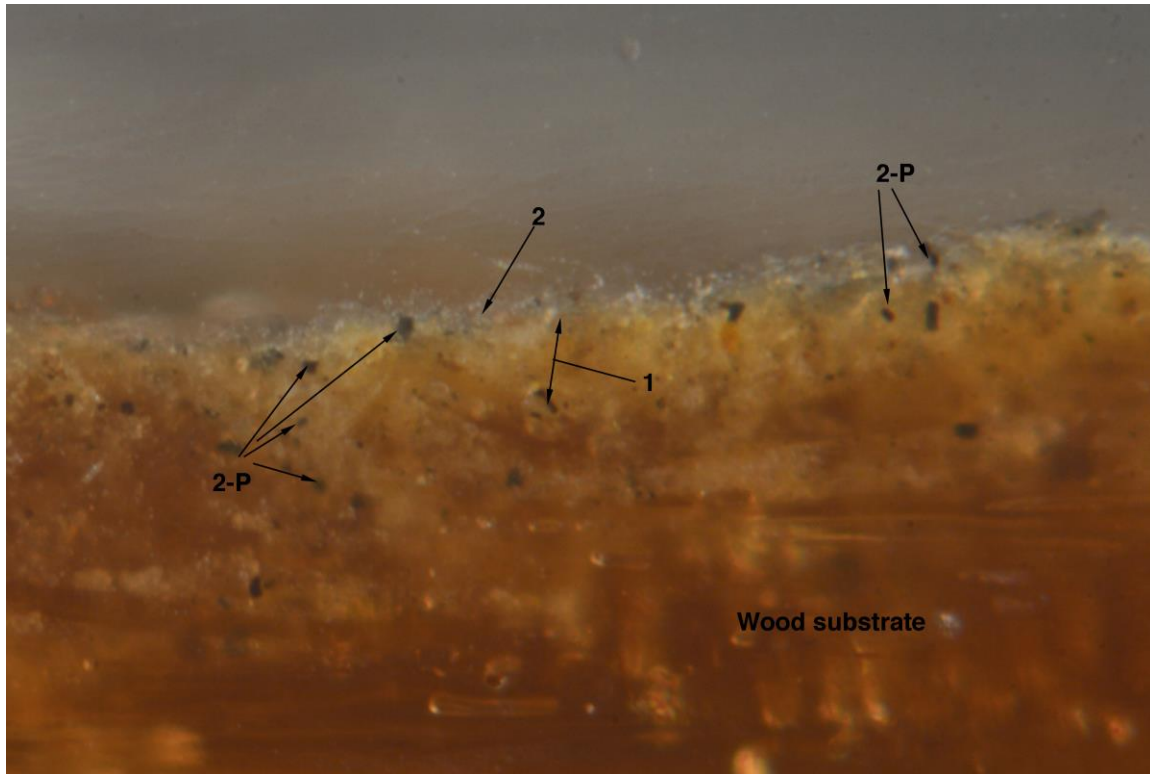
Photomicrograph: Mounted sample, Olympus BMAX-50 polarized light microscope/ 10x objective, (100x total microscopic magnification) with Nikon D7100 digital camera body Lexar Media 1GB flash card Dolan Jenner Fiber optics illuminator, daylight filtering [Additional enlargement in computer]



Note: The sample has been mounted in polymer resin, cut and polished to 8000 micron grit polishing cloth for additional examination. The wood substrate is clearly seen at the base of the sample. The first finish [1] is clearly seen, and appears to be made with a yellow ochre and lead white. Fragments of the darkened natural resin varnish are also visible [1v].

Sample 201-10: Stair railing, Baluster

Photomicrograph: Mounted sample, Olympus BMAX-50 polarized light microscope/ 10x objective, (100x total microscopic magnification) with Nikon D7100 digital camera body Lexar Media 1GB flash card Dolan Jenner Fiber optics illuminator, daylight filtering [Additional enlargement in computer]



Note: The sample has been mounted in polymer resin, cut and polished to 8000 micron grit polishing cloth for additional examination. The wood substrate is clearly seen at the base of the sample. **This is a very unusual cross section:** this is from a location that was stripped of paint in 1972. The first finish, the light yellow [1] still survives relatively intact, but has been greatly altered by the paint removal process. Note that the second finish [2] is almost completely removed: there is thin haze of lead white and prussian blue pigment: note that the prussian blue pigments have been driven into the first finish and into the wood substrate [2-P] by the action of the paint removal. This gives the yellow a greenish tint, which would not have been present at first.

Note: the same finish was observed on the following sample:

Sample: 201-15: Handrail, apron

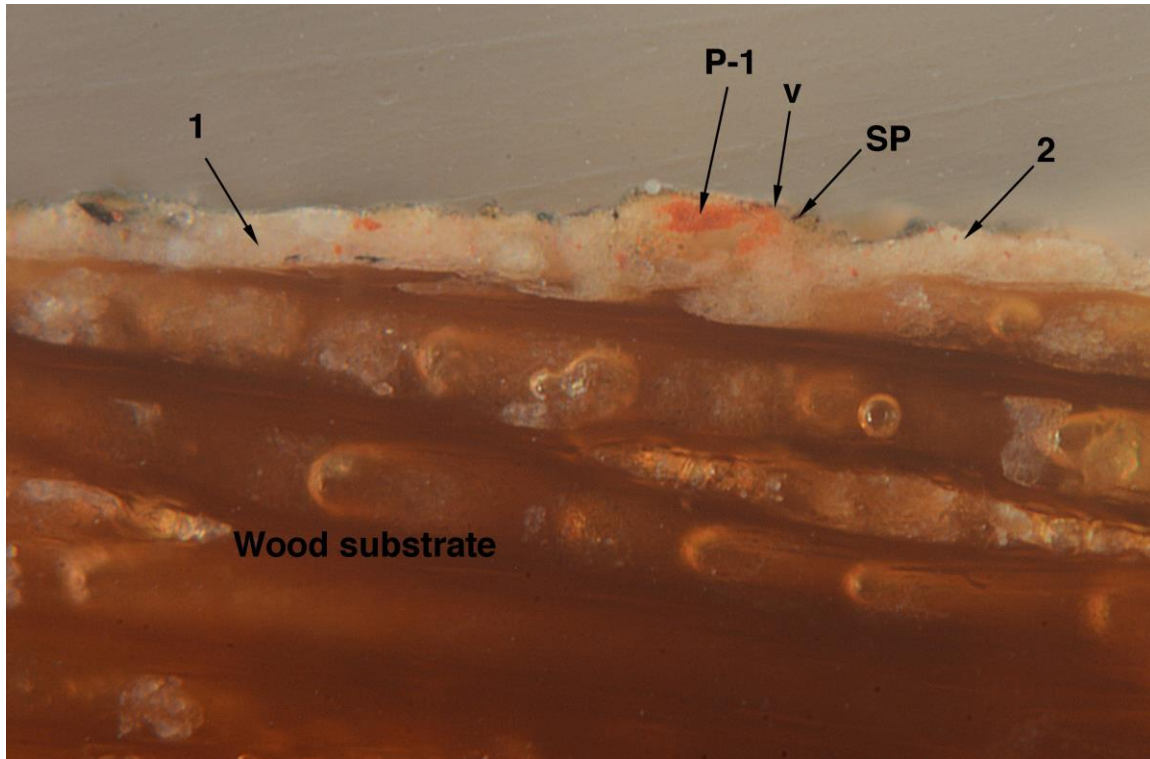
Sample 201-11: Wall field



Note: the paint removal process disrupted the original finishes, however, the ghost marks of the early marbling is still visible, and indicated above the door to the West bedroom.

Sample 201-11: Wall field

Photomicrograph: Mounted sample, Olympus BMAX-50 polarized light microscope/ 10x objective, (100x total microscopic magnification) with Nikon D7100 digital camera body Lexar Media 1GB flash card Dolan Jenner Fiber optics illuminator, daylight filtering [Additional enlargement in computer]



Note: The sample has been mounted in polymer resin, cut and polished to 8000 micron grit polishing cloth for additional examination. The wall field in the Second Floor Hall, 201, shows the pink finish on the wood as the first layer [1]. Note the vermillion type pigment particle [P-1] which was the tinting pigment. The white “blotches” that create the marbling effect were added [2], probably while the first layer [pink] was still wet, and melded into the pink ground. There is also a thin natural resin varnish layer on the surface [v].

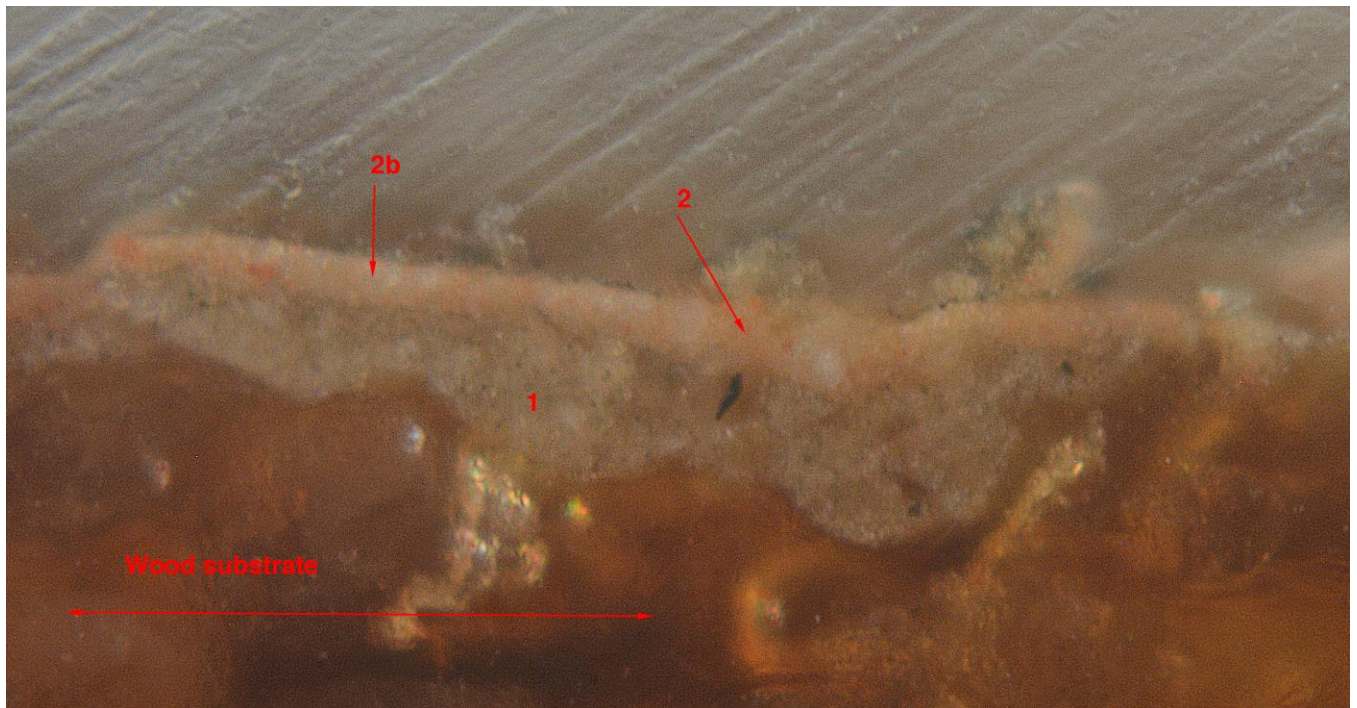
This sequence is seen in the West Bedroom, but also a different sequence that begins with the initial layer being the lead white layer.

Note: The same paint layering sequence was observed on the following sample:

Sample 201-17: Ceiling

201-12: Stair carriage and underside

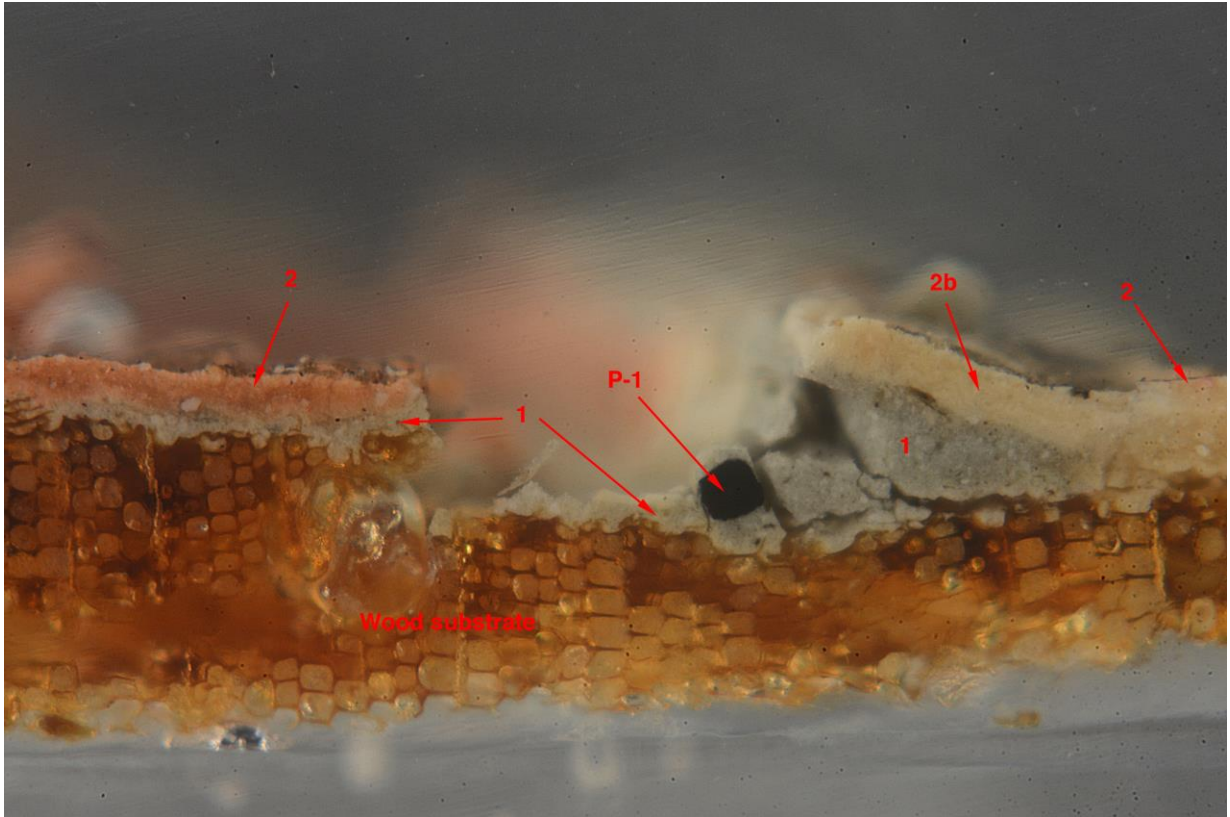
Photomicrograph: Mounted sample, Olympus BMAX-50 polarized light microscope/ 10x objective, (100x total microscopic magnification) with Nikon D7100 digital camera body Lexar Media 1GB flash card Dolan Jenner Fiber optics illuminator, daylight filtering [Additional enlargement in computer]



Note: The sample has been mounted in polymer resin, cut and polished to 8000 micron grit polishing cloth for additional examination. The wall field in the Second Floor Hall, 201, shows a lead white layer [discolored] as the first layer. This layer appears to be the initial layer in a sequence of paint layers applied to create the finish. The second layer is the pink layer [2] which has areas of lead white [2b] worked into the pink: a wet on wet system of creating a marbling effect.

Sample: 201-13: Stair Bracket

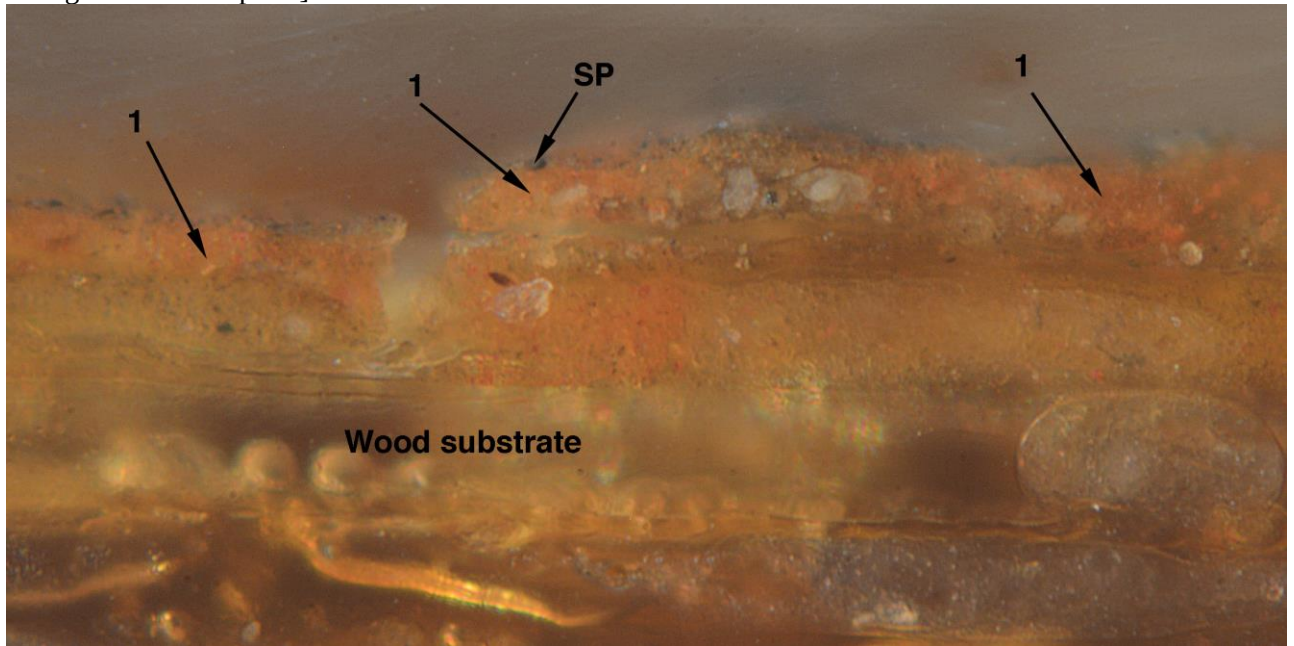
Photomicrograph: Mounted sample, Olympus BMAX-50 polarized light microscope/ 10x objective, (100x total microscopic magnification) with Nikon D7100 digital camera body Lexar Media 1GB flash card Dolan Jenner Fiber optics illuminator, daylight filtering [Additional enlargement in computer]



Note: The sample has been mounted in polymer resin, cut and polished to 8000 micron grit polishing cloth for additional examination. This is an unusual paint sequence. Note that the first paint layer [1] is a prussian blue color prepared with prussian blue pigment [P-1] in a lead white base. One of the samples from the underside of the stair also showed this sequence. This sample may support the theory that some of the woodwork was from an earlier house and reused. It has been suggested that some of the woodwork is from an unidentified site in Virginia. This sample however would be insufficient evidence to support that idea without other similar indications. The pink finish layer [2] stands out on top of the light blue color, on the left. The white finish, which may be part of the marbling finish [2b] is clearly see and appears as a distinct paint finish that appears to be made with two separate finishes. Note the small area of the pink paint [2] at the far right: this appears to have been part of the marbling treatment.

201-14: Stair to attic, vertical boards

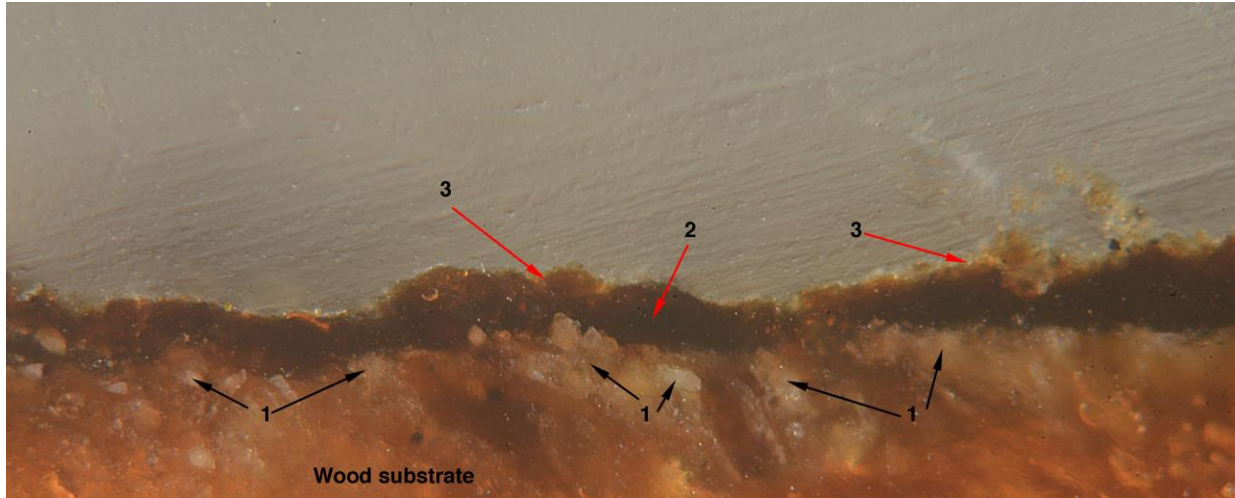
Photomicrograph: Mounted sample, Olympus BMAX-50 polarized light microscope/ 10x objective, (100x total microscopic magnification) with Nikon D7100 digital camera body Lexar Media 1GB flash card Dolan Jenner Fiber optics illuminator, daylight filtering [Additional enlargement in computer]



Note: The sample has been mounted in polymer resin, cut and polished to 8000 micron grit polishing cloth for additional examination. The wood substrate is seen at the base of the sample, and is indicated. The surface of these boards may have been uncoated prior to the opaque pink coating [1]. Note the surface particulate on the surface of the pink paint layer.

Sample 201-16: Stair nosing and molding under the nosing

Photomicrograph: Mounted sample, Olympus BMAX-50 polarized light microscope/ 10x objective, (100x total microscopic magnification) with Nikon D7100 digital camera body Lexar Media 1GB flash card Dolan Jenner Fiber optics illuminator, daylight filtering [Additional enlargement in computer]



Note: The sample has been mounted in polymer resin, cut and polished to 8000 micron grit polishing cloth for additional examination. The wood substrate is seen at the base of the sample. Only minute remnants of the first layer [lead white, whiting] appear to remain; if indeed this was a finish. It appears to be the same paint as seen as the primer for the second finish on Sample 202-7: Door to Hall 201, Frame, return natural resin varnish coating. The second finish is the carbon black finish, that is still exposed [2]. At some later date, a layer of a natural resin varnish was applied [3]. This appears to have darkened with age.

**Second Floor level: Passage 201:
First finish identification**

Sample Locations:

201-1: Crown molding, proximate to stair to attic

First Finish: Natural resin varnish coating

Second Finish: Black: Benjamin Moore CW-680

201-2: Baseboard:

First Finish: Natural resin varnish coating

Second Finish: Black: Benjamin Moore CW-680

201-3: Chair rail, Cap

First Finish: Natural resin varnish coating

Second Finish: Black: Benjamin Moore CW-680

201-4: Chair rail, Apron f-1 dark natural resin varnish F-2 Black

First Finish: Natural resin varnish coating

Second Finish: Black: Benjamin Moore CW-680

201-5: Dado, ground: Dark brown: Benjamin Moore CSP-390

201-6: Door frame to Chamber 203 [West Chamber] White Benjamin Moore CW-5 [Harwood Putty]
with dark brown natural resin varnish

Second Finish: Black: Benjamin Moore CW-680

201-7: Door frame, to Chamber 202 [South Chamber] White Benjamin Moore CW-5 [Harwood
Putty] with dark brown natural resin varnish

Second Finish: Black: Benjamin Moore CW-680

201-8: Stair newel Dark brown: Benjamin Moore CSP-390 [existing to be retained]

201-9: Stair newel flutes: paint remnants too altered by paint removal for color determination

201-10: Stair railing: Baluster too damaged for adequate color determination

201-11: Wall field; marbling effect as per the West Bedroom:

Note: The marbling effect was created with the interaction of the white and pink colors
primarily, however, there is evidence that certain areas used a light blue color, as
indicated. This light blue has faded toward gray.

White: Benjamin Moore CW-5 [Harwood Putty]

Pink: Benjamin Moore 1290 [Fantasy Pink] and variants

Light blue: Special Standard: BM 800 M/1

201-12: Stair, underside and Ceiling as per 201-11: Wall field; marbling effect as per the West
Bedroom:

White: Benjamin Moore CW-5 [Harwood Putty]

Pink: Benjamin Moore 1290 [Fantasy Pink] and variants

Light blue: Special Standard: BM 800 M/1

201-13: Stair Bracket marbling effect: as per 201-11: Wall field; marbling effect as per the West Bedroom:

White: Benjamin Moore CW-5 [Harwood Putty]
Pink: Benjamin Moore 1290 [Fantasy Pink] and variants
Light blue: Special Standard: BM 800 M/1

201-14: Stair to attic, vertical boards as per 201-11: Wall field; marbling effect as per the West Bedroom:

White: Benjamin Moore CW-5 [Harwood Putty]
Pink: Benjamin Moore 1290 [Fantasy Pink] and variants

201-15: Handrail apron too damaged for adequate color determination

201-16: Stair nosing and molding under the nosing
First finish: Fragments only inadequate for color matching

201-17: Ceiling as per 201-11: Wall field; marbling effect as per the West Bedroom:

White: Benjamin Moore CW-5 [Harwood Putty]
Pink: Benjamin Moore 1290 [Fantasy Pink] and variants
Light blue: Special Standard: BM 800 M/1

The South Bedchamber Room 202

The South Bedchamber, Room 202

This room is the smaller of the two bedrooms on the second floor. When the 1972



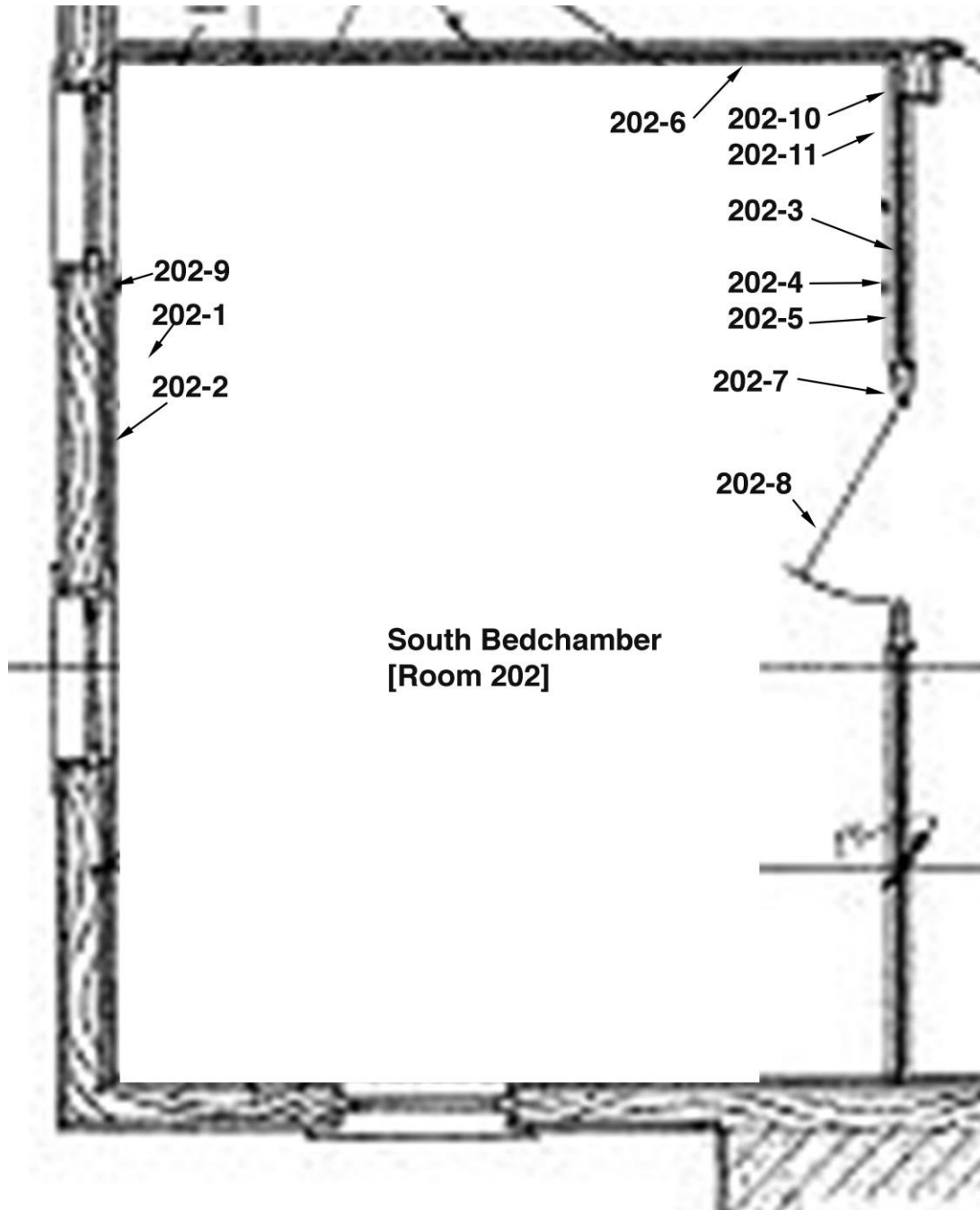
restoration was done, this room was subject to paint removal. It was possible to disclose the trompe-l'oeil panel painting on the dado, but the other surfaces appear to have been over-cleaned, as can be seen in the site photograph to the left. Despite this it has been possible to extract paint samples that indicate what the earliest finish was.

South Bedchamber, Room 202

List of Paint Samples:

- Sample 202-1: Ceiling [approximately 5' from the west wall, first board south]**
- Sample 202-2: Crown Molding South wall, approximately 5 feet from the west wall**
- Sample 202-3: Wall field, North wall approximately 3 feet west of Door Frame**
- Sample 202-4: Chair rail, cap**
- Sample 202-5: Chair rail, apron**
- Sample 202-6: Wall, Dado: field of the trompe-l'oeil panel decoration, North wall behind door**
- Sample 202-7: Door to Hall 201, Frame, return**
- Sample 202-8: Door to Hall 201**
- Sample 202-9: Window frame, west window, return**
- Sample 202-10: Baseboard quarter round**
- Sample 202-11: Baseboard fascia**

Locations of the Paint Samples:



The South Bedchamber

Examination of the Paint Samples

Samples from the trim woodwork all showed the same sequence of finishes, as indicated below.

Samples:

Sample 202-2: Crown Molding South wall, approximately 5 feet from the west wall

Sample 202-4: Chair rail, cap

Sample 202-5: Chair rail, apron

Sample 202-7: Door to Hall 201, Frame, return

Sample 202-9: Window frame, west window, return

The cross section photomicrographs of Sample 202-2: Crown Molding South wall, approximately 5 feet from the west wall and Sample 202-5: Chair rail, apron show the sequence to best advantage.

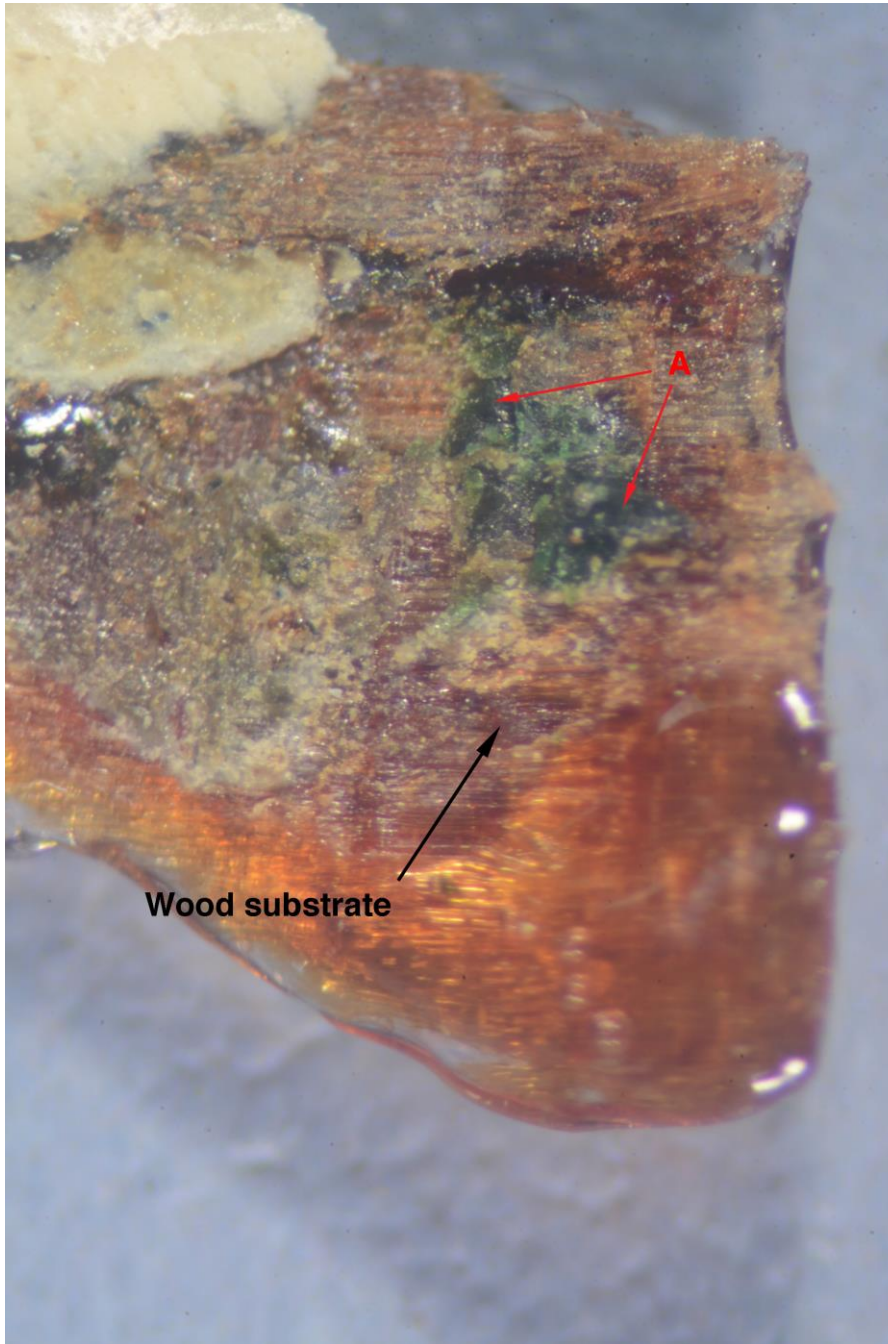
Sample 202-10: Baseboard quarter round and Sample 202-11: Baseboard fascia show the early finish in the more intact condition, but heavily encrusted with surface particulate [essentially dust, soot particles, etc.]

The initial finish was largely brown, best surviving on the dado. The surface of the ceiling and the walls were covered with the natural resin varnish. Considering the history of the Carters and of the Carter Mansion, it may be that the interior decoration was not completed until a number of years after the construction of the house. The house is believed to have been constructed between 1775 and 1780. John Carter (born 1737) died in 1781. The property was inherited by his son, Landon Carter. According to the *Tennessee Encyclopedia* "References to such a grand house do not appear until 1796 and 1800, when French botanist Andre Michaux and Governor John Sevier visited the Carters."

Examination of the Samples:

Sample 202-1: Ceiling [approximately 5' from the west wall, first board south]

Photomicrograph: Unmounted sample, Olympus SZ-1145 microscope, with Nikon D7100 digital camera body Lexar Media 1GB flash card Dolan Jenner Fiber optics illuminator, daylight filtering.

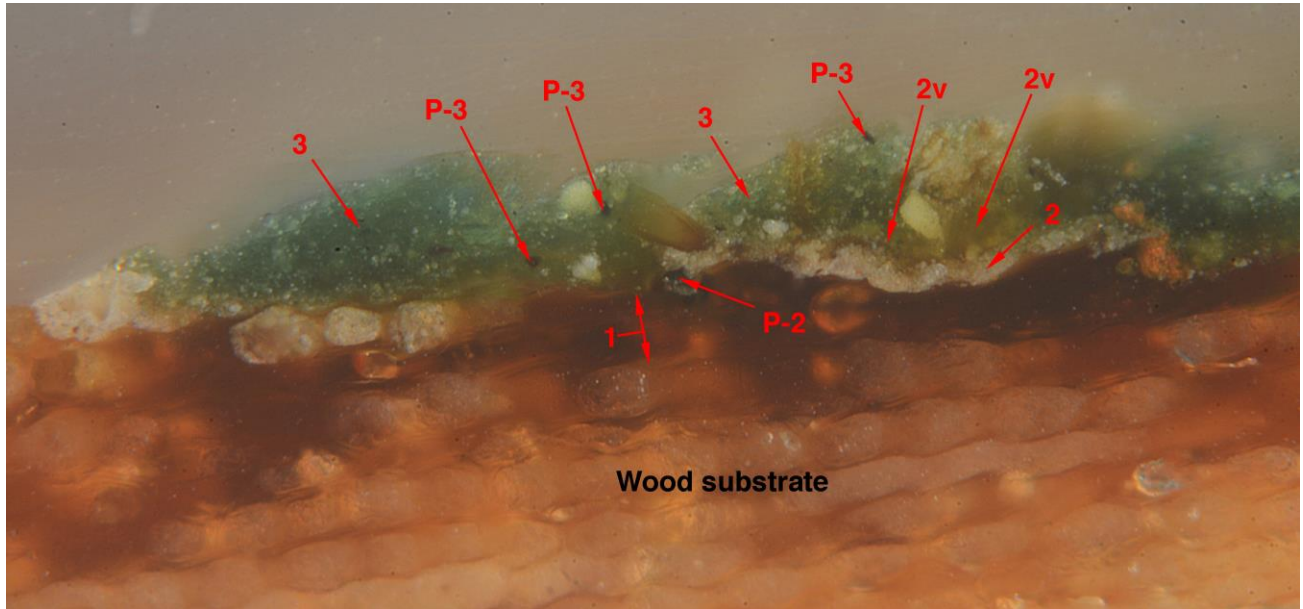


Note: The view of this sample is looking down onto the finish surface of the sample, from an angle. The sample has been re-saturated with a droplet of ethyl alcohol to emphasize the colors. Note the vivid green [A] is a penetration of the chromium oxide green finish that is from the late nineteenth or early twentieth century. This is an indication of the complexity of the conditions, caused in part by the paint removal process in this room. Refer to the cross sections on the next pages.

Sample 202-1: Ceiling [approximately 5' from the west wall, first board south]

Photomicrograph: Mounted sample, Olympus BMAX-50 polarized light microscope/ 10x objective, (100x total microscopic magnification) with Nikon D70 digital camera body Lexar Media 1GB flash card Dolan Jenner Fiber optics illuminator, daylight filtering. Additional enlargement in computer.

Note: The ceiling of this room was subject to paint removal along with the other surfaces of this room. There is considerable disruption of the paint layers, particularly layer 3.



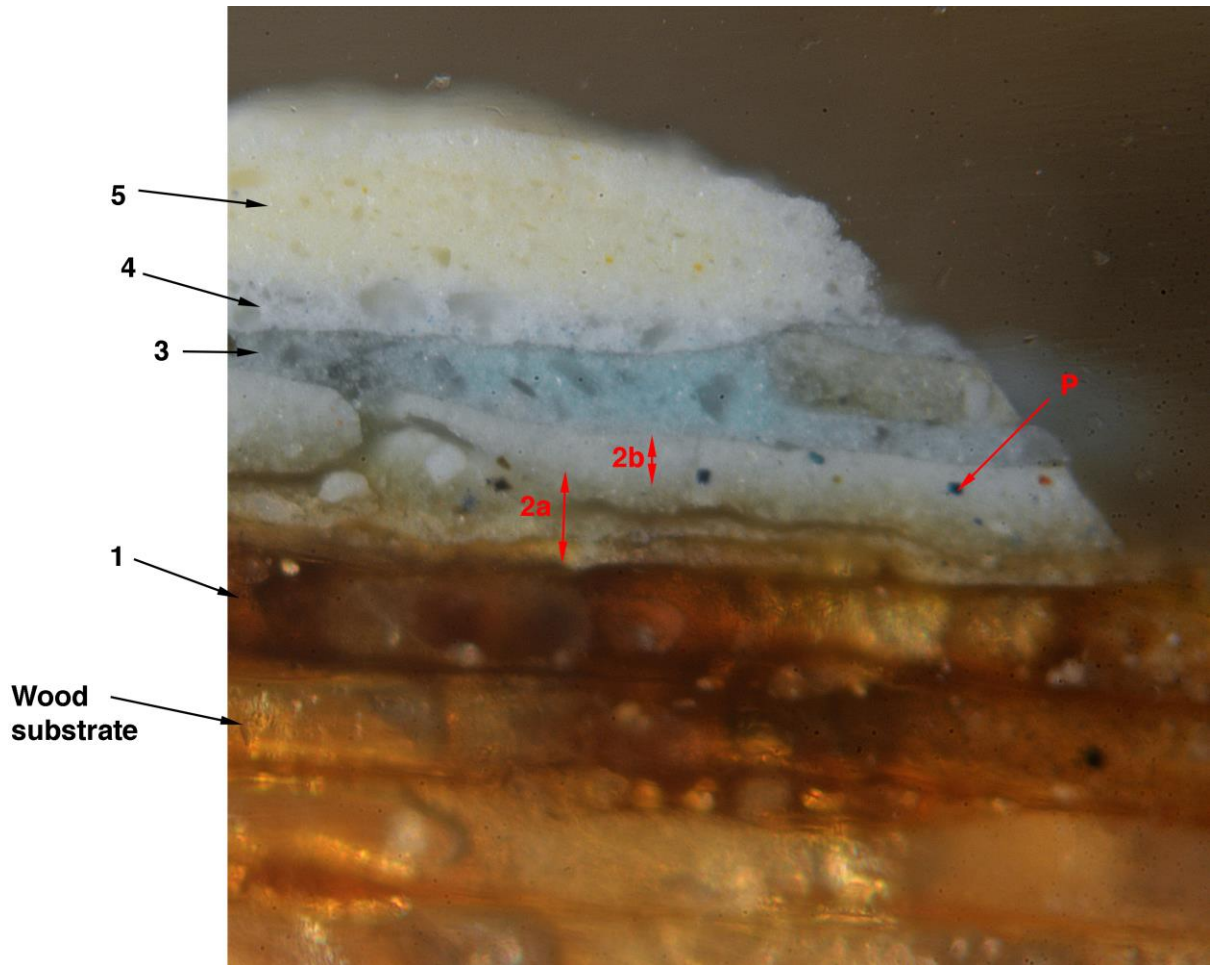
Note: The sample has been mounted in polymer resin, cut and polished to 8000 micron grit polishing cloth for additional examination. The wood substrate is seen at the base of the sample. The first finish [1] is the natural resin varnish that is seen on the other surfaces of the room. The second finish was executed in two different layers. The first is a pale blue-white [2]: a lead white layer tinted very slightly with Prussian blue pigment [P-2: an example of the Prussian blue pigment in this layer. This pale blue-white is also coated with a clear natural resin coating [2v]. The next layer [3] is a moderate blue, prepared with lead white and Prussian blue that has discolored and yellowed. There are numerous larger Prussian blue pigment particles that stand out within the matrix of layer 3 [P-3]. The later finishes are not present.

For more accurate color record, refer to:

Sample 202-2: Crown Molding South wall, approximately 5 feet from the west wall
on the following page.

Sample 202-2: Crown Molding South wall, approximately 5 feet from the west wall

Photomicrograph: Mounted sample, Olympus BMAX-50 polarized light microscope/ 3x objective, (30x total microscopic magnification) with Nikon D70 digital camera body Lexar Media 1GB flash card Dolan Jenner Fiber optics illuminator, daylight filtering.

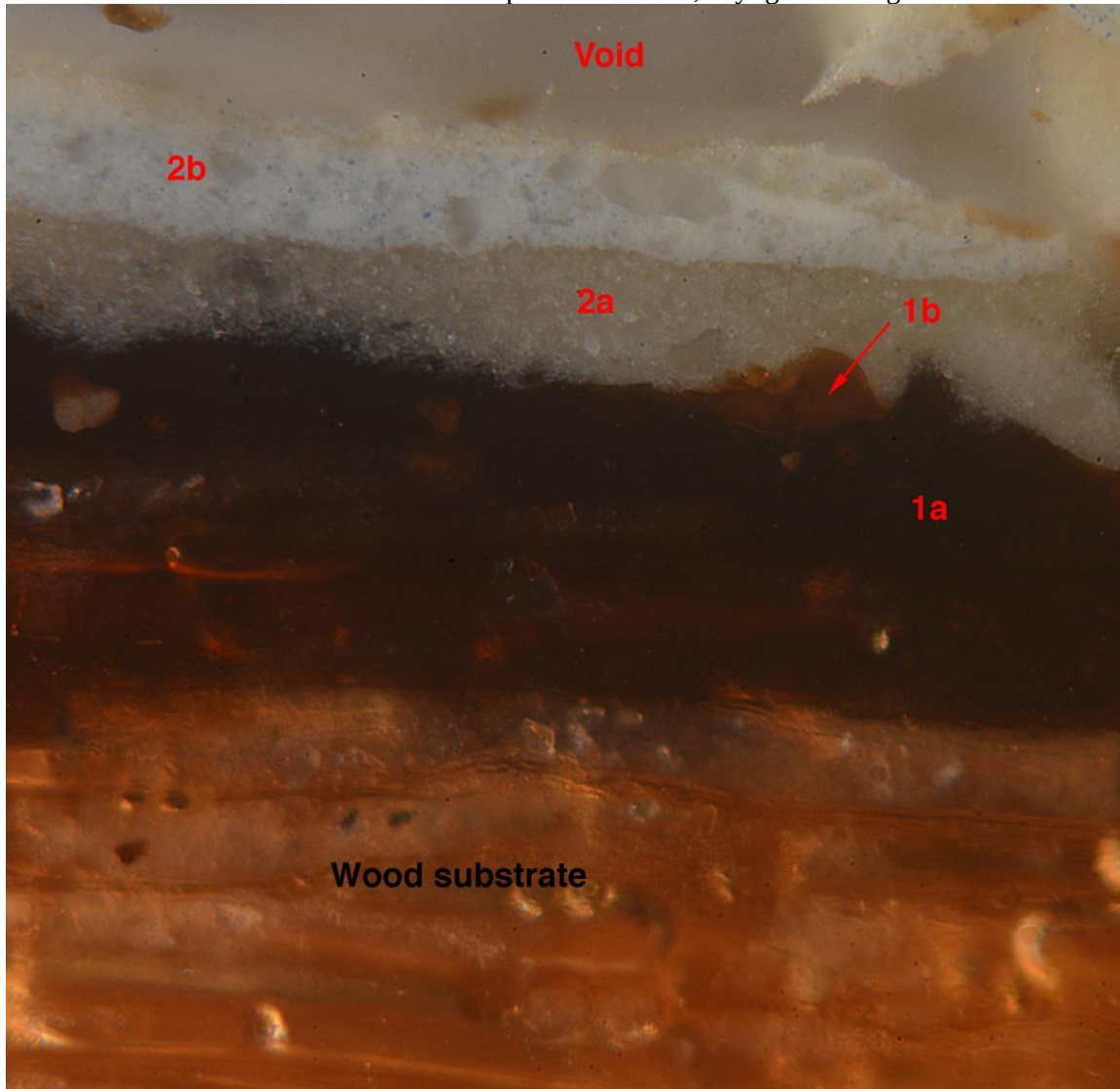


Note: The sample has been mounted in polymer resin, cut and polished to 8000 micron grit polishing cloth for additional examination. The wood substrate is seen at the base of the sample. The first finish is the clear but brown natural resin varnish layer. The second finish is comprised of two layers: the first, 2a, is made with lead white, chalk-whiting and lightly tinted with Prussian blue pigment. Note that there are two layers of this prime/undercoat paint applied first; then an additional layer applied just before the finish coat, 2b was applied. The Prussian blue pigments [P] are prominent in this layer: the second finish [2b] is thus a pale blue, made with lead white and tinted with Prussian blue pigment.

The third finish, [3] which may date to the period of Landon Carter's occupancy, is prepared with lead white and Prussian blue pigment: the retention of the color is notable. This third finish would have been exposed for a long period of time: note the dark gray line of surface particulate on the finish surface of the paint indicating the finish surface. The fourth finish, [4] is from the nineteenth century and is prepared with artificial ultramarine blue pigment that was not available until after 1826, the date of its first manufacture in France. The later finish, 5, appears to be a white primer with a yellow finish: these may be from the late nineteenth or early twentieth century.

Sample 202-3: Wall field, North wall approximately 3 feet west of Door Frame

Photomicrograph: Mounted sample, Olympus BMAX-50 polarized light microscope/ 10x objective, (100x total microscopic magnification) with Nikon D70 digital camera body Lexar Media 1GB flash card Dolan Jenner Fiber optics illuminator, daylight filtering

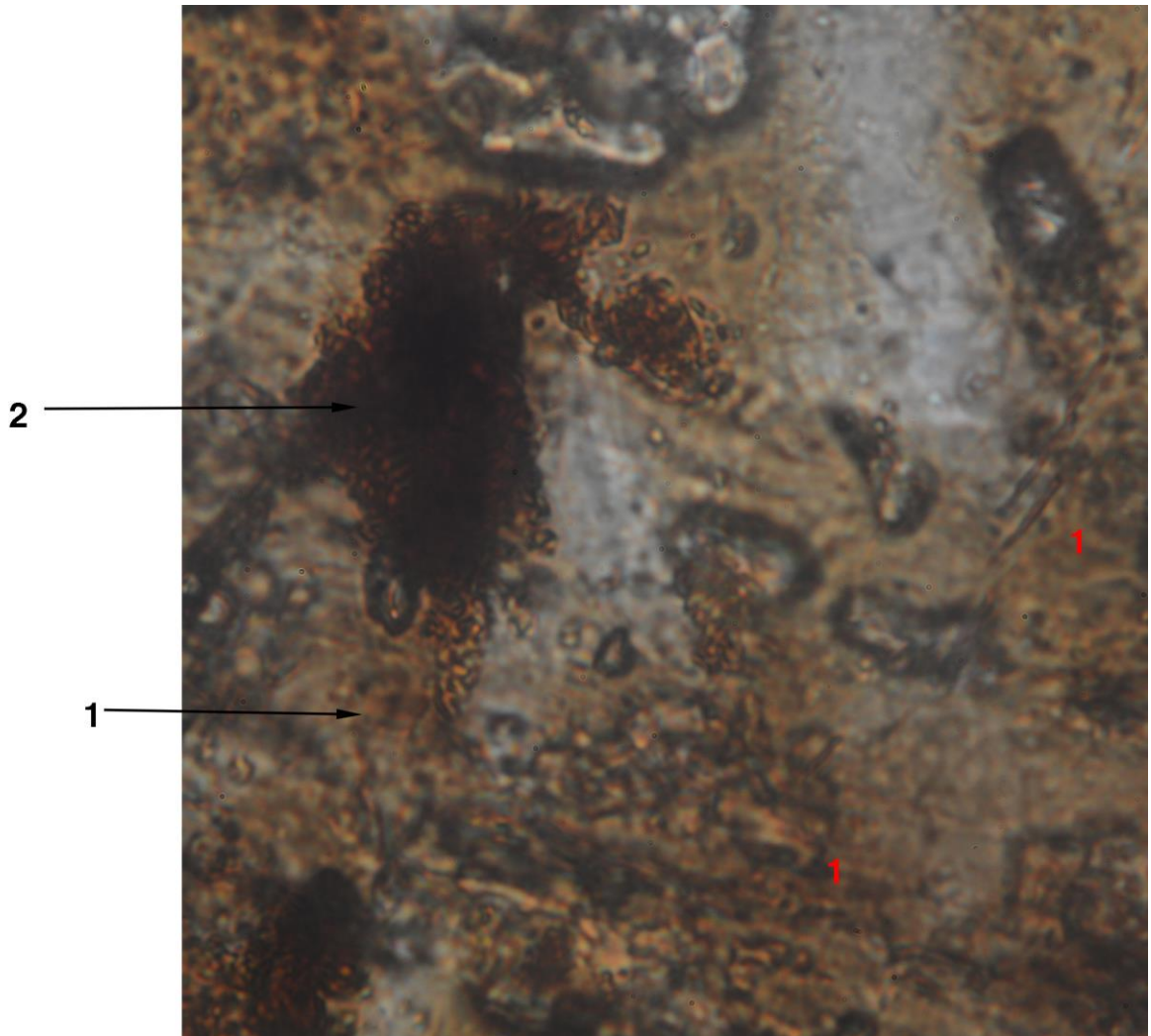


Note: The sample has been mounted in polymer resin, cut and polished to 8000 micron grit polishing cloth for additional examination. The wood substrate is seen at the base of the sample as indicated. The first layer is a dense pigmented layer [1a] of a natural brown pigment [i.e. burnt umber type] with a clear brownish natural resin on the surface [1b]. The finish would have been a dark brown finish with a high gloss. This would have been exposed for a long period of time. The second finish is made of two layers, the first being a semi-opaque white layer applied as an undercoat, [2a] and the finish [2b] is a light blue: **this is the same as layer 3 on Sample 202-2: Crown Molding South wall, approximately 5 feet from the west wall** prepared with artificial ultramarine blue, which would not be available until after 1826, and probably was not available in East Tennessee until considerably later in date.

Polarized light microscopy:

Sample 202-3: Wall field, North wall approximately 3 feet west of Door Frame

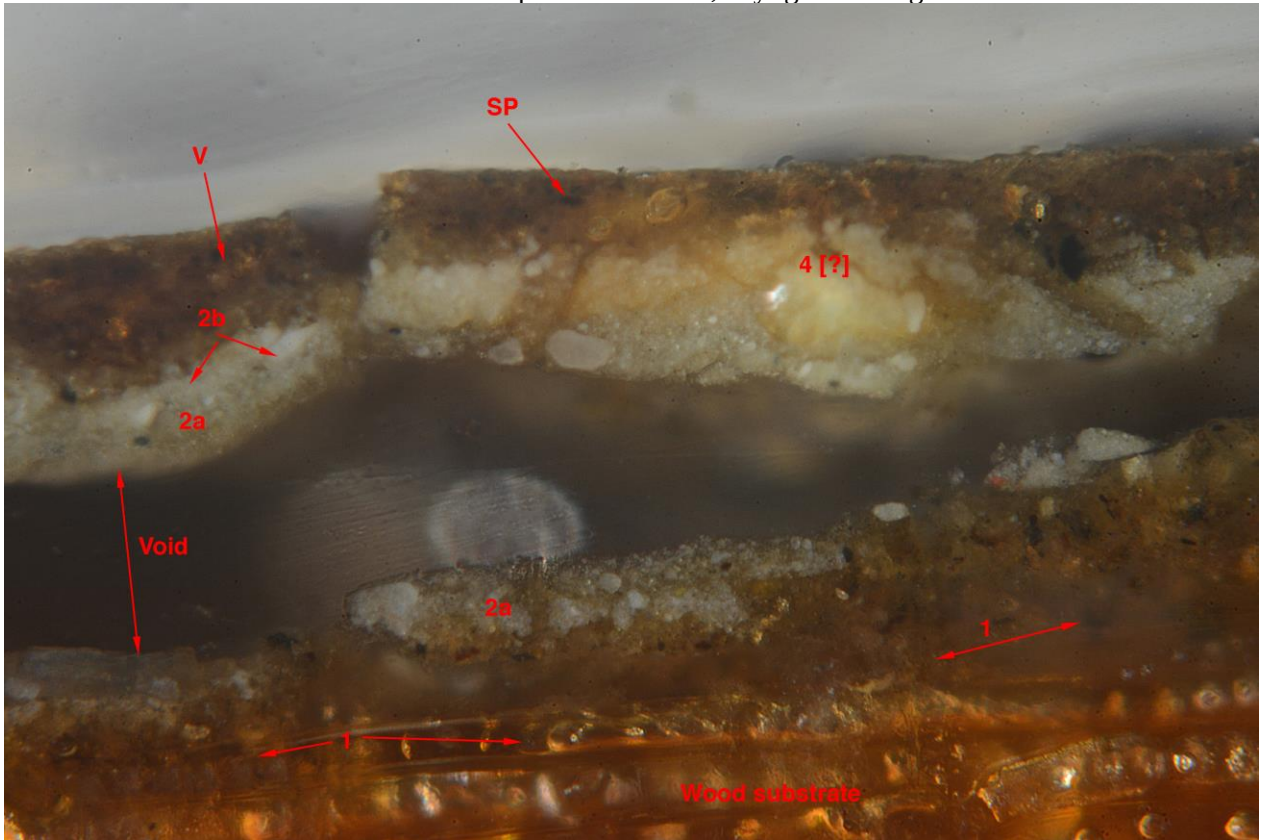
Photomicrograph: Slide Mounted sample, Olympus BMAX-50 polarized light microscope/ 40x objective, (400x total microscopic magnification: additional enlargement in computer) with Nikon D7100 digital camera body Lexar Media 1GB flash Uncrossed polars.



Note: The pigment particles [2] were extracted using a tungsten needle, and mounted on a glass slide in Meltmount Medium 1.662. These pigment particles were removed from layer 1a. The illumination is uncrossed polars. The brown particles are clearly seen (1) this appears to be a sienna type pigment: the color is a yellowish brown: natural pigments vary in color to a great degree: it is isotropic (disappears when the polars are crossed and the background is black) and has a refractive index greater than 1.662.

Sample 202-4: Chair rail, cap

Photomicrograph: Mounted sample, Olympus BMAX-50 polarized light microscope/ 10x objective, (100x total microscopic magnification) with Nikon D70 digital camera body Lexar Media 1GB flash card Dolan Jenner Fiber optics illuminator, daylight filtering

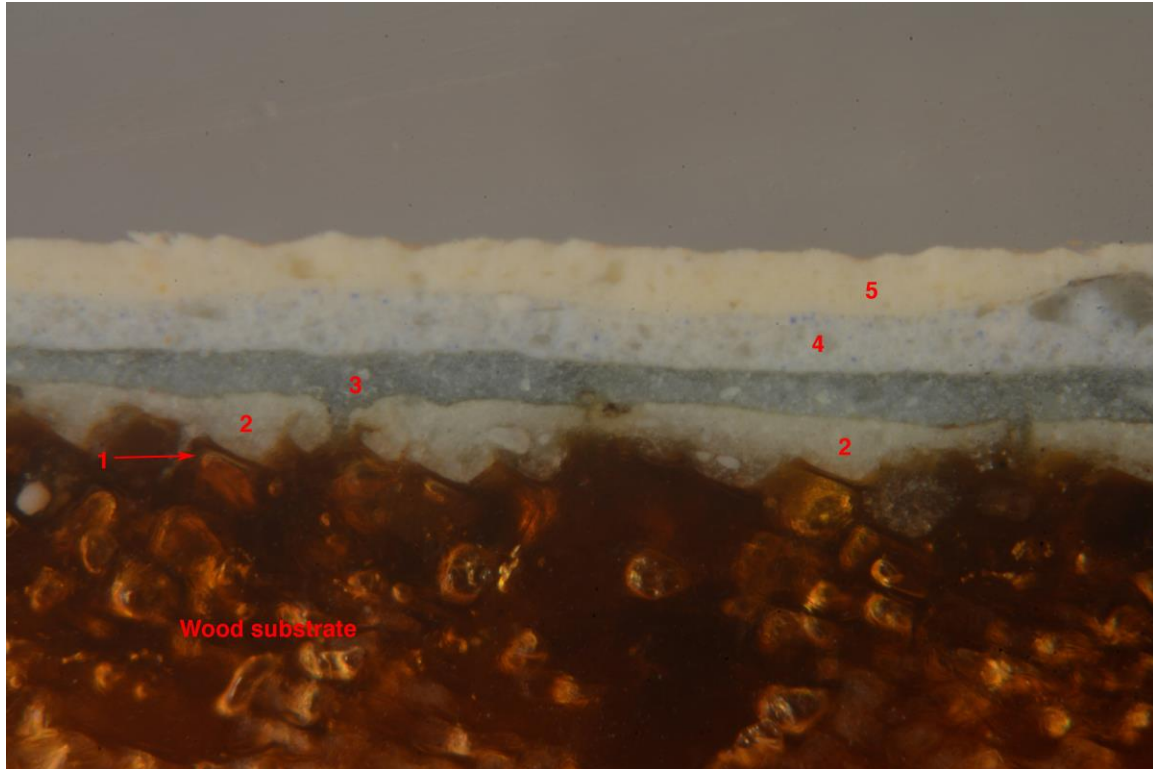


Note: The sample has been mounted in polymer resin, cut and polished to 8000 micron grit polishing cloth for additional examination. This sample is almost unrecognizable because of the deterioration of the paint materials and the accumulation of hardened grime and dirt. The wood substrate is seen at the base of the sample. Layer 1 is the natural resin varnish layer that is seen elsewhere. There may be two separate layers on this surface, [probably for maintenance of the surface]. The second finish is produced in two layers, the primer/undercoat, 2a made with lead white, chalk-whiting, and small amount of Prussian blue pigment. The finish is layer 2b. Both of these paint layers are very broken up and deteriorated. Note the white lead element- [4 ?] which may be from the fourth finish period. There is a second varnish coating [V] and a heavy coating of hardened grime with surface particulate [SP].

Compare this with the well preserved sample extracted from Sample 202-5: Chair rail, apron that follows on the next page.

Sample 202-5: Chair rail, apron

Photomicrograph: Mounted sample, Olympus BMAX-50 polarized light microscope/ 10x objective, (100x total microscopic magnification) with Nikon D70 digital camera body Lexar Media 1GB flash card Dolan Jenner Fiber optics illuminator, daylight filtering.



Note: The sample has been mounted in polymer resin, cut and polished to 8000 micron grit polishing cloth for additional examination. The wood substrate is visible at the base of the sample. The first finish is the natural resin varnish coating [1]. The second layer is a pale blue prepared with lead white and lightly tinted with Prussian blue. The third finish is a moderate Prussian blue color, prepared with lead white and Prussian blue pigment: there are lead white agglomerations visible within the matrix. The fourth finish [4] is prepared with artificial ultramarine blue which was first made in France in 1826 and may not have arrived in East Tennessee until many years later. The pale yellow finish [5] may date to the early twentieth century; the last surviving paint layer on this sample.

Sample 202-6: Wall, Dado: field of the trompe-l'oeil panel decoration, North wall behind door

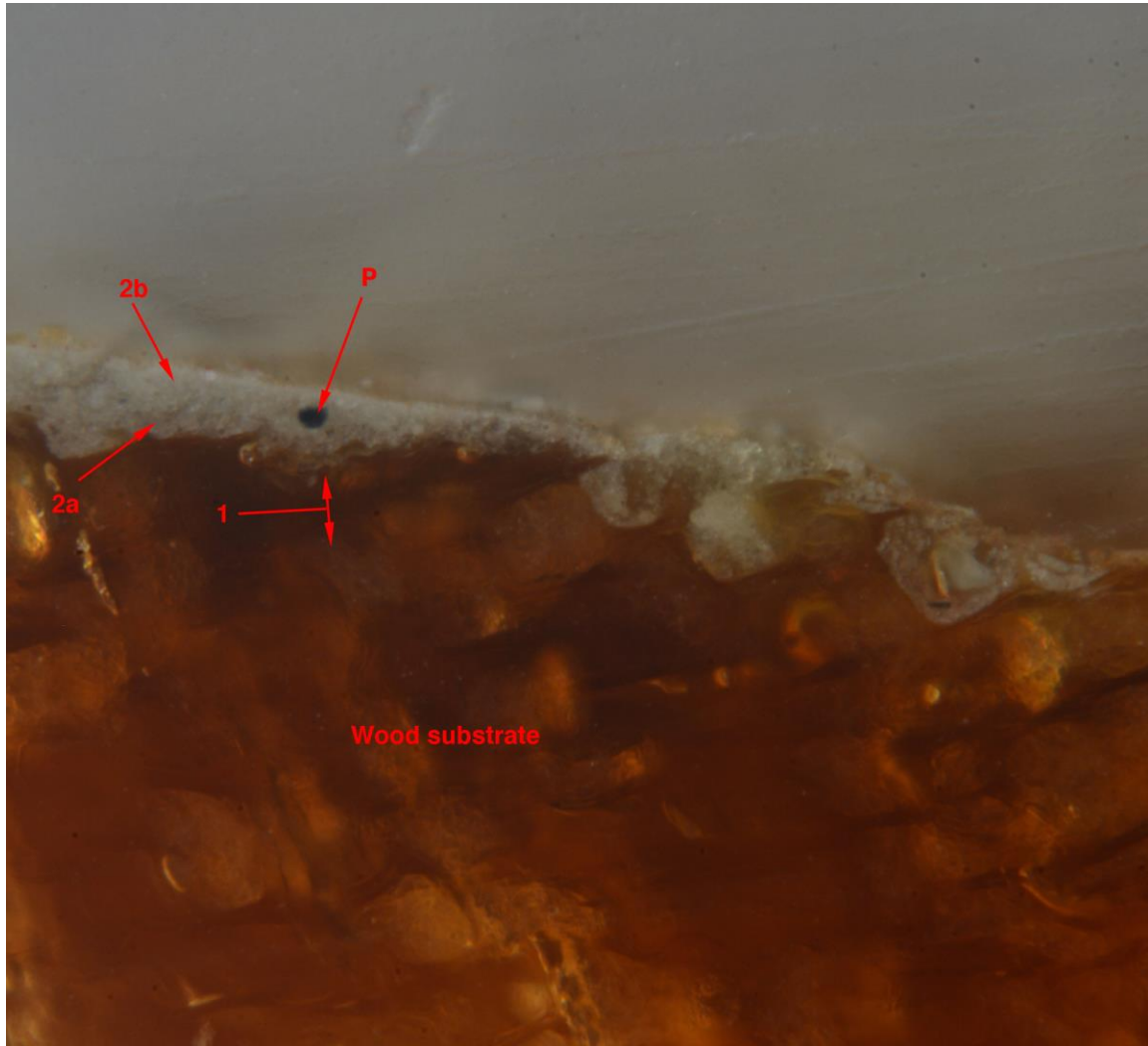
Photomicrograph: Unmounted sample, Olympus SZ-1145 microscope, with Nikon D7100 digital camera body Lexar Media 1GB flash card Dolan Jenner Fiber optics illuminator, daylight filtering.



Note: The view of this sample is looking down onto the finish surface. The surface shows the original dark brown ochre [1] as retained on the sample: later finishes were removed in 1972 and this action disrupted the original brown finish as well.

Sample 202-7: Door to Hall 201, Frame, return

Photomicrograph: Mounted sample, Olympus BMAX-50 polarized light microscope/ 10x objective, (100x total microscopic magnification) with Nikon D70 digital camera body Lexar Media 1GB flash card Dolan Jenner Fiber optics illuminator, daylight filtering. Additional enlargement in computer.



Note: The sample has been mounted in polymer resin, cut and polished to 8000 micron polishing cloth for additional examination. The wood substrate is observed at the base of the sample and is indicated. The first finish [1] is the clear natural resin varnish coating. The first opaque coating is the light blue color prepared in two layers. The first is a primer prepared with lead white, chalk-whiting and a small amount of Prussian blue pigment [2a]. This layer forms the surface for the actual finish coat, 2b, that is prepared with lead white and Prussian blue. Note the individual Prussian blue pigment particle. This example retains the original blue coloration. Later paint layers are not present on this specific sample. Refer to Sample 202-5: Chair rail, apron

Sample 202-8: Door to Hall 201

Photomicrograph: Unmounted sample, Olympus SZ-1145 microscope, with Nikon D7100 digital camera body Lexar Media 1GB flash card Dolan Jenner Fiber optics illuminator, daylight filtering.



Note: The view of the sample is looking down onto the finish surface. This surface was subject to paint removal during the restoration of 1972. Despite that, the original finish was retained at least partially, which was the intention. The wood substrate is clearly seen and noted. The dark brown finish [1] is the first finish. This is the same brown pigment that was used on the dado as the ground. The second finish, which appears gray is actually an example of the Prussian blue color [2, Prussian blue pigment with lead white]. The third finish is the brighter Prussian blue color that is also seen as the third finish on **Sample 202-2: Crown Molding South wall,**

approximately 5 feet from the west wall.

Sample 202-9: Window frame, west window, return

Note: As in the case of the Sample 202-7: Door to Hall 201, Frame, return, the sample showed disrupted layering, however, it appears that the Window frames would have been painted in the same manner as is seen on the following samples:

Sample 202-2: Crown Molding South wall, approximately 5 feet from the west wall

Sample 202-5: Chair rail, apron

Sample 202-7: Door to Hall 201, Frame, return

Sample 202-10: Baseboard quarter round

Sample 202-11: Baseboard fascia

Photomicrograph: Unmounted sample, Olympus SZ-1145 microscope, with Nikon D7100 digital camera body Lexar Media 1GB flash card Dolan Jenner Fiber optics illuminator, daylight filtering. Additional enlargement in computer.



Note: The view of the sample is looking down onto the finish surface. This is a detail view of the surface of the **Sample 202-11: Baseboard fascia**. The first layer is a natural brown ochre [1a], slightly lighter than the dark brown finish [1b]. The layer of accumulated surface particulate is clearly visible also [SP].

South Chamber, Room 202

First Finish Identification

202-1: Ceiling [approximately 5' from the west wall, first board south]
First Finish: Natural resin varnish

202-2: Crown Molding South wall, approximately 5 feet from the west wall
First Finish: Natural resin varnish

202-3: Wall field, North wall approximately 3 feet west of Door Frame
First Finish: Dark brown: Benjamin Moore CSP-390, with natural resin varnish coating

202-4: Chair rail, cap
First Finish: Natural resin varnish

202-5: Chair rail, apron
First Finish: Natural resin varnish

202-6: Wall, Dado: field of the trompe-l'oeil panel decoration, North wall behind door
First Finish: Dark brown: Benjamin Moore CSP-390,

202-7: Door to Hall 201, Frame,
First Finish: Natural resin varnish

202-8: Door to Hall 201
First Finish: Dark brown: Benjamin Moore CSP-390

202-9: Window frame, west window
First Finish: Natural resin varnish

202-10: Baseboard quarter round
First Finish: Dark brown: Benjamin Moore CSP-390,

202-11: Baseboard fascia
First Finish: Dark brown: Benjamin Moore CSP-390

The West Bedchamber Room 203

The West Bedchamber, 203

This room is the larger of the two bedchambers on the second floor and is an amazing example of surviving original finishes from the eighteenth century. The walls show a remarkable marbling effect in pink and white with occasional red veining. The ceiling may have also been marbled, but the surviving finish is more uniform. A marbled ceiling would be very unusual.

The overmantel of the West Bedchamber has one of the two landscape paintings by an unknown painter: in itself, it is a extraordinary indication of the desire for high style decoration following the architectural trends from Philadelphia and ultimately London.



Above is the mantel and overmantel painting with its landscape painting. The painted marble effect of the walls and mantel are clearly seen. Note that the ceiling also shows some variation that indicates the marbled effect carried out on the ceiling as well: an unusual conceit.

West Chamber: Toward East Wall, lower: South east corner



List of Samples:

West Chamber, 203

Sample 203-1: Ceiling near north east corner

Sample 203-2: Chair rail, apron

Sample 203-3: Wall field, East wall approximately 1' north of door frame

Sample 203-4: Mantel Shelf, return

Sample 203-5: Chair rail, cap

Sample 203-6: Crown Molding, East Wall

Sample 203-7: Wall, Dado: field of the trompe-l'oeil panel decoration, North wall

Sample 203-8: Baseboard, quarter round

Sample 203-9: Baseboard, fascia

Sample 203-10: Door to Hall, Frame, return

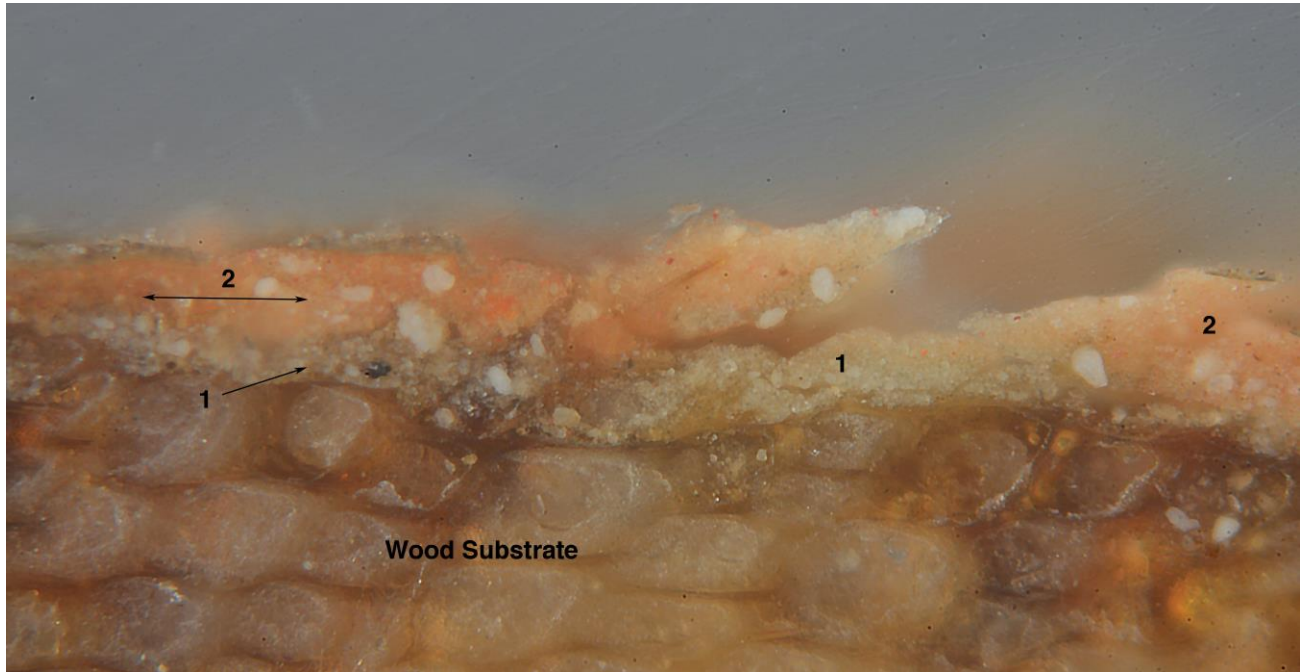
Sample 203-11: Door to Hall 201

Sample 203-12: Window frame, north window, return

Examination of the Samples

Sample 203-1: Ceiling near north east corner

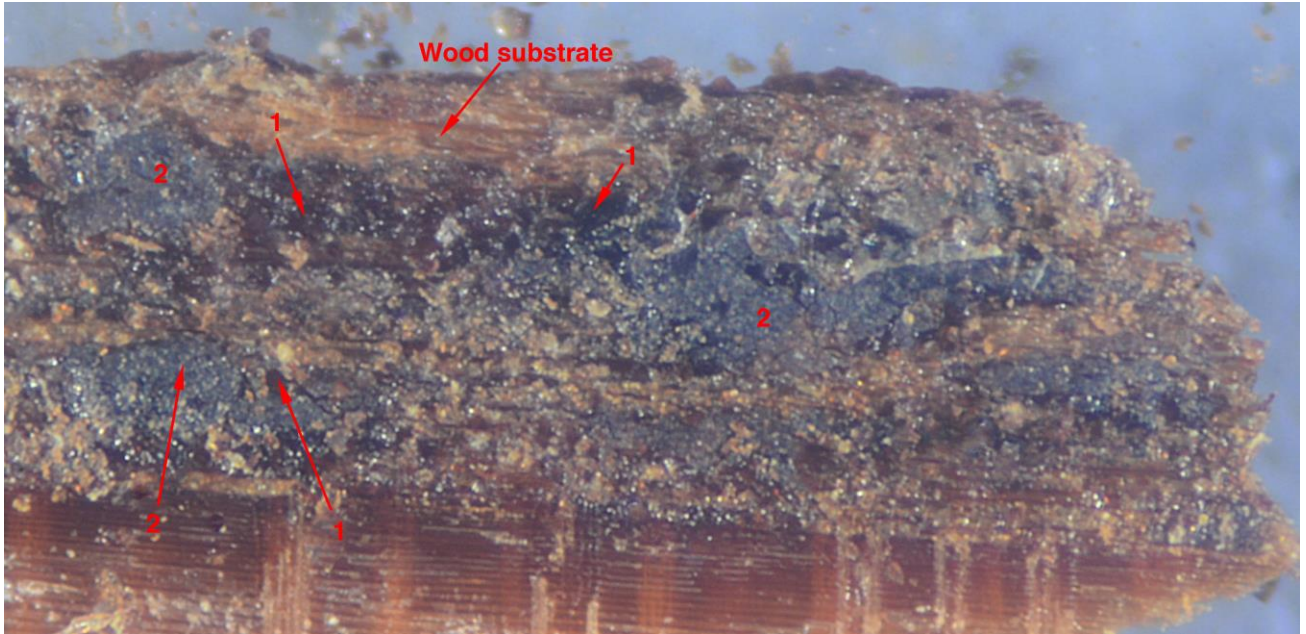
Photomicrograph: Mounted sample, Olympus BMAX-50 polarized light microscope/ 10x objective, (100x total microscopic magnification) with Nikon D70 digital camera body Lexar Media 1GB flash card Dolan Jenner Fiber optics illuminator, daylight filtering. Additional enlargement in computer.



Note: The sample has been mounted in polymer resin , cut and polished to 8000 micron grit polishing cloth for additional examination. The wood substrate is seen at the base of the sample. The first layer of this marbling finish is the lead white layer [1] which is not expected in view of the final appearance of the walls. The white layer is clearly under the pink layer, as seen toward the left of the photomicrograph. The exposed white areas appear to have been achieved by interruption or removal of the pink layer [2]. The pink layer [2] was prepared with a vermilion pigment with lead white base. **Note that this is the one and only finish treatment on the ceiling.**

Sample 203-2: Chair rail, apron

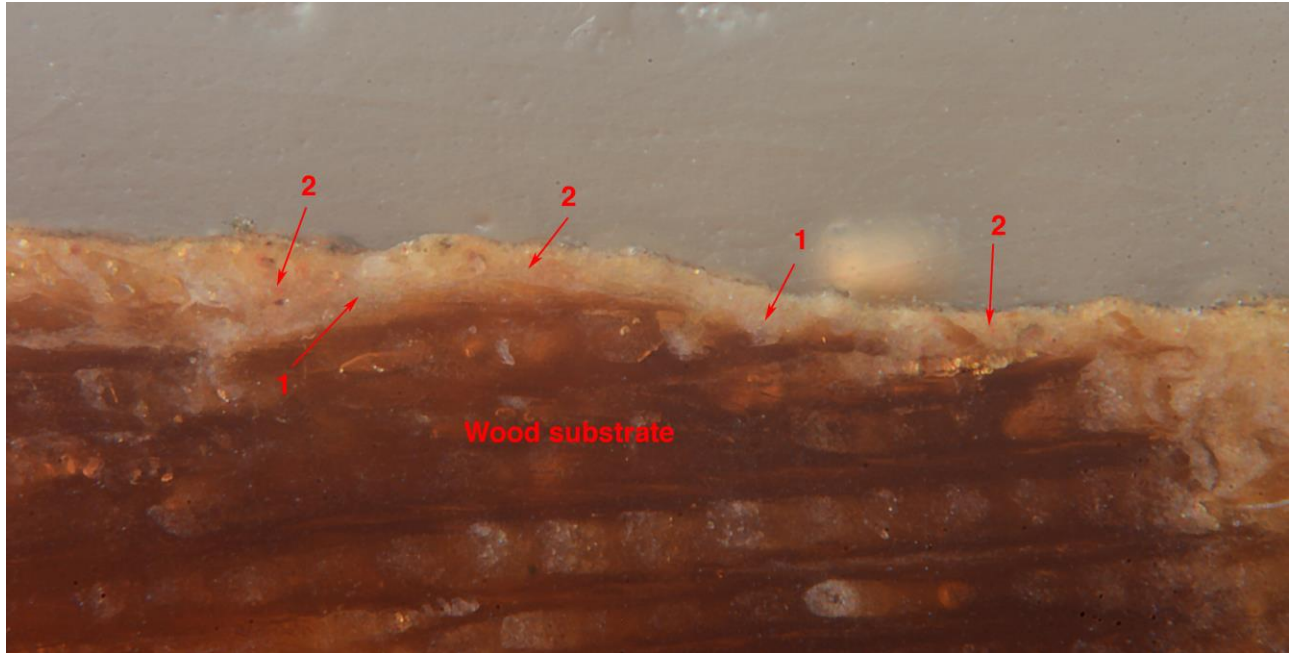
Photomicrograph: Unmounted sample, Olympus SZ-1145 microscope, with Nikon D7100 digital camera body Lexar Media 1GB flash card Dolan Jenner Fiber optics illuminator, daylight filtering. Additional enlargement in computer.



Note: The view of the sample is looking down onto the finish surface. The sample was scraped to present a view of all of the layers. The first layer is the dark varnish [1]. The second finish is a black finish, the carbon black [2]. This finish is still exposed and appears more gray because of the deterioration of the finish surface through loss of gloss level.

Sample 203-3: Wall field, East wall approximately 1' north of door frame

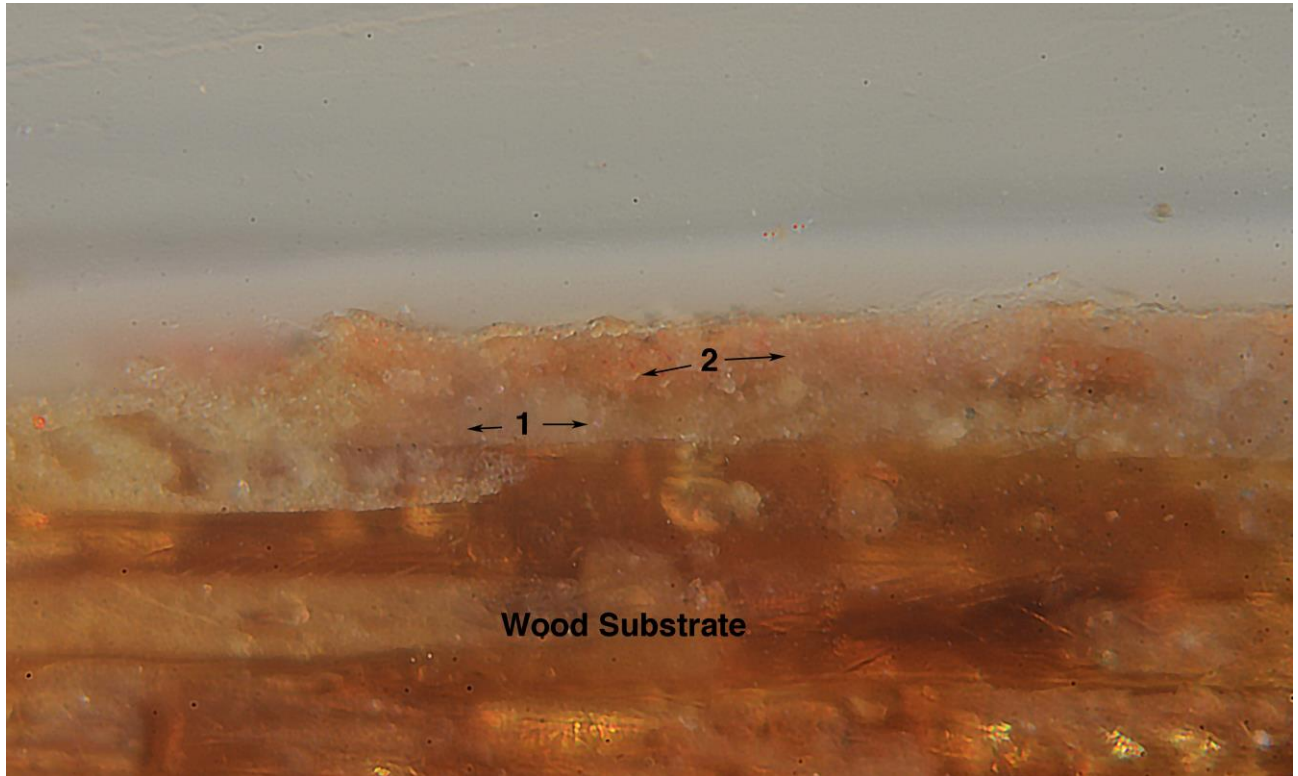
Photomicrograph: Mounted sample, Olympus BMAX-50 polarized light microscope/ 10x objective, (100x total microscopic magnification) with Nikon D70 digital camera body Lexar Media 1GB flash card Dolan Jenner Fiber optics illuminator, daylight filtering. Additional enlargement in computer.



Note: The sample has been mounted in polymer resin, cut and polished to 8000 micron grit polishing cloth for additional examination. This sample shows the same formation as the Sample 203-1: Ceiling near north east corner, above. The first layer is a layer of lead white in a drying oil [1], and the second layer is the pink layer, prepared with vermilion and lead white [2]. The pink is clearly intermittent, possibly wiped off while still wet. **As in the case of the ceiling, this is the only finish on the wall boards.**

Sample 203-4: Mantel Shelf, return

Photomicrograph: Mounted sample, Olympus BMAX-50 polarized light microscope/ 10x objective, (100x total microscopic magnification) with Nikon D70 digital camera body Lexar Media 1GB flash card Dolan Jenner Fiber optics illuminator, daylight filtering. Additional enlargement in computer.



Note: The sample has been mounted in polymer resin, cut and polished to 8000 grit polishing cloth for additional examination. The wood substrate is seen at the base of the sample as indicated. Of the collected samples, this may show the sequence of paint layers to create the marbling effect. The first layer [1] is the lead white layer. Once dry, the second layer, [2] was applied. This layer is lead white tinted with a vermillion pigment. The individual vermillion particles may be discerned in this historic paint layer.

Once again, this is the only paint finish on this surface.

Sample 203-5: Chair rail, cap

Sample 203-6: Crown Molding, East Wall

Photomicrograph: Unmounted sample, Olympus SZ-1145 microscope, with Nikon D7100 digital camera body Lexar Media 1GB flash card Dolan Jenner Fiber optics illuminator, daylight filtering.



Note: The view of the sample is looking down onto the finish surface of the sample. This sample is particularly informative. The sample is extremely minute. The wood substrate is clearly seen and noted. The first finish is the brown varnish coating, which retains the gloss level [1]. The black opaque paint layer [2] was applied over the glossy brown coating; the black finish [2] is still exposed.

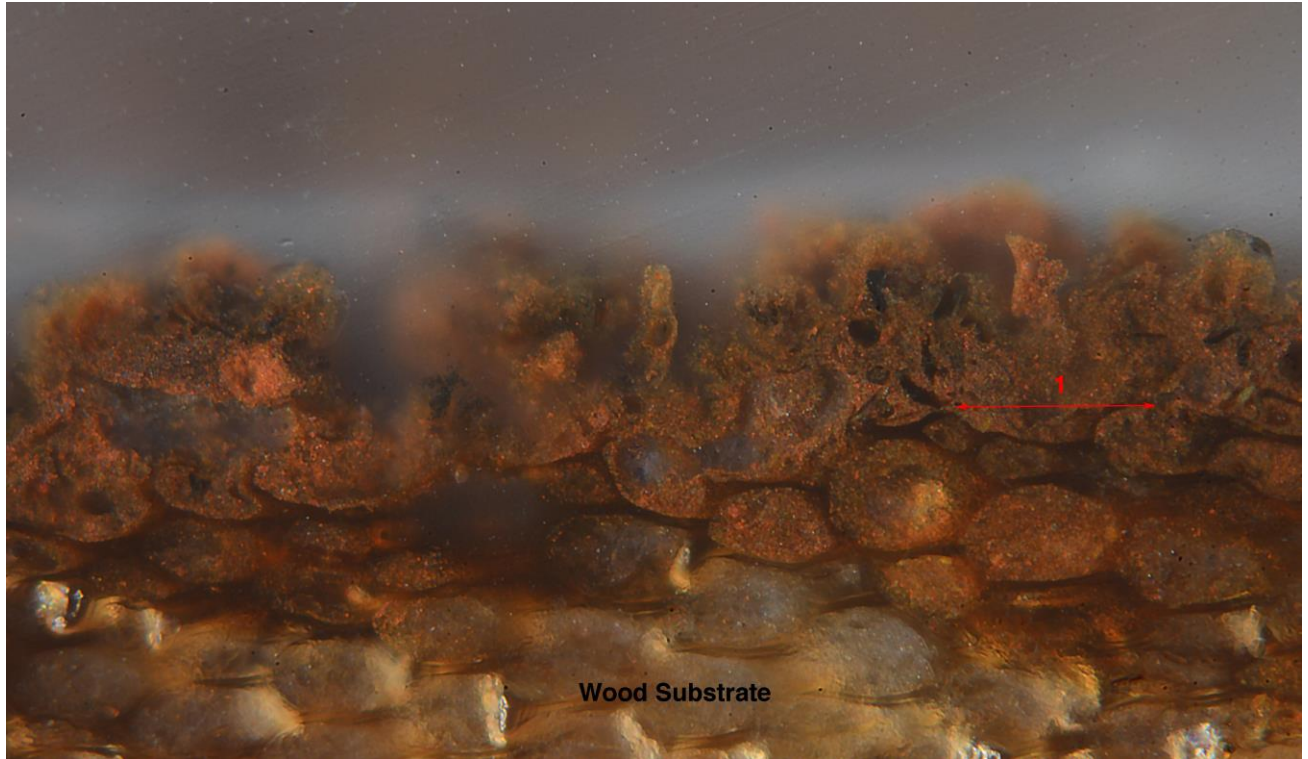
Note: the same finishes were observed on the following samples:

Sample 203-10: Door to Hall, Frame, return

Sample 203-12: Window frame, north window, return

Sample 203-7: Wall, Dado: field of the trompe-l'oeil panel decoration, North wall

Photomicrograph: Mounted sample, Olympus BMAX-50 polarized light microscope/ 10x objective, (100x total microscopic magnification) with Nikon D70 digital camera body Lexar Media 1GB flash card Dolan Jenner Fiber optics illuminator, daylight filtering. Additional enlargement in computer.



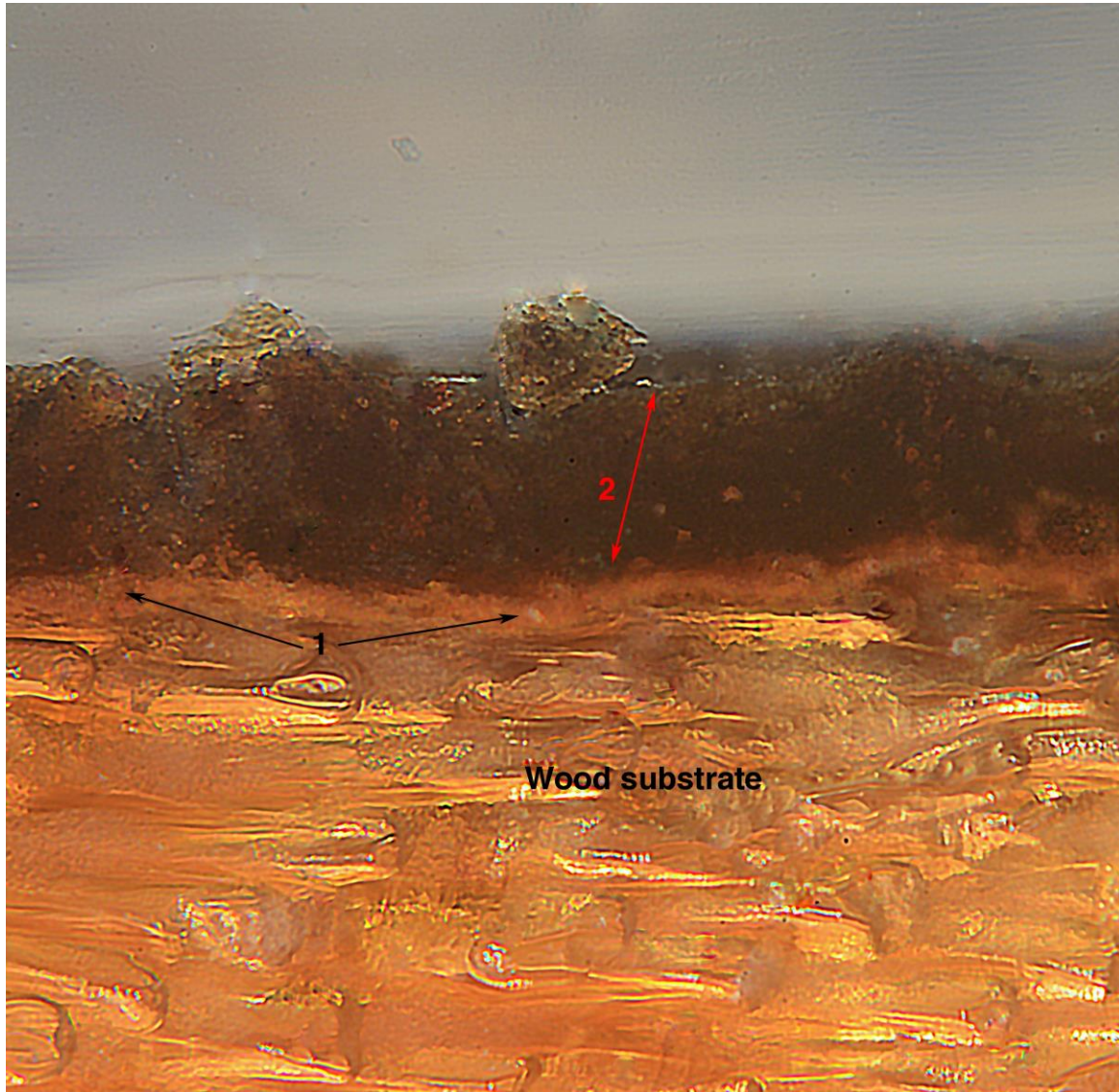
Note: The sample has been mounted in polymer resin, cut and polished to 8000 grit polishing cloth for additional examination. The wood substrate is seen at the base of the sample and is indicated. The brown ochre paint is clearly seen, and has invaded the cell structure of the wood at the surface [1]. This is the only paint finish on this sample.

Note: the same paint finish was observed on the following sample:

Sample 203-11: Door to Hall 201

Sample 203-8: Baseboard, quarter round

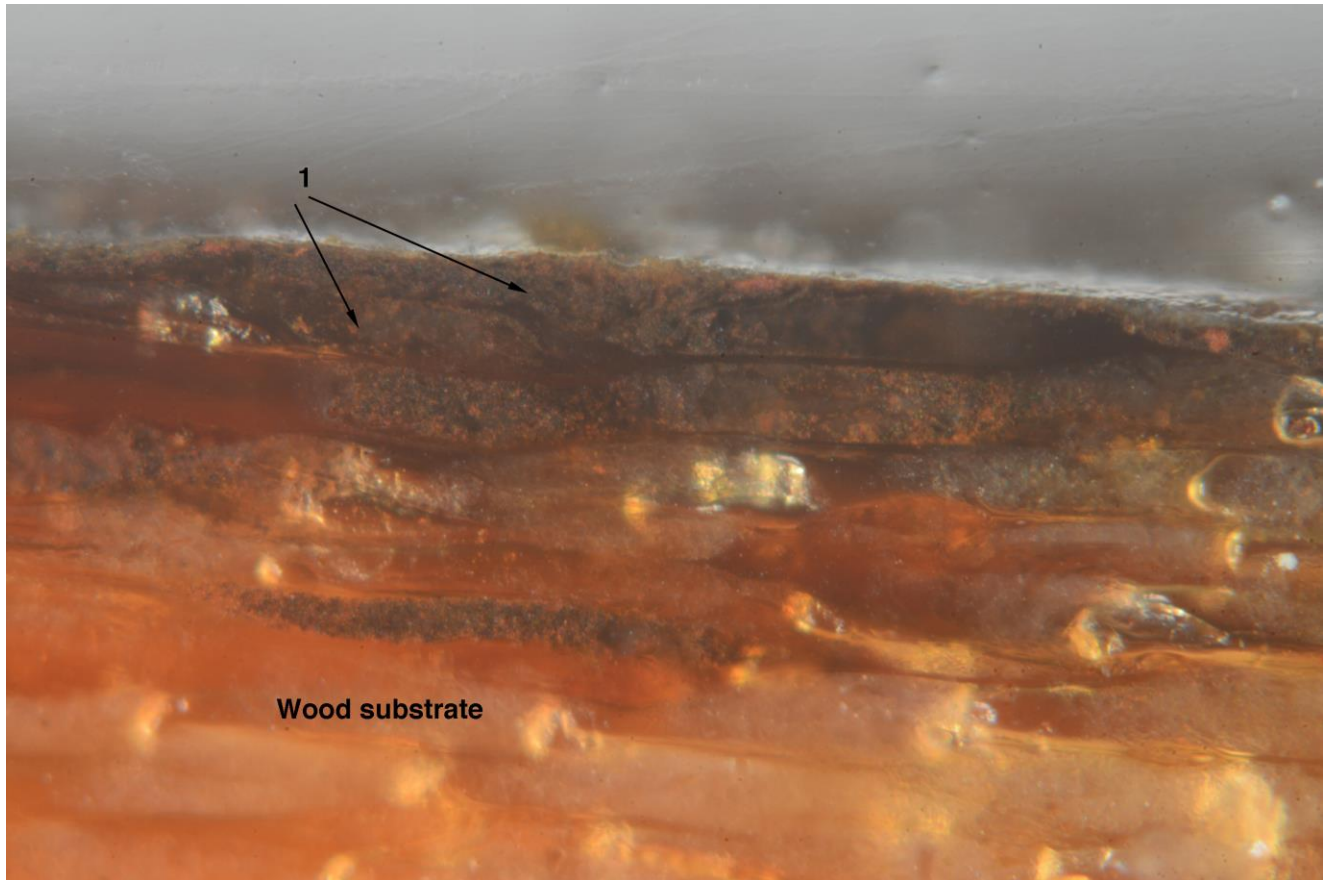
Photomicrograph: Mounted sample, Olympus BMAX-50 polarized light microscope/ 10x objective, (100x total microscopic magnification) with Nikon D70 digital camera body Lexar Media 1GB flash card Dolan Jenner Fiber optics illuminator, daylight filtering. Additional enlargement in computer.



Note: The sample has been mounted in polymer resin, cut and polished to 8000 grit polishing cloth for additional examination. The wood substrate is seen at the base of the sample as indicated. There is a thin red-brown ochre layer [1] followed by a thick layer of a brown varnish coating. In this case, the brown varnish may have been added later.

Sample 203-9: Baseboard, fascia

Photomicrograph: Mounted sample, Olympus BMAX-50 polarized light microscope/ 10x objective, (100x total microscopic magnification) with Nikon D70 digital camera body Lexar Media 1GB flash card Dolan Jenner Fiber optics illuminator, daylight filtering. Additional enlargement in computer.



Note: The sample has been mounted in polymer resin, cut and polished to 8000 grit polishing cloth for additional examination. The wood substrate is seen at the base of the sample as indicated. The paint layer [1] is a dark brown, prepared with a brown ochre base. The natural ochres are available in many color variations.

The West Bedchamber: First Finish indications

The first finish of the bedchamber is still exposed and will be retained. It may be that at some point in the future that the room will require conservation. That would entail various aspects of fine arts conservation such as re-adhesion, isolation coating with a reversible conservation material and inpainting. The indicated finishes below would be a general guide, and do not purport to be the paint colors that would be required.

Note also that some of the light blue was used for the marbling effect.

203-1: Ceiling near north east corner: Marbling pink/white
White: Benjamin Moore CW-5 [Harwood Putty]
Pink: Benjamin Moore 1290 [Fantasy Pink] and variants
Light blue: Special Standard: BM 800 M/1

203-2: Chair rail, apron:
First Finish: Natural resin varnish coating
Second Finish: Black: Benjamin Moore CW-680

203-3: Wall field, East wall approximately 1' north of door frame: Marbling pink/white
White: Benjamin Moore CW-5 [Harwood Putty]
Pink: Benjamin Moore 1290 [Fantasy Pink] and variants
Light blue: Special Standard: BM 800 M/1

203-4: Mantel Shelf, return: Marbling pink/white
White: Benjamin Moore CW-5 [Harwood Putty]
Pink: Benjamin Moore 1290 [Fantasy Pink] and variants
Light blue: Special Standard: BM 800 M/1

203-5: Chair rail, cap
First Finish: Natural resin varnish coating
Second Finish: Black: Benjamin Moore CW-680

203-6: Crown Molding, East Wall
First Finish: Natural resin varnish coating
Second Finish: Black: Benjamin Moore CW-680

203-7: Wall, Dado: field of the trompe-l'oeil panel decoration, North wall
201-5: Dado, ground: Dark brown: Benjamin Moore CSP-390

203-8: Baseboard, quarter round
First Finish: Benjamin Moore CSP-390

203-9: Baseboard, fascia
First Finish: Dark brown: Benjamin Moore CSP-390

203-10: Door to Hall, Frame, return
First Finish: Natural resin varnish coating

Second Finish: Black: Benjamin Moore CW-680

203-11: Door to Hall 201

First Finish: Dark brown: Benjamin Moore CSP-390

203-12: Window frame, north window, return

First Finish: Natural resin varnish coating

Second Finish: Black: Benjamin Moore CW-680

General Conclusion:

The second floor of the Carter Mansion presents an extremely important view of historic finishes. These finishes have faded, but the Second Floor Passage 201 and the West Bedroom 203 show the significance of painted marbling as an indication of status and importance. The survival of early graffiti in the West Bedchamber 203 is an added point of significance.

The most important approach for these rooms is the retention of all of the surviving paint, despite the faded and in some cases damaged condition. The social history of the period is indicated by the elaborate finishes used.

The examination of the finishes indicate that what survives reflects how the house would have appeared during the lifetime of Landon Carter (1760-1800).

Significant Pigments Identified

1. White lead

White lead has been in use since antiquity.

White lead, or lead carbonate (it is actually about seventy percent lead carbonate and about thirty percent lead hydrate) was the most important white pigment from ancient times to the present. The procedure for making white lead changed very little until the twentieth century. It was produced by the "Dutch" method generally, where lead sheets were suspended in clay vats with a separate compartment at the bottom filled with acetic acid (vinegar). These vats were stacked with manure separating them and the building in which they were placed was sealed. The combination of the acid vapor, carbon dioxide from the manure, oxygen and water vapor gradually turned the lead to basic lead carbonate. This was then washed, dried and screened. The resulting white pigment was either sold dry or (more recently-since about 1870) sold in paste, ground with linseed oil.

White lead is not an absolutely stable pigment. It tends to blacken on exposure to sulfides, and this is the basis of one of the most significant micro-chemical solvent tests: white lead on exposure to sodium sulfide solution will turn black.

2. Massicot, Yellow monoxide of lead

The result of the report establishes that the yellow pigment is identified as yellow monoxide of lead [PbO], which was known in the eighteenth century as *Massicot* or *Litharge*, both names being in use at that time.

Described as follows in *Painting Materials*:

"Both massicot and litharge are names which have long been used for the yellow monoxide of lead. Some writers have used them as synonyms but, on better authority, they are separated in meaning to indicate lead monoxides that are derived from different sources and have slightly different properties.

Massicot is understood to be the unfused monoxide of lead that is made by the gentle roasting of white lead. At a temperature of about 300 degrees C., white lead gives off carbon dioxide and water and the oxide is left as a soft, sulphur- yellow powder. It is not an intense yellow but it has good hiding power and is similar to white lead in pigment properties."¹

3. Lamp Black

Lamp black has been used in painting since pre-history.

This was the most common of the black pigments used and was an inexpensive material. the production of lamp black has changed very little: it is the collected soot from the burning of oil. The oil was usually burned in a lamp, thus the pigment's name. This pigment was also known to

¹ Painting Materials Rutherford J. Gettens and George L. Stout, 1942 Reprint, Dover Publications 1966, New York, New York page 129

pre-history.

Lamp black renders white a cool grey, and was also combined with charcoal, to produce a more neutral grey when mixed with white. It readily mixes with oil, since the oil from which it is made gives it a slightly greasy quality. The pigment is also very stable, and is clearly recognized by its optical character.

4. Brown ochres and umbers

The umber pigments have been used in painting since the middle ages.

The earth pigments include two sub-groups the umbers and siennas, so named for their locations near Italian cities. The umbers are natural earth pigments, of which burnt umber is a deep rich brown pigment made by roasting natural umber. This gives it a very warm brown shade, since the yellow hydrous oxides are changed to reddish anhydrous oxides. It has a high hiding power and mixed readily with oil and resin varnish media.

5. Prussian Blue

Prussian blue was first made in Berlin between 1704 and 1710.

Perhaps no pigment has had a more significant effect on the decoration of houses from the time of its first manufacture. It was first made in Berlin between 1704 and 1710, hence the name.

Prussian blue is the first modern synthetic color and is a complex chemical compound, technically expressed as ferric ferrocyanide (also potassium ferric ferrocyanide). The formulation was evolved over time, however, originally it involved organic materials in its production. It is a very finely ground pigment, which produces a very intense blue color. The best grades of prussian blue produce bright blues, sometimes tending toward a slightly green color. The poorer qualities of prussian blue generally are weaker pigments and give a somewhat purplish tone. Pigment lists of the eighteenth century and early nineteenth century often list up to five grades of prussian blue.

The general characteristic of prussian blue is its tendency to continue to disperse in the paint film, causing some streaking in the finish due to uneven brushing (an inevitable effect). For this stury, Prussian blue was identified using polarized light microscopy. Prussian blue is very variable as to its stability, as it tends to fade in sunlight, however, there are many examples of brilliant prussian blue colors surviving where they were not exposed to direct light.

6. Yellow Ochres

The ochres include yellow pigments which, like all ochres are natural earth materials consisting of silica and clay, and which is given color by iron oxide in either anhydrous or hydrous form. The yellow ochres are colored by various hydrated forms of iron oxide, goethite being the most important. It appears that the yellow ochres used were natural rather than manufactured pigments. The manufacture of ochres-known as Mars pigments- was done during the nineteenth century and is distinguished by the presence of alum. Natural yellow ochre has been used since pre-history and like all of the iron oxide pigments is very stable in all media.

6. Red ochres

The red ochres are part of the large family of earth pigments, but unlike the yellow ochres they are characterized by anhydrous ferric oxide in the silica and clay matrix.

Despite the various names given to the different tones of red pigments, these pigments have been known since prehistory. They are stable in all media and were frequently used in oil based as well as water based paint materials. They are very characteristic microscopically and are identified by optical features of the pigment particles. During the nineteenth century, and particularly from ca. 1840 on, manufactured iron oxide pigments were increasingly important. These pigments were collectively known as “Mars” pigments and ranged from yellows to dark brown. Purplish browns were particularly important and were used during the era of brownstone as a building material.

7. Vermillion

Vermillion has been used since ancient times and exists in both a natural form and an artificial form. It is red mercuric sulphide. The natural mineral [cinnabar] was used by the Greek and Roman civilizations. The artificial pigment was produced by the Fifteenth Century. The pigment used at the Carter Mansion would have been the artificial pigment. For this study it was identified using polarized light microscopy.

Color standards: CIE Lab coordinates, Hunter Lab

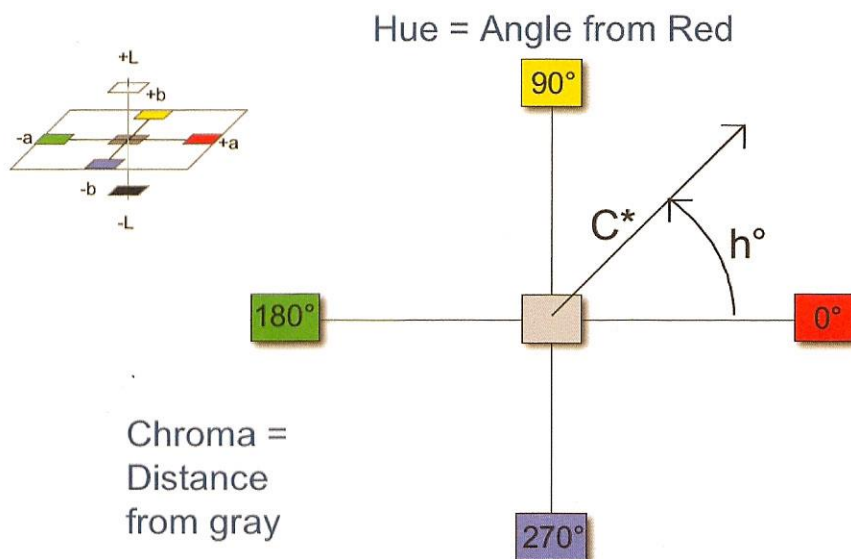
Using the spectrophotometer to provide CIE Lab coordinates makes it possible to register any color standard or paint sample into the CIE Lab system, which provides a written expression for any color.

CIE is the abbreviation for the Commission Internationale de l'Eclairage the French title for the International Commission on Illumination, which devised the CIE Lab system in 1931. It is devoted to standardization in illumination and related areas that include color.

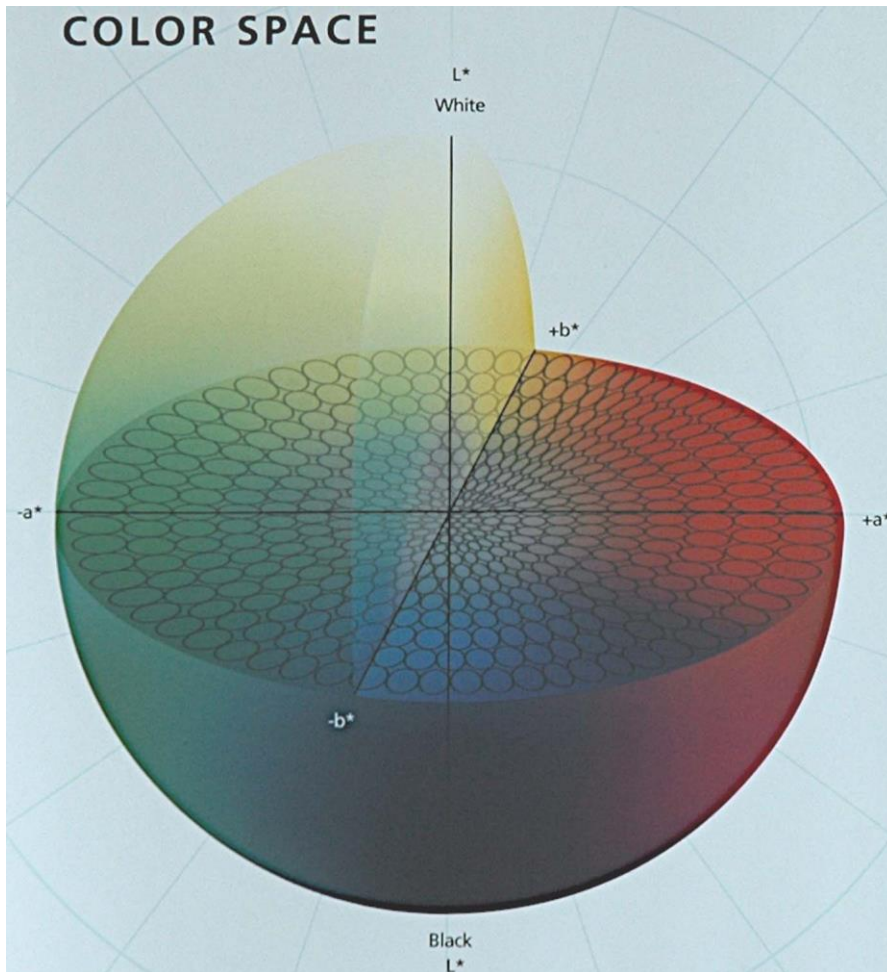
The spectrophotometer registers color standards into a system of measuring color devised in 1931 known as CIE Lab (pronounced See-lab). CIE Lab is a uniform (opponent color scale) color space in which colors are located within a three-dimensional rectangular coordinate system. The three dimensions are Lightness (L^*), redness/greenness (a^*) and yellowness/blueness (b^*). CIE Lab is part of current CIE recommendations.

In addition to the CIE Lab coordinates, the Hunter Lab numbers are also provided. These are based on developments undertaken by Richard Sewall Hunter (1909-1991) who developed a different means of identifying color. The Hunter color space was an effort to regularize the color space: the L axis represents lightness/darkness, with absolute white at 100 and absolute black at 0. Note the drawing below that shows the means of locating any color within the Hunter color space.

On the $L^* a^* b^*$ color model, where a^* and b^* are zero (point where the axes cross), the color is gray. Gray is without chroma (i.e.: saturation of color) and has undefined hue. Moving out from gray in any direction, the color increases in chromatic strength. Hue becomes defined by the angle of departure, as noted below, from a^+ that is set at 0 degrees. The distance moving out from the L axis is C^* ; the angle of departure is h degrees.



All of the Spectrophotometric readings are done with the X-Rite SP-62 Sphere Spectrophotometer, Designated observer 2 degrees; Illuminant C. Illuminant C is a mathematical representation of filtered tungsten halogen (daylight). The color temperature is 6770K, simulating CIE average daylight.



Color Standards:

White Benjamin Moore CW-5 [Harwood Putty]

CIE Lab coordinates

Designated observer 2 degrees

Illuminant C

$L^* = 93.40$ $a^* = -1.28$ $b^* = 2.70$

Hunter Lab:

$L^* = 93.40$ $C^* = 2.99$ $h \text{ degrees} = 115.39$

Munsell Conversion Number: 3.45GY9.24/0.32

Color Standards:

Special Standard: Carter Mansion Light greenish blue

CIE Lab coordinates

Designated observer 2 degrees

Illuminant C

$L^* = 73.40$ $a^* = -9.51$ $b^* = -1.48$

Hunter Lab:

$L^* = 73.40$ $C^* = 9.63$ $h \text{ degrees} = 188.82$

Munsell Conversion Number: 6.24BG7.18/1.82

Color Standards:

Special Standard: Light pink [this color would have been variable]

Benjamin Moore 1290

CIE Lab coordinates

Designated observer 2 degrees

Illuminant C

$L^* = 84.02$ $a^* = 13.01$ $b^* = 6.18$

Hunter Lab:

$L^* = 84.02$ $C^* = 14.40$ $h \text{ degrees} = 25.41$

Color Standards:

Dark brown: Benjamin Moore CSP-390

CIE Lab coordinates

Designated observer 2 degrees

Illuminant C

$L^* = 35.88$ $a^* = 4.84$ $b^* = 5.77$

Hunter Lab:

$L^* = 35.88$ $C^* = 7.53$ $h \text{ degrees} = 49.97$

Munsell Conversion Number: 3.75YR3.49/1.24

Color Standards:

Black: Benjamin Moore CW-680 [Mopboard Black]

CIE Lab coordinates

Designated observer 2 degrees

Illuminant C

$L^* = 32.21$ $a^* = 0.50$ $b^* = -0.74$

Hunter Lab:

$L^* = 32.21$ $C^* = 0.90$ $h \text{ degrees} = 304.10$

Munsell Conversion Number: 1.92P 3.14/0.17

Color Standards:

Special Standard: Carter Mansion Light blue

CIE Lab coordinates

Designated observer 2 degrees

Illuminant C

$L^* = 85.57$ $a^* = -5.24$ $b^* = -15.15$

Hunter Lab:

$L^* = 85.57$ $C^* = 16.03$ $h \text{ degrees} = 250.91$

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8. The Particle Atlas: Edition Two Volumes 1-5

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9. Artists' Pigments: A handbook of their History and Characteristics, Robert L. Feller, Editor, Cambridge University Press, National Gallery of Art, Washington, D.C. 1985

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Addendum: Instrumental Readings

Addendum: The “Green Varnish”: Results of the instrumental readings and information on the preparation of and use of Green varnish coatings.

The Carter Mansion Phase 2 Report afforded the opportunity to examine the green varnish coating that was found on a number of samples, most clearly photomicrographed on page 20 of the Phase 2 Report [Sample SL-5: North wall: Molding, Location 1 and Location 2]. These elusive green agglomerations had also been seen in the first study, on the balusters.

Samples were sent to Ms. Catherine Matsen, Conservator, for instrumental examination to determine, as far as possible, the composition of the transparent discolored resin coating. The following examination and appendix of the reading print outs follow:

Date: October 17, 2020

Requestor: Matthew J. Mosca
Historic Paint Finishes Specialist
Artifex, Ltd.
2641 North Charles Street
Baltimore, Maryland 21218

Analyst: Catherine Matsen
2001 North van Buren Street
Wilmington, DE 19802

SAMPLE DESCRIPTION

Two samples of dark, natural resin, possibly with pigment from the Carter Mansion.

Vial 1: Carter Mansion, second floor stair hall, chair rail cap
(finish on wood substrate)

Vial 2: Carter Mansion, second floor door frame of door to west bedroom
(agglomerations of natural resin)

PARTICULAR INTEREST

To identify the composition of the finishes present in the two samples. Elements contained in the finishes were identified with XRF (x-ray fluorescence) spectroscopy; Fourier-transform infrared (FTIR) spectroscopy was used to characterize both organic and inorganic components, and gas chromatography mass spectrometry (GC-MS) were used to identify the organic components within the finishes.

EXPERIMENTAL

XRF

Non-destructive, qualitative ED-XRF (energy-dispersive x-ray fluorescence) spectroscopy was performed to determine the sample area's elemental composition. The samples were placed on a piece of weigh paper on top of ethafoam to minimize elemental contribution from below the relatively small sample. Analysis was performed with the ArtTAX μ XRF spectrometer using a rhodium tube (600 μ A current, 50kV voltage, 100 seconds live time irradiation, approximately 70-100 micron spot size) with element detection range of potassium (K) to uranium (U). Spectra were interpreted using the Intax version 4.5.18.1 software; an integrated CCD camera allowed a magnified image of the region of analysis to be acquired.

FTIR

The two finish samples were analyzed by FTIR (Fourier-transform infrared) microspectroscopy, an instrumental technique that permits the general classification of natural organic materials (such as waxes, proteins, oils, polysaccharides, and resins) and the more specific identification of synthetic resins, inorganic pigments, and natural minerals. Sample material was acquired with a stainless steel scalpel and the aid of a stereomicroscope and then placed directly on a diamond cell. The material was rolled flat on the cell with a steel micro-roller to decrease thickness and increase transparency. The sample was analyzed using the Thermo Scientific Nicolet 6700 FT-IR with Nicolet Continuum FT-IR microscope (transmission mode); data was acquired for 128 scans from 4000 to 650 cm^{-1} at a spectral resolution of 4 cm^{-1} . Multiple scrapings of the sample were taken from the bulk sample and multiple spectra were taken from different areas within each scraping. Spectra were collected with Omnic 8.0 software and analyzed in this program with various IRUG and commercial reference spectral libraries.

GC-MS

Oils, resins, varnishes, and waxes

Samples containing the aforementioned classes of compounds are often composed, in part, of carboxylic acids or esters. To reduce the molecular weight and make the components more volatile, treatment of the samples with MethPrep II reagent converts carboxylic acids and esters to their methyl ester derivatives. Samples were transferred directly to a heavy-walled glass GC vial and then 100 μ L of 1:2 MethPrep II reagent (Alltech) in benzene was added. The vials were warmed at 60°C for one hour in the heating block, removed from heat, and allowed to stand to cool.

Samples were analyzed using the Agilent Technologies 7890B gas chromatogram equipped with Agilent 5977A mass selective detector (MSD) and an automatic liquid injector. A sample volume (splitless) of 1 μ L was injected onto a 30m $\times$ 250 μ m $\times$ 0.25 μ m film thickness HP-5MS column (5% phenyl methyl siloxane at a flow rate of 1.5mL/minute). The Agilent Technologies MassHunter Workstation GC/MS Data

Acquisition (version 10.0.368) software was used with Winterthur RTLMPREP method with conditions as follows: inlet temperature was 320°C (splitless mode) with a nine minute solvent delay. The GC oven temperature program was 55°C for two minutes, then ramped at 10°C/minute to 325°C, followed by a ten minute isothermal period. The transfer line temperature to the MSD (SCAN mode) was 280°C, the source at 230°C and the MS quad at 150°C.

RESULTS

The combined results of the three instrumental techniques are summarized in Table 1 below.

XRF spectra are included as Figures 1 and 2 of the Appendix; rhodium (Rh) is labeled on the spectra due to the instrument x-ray source.

FTIR spectra are included as Figures 3 and 4; commercial FTIR reference spectra are provided for comparison but are not intended as specific identifications.

Annotated gas chromatograms of samples from Vials 1 and 2 are included as Figure 5 and 6, respectively. The two chromatograms are overlaid with one another in Figure 7. Table 2 in the Appendix indicates the compounds detected in the chromatograms that correspond to components of a drying oil. Table 3 in the Appendix outlines compounds detected in the chromatograms that correspond to components of pine resin.

Table 1. *Summary of results from analysis of two Carter Mansion samples with three instrumental techniques*

Instrumental Technique	Carter Mansion Sample	
	Vial 1 second floor stair hall, chair rail cap	Vial 2 second floor door frame of door to west bedroom
XRF	Ca, Fe, Cu, Pb	Cu, Pb
FTIR	drying oil natural resin lead white copper stearate	drying oil natural resin
GC-MS	drying oil pine resin (minor)	drying oil pine resin (trace)

DISCUSSION

XRF

Calcium (Ca) and iron (Fe) are often detected in architectural finishes likely present as the filler whiting (calcium carbonate, CaCO_3) and the pigment ochre (iron oxide, Fe_2O_3), respectively. Calcium and iron are also common elements detected in dirt and so the exact source of the elements is uncertain.

Copper detected in the samples is likely due to the presence of a copper-based pigment responsible for the green particles visible with magnification of the sample using a stereomicroscope. Lead is likely present as lead white (basic lead carbonate, $2\text{PbCO}_3 \cdot \text{Pb(OH)}_2$) included as either a pigment or a drier for the finish. Phase identification with a technique such as Raman spectroscopy or x-ray diffraction (XRD) would be necessary to confirm the presence of the compounds responsible for the detection of calcium, iron, copper and lead.

The x-rays lines detected in the sample of Vial 1 (Figure 1) are much stronger compared to those of Vial 2 (Figure 2); this suggests the sample of Vial 2 is more organic in nature, and supports visual observation by the requestor and analyst.

FTIR

For both samples of Vial 1 and 2, the major components are a drying oil (reference spectrum for linseed oil is provided) and resin (reference spectrum for pine resin is provided). The carbonyl (C=O) stretch at 1709cm^{-1} is between what is typical for oils (approximately 1740cm^{-1}) and resins (approximately 1715cm^{-1}) (Figures 3 and 4). The stretch centered at 1415cm^{-1} is characteristic of carbonates which, together with the presence of lead and calcium, may be due to lead white and/or whiting. A reference spectrum for lead white is provided in Figure 3 for comparison. (The presence of lead white in Vial 2 is also suggested with the stretch centered at 1415cm^{-1} , though a reference spectrum is not included in Figure 4).

A stretch clearly visible in the Vial 1 sample that is not present in the Vial 2 sample occurs at 1588cm^{-1} and is characteristic of copper stearate; the wavelength stretch for other metal stearates such as lead and cobalt occur at slightly shifted wavelengths. Copper stearates are green in color and would explain the green particles visible in the sample under magnification.

GC-MS

The major organic components of Vials 1 and 2 correspond to fatty acids present in drying oils. There are three minor components (peaks labelled 8, 10, and 12) the correspond to components of pine resin in Vial 1 (Figure 5) and only one component of pine resin in Vial 2 (Figure 6).

CONCLUSIONS

Vial 1 contains a drying oil with minor amounts of pine resin. Copper stearate, a green complex, is detected. Lead is detected in the sample most likely due to lead white, or possibly whiting.

Vial 2 contains primarily a drying oil. The presence of a natural resin is suggested based on the FTIR spectrum, but only a small, single component of pine resin is detected with GC-MS. Copper and lead are detected – but with far less intensity as compared to Vial 1. A copper stearate complex is not detected with FTIR, however the elemental information with XRF suggests the presence of a copper-based green pigment.

[End of Matsen Report]

An historical context for the Carter Mansion “green varnish”

Green pigments from copper were known in ancient times, and the most common copper green pigment was cupric acetate: *Verdigris* which was produced by the exposure of copper plates to the fumes of vinegar. This initial salt, which was called *Common Verdigris* was less expensive, but less brilliant than finer *Distilled Verdigris*. Robert Dossie in his important first edition [1758] of *The Handmaid to the Arts* includes the following:

Crystals of verdigrise, called distilled verdigrise.

“Distilled verdigrise [*sic*] is the salt produced by the solution of copper or common verdigrise in vinegar. The crystals thus formed are of an extremely bright green colour, and in varnish, where they stand perfectly well they have a very fine effect. In oil they hold their colour well enough to answer many purposes, where colours are not required to be greatly durable, but in paintings of consequence they cannot be depended upon, being apt to turn black with time.”

The process of combining the distilled verdigris crystals with varnish as indicated by Dossie, is cited by Rosamond D. Harley in her *Artist's Pigments ca. 1600-1835*, page 74:

“...it [distilled verdigris] was mixed with resin and used for glazing, a technique used by Flemish painters at an earlier period. De Mayerne noted a method for making a transparent copper resinate [emphasis added] suggesting that verdigris and Venice turpentine should be mixed together and heated.

A tradition that a bright green could be obtained in oil painting by laying a glaze of copper resinate over a white ground appears to have continued from the seventeenth century until the end of the eighteenth century, when it was recommended in the *Practical Treatise*.” – Theodore Turquet de Mayerne [1573-1655] compiled a detailed manuscript between 1620 and 1646, that includes contemporary information on painting through conversations with painters, including Rubens and Van Dyke.

In the case of the green varnish coating at the Carter Mansion, the identification of a pine resin and linseed oil would conform with the historical use of a transparent copper resinate prepared with Venice turpentine, which is a pine resin from the Larch tree [genus: *Larix*] then combined with linseed oil. If the linseed oil was a boiled oil that would also account for the presence of lead which was used as a siccative for the oil. The lead pigment used was usually red tetroxide of lead or yellow lead monoxide.

Another important description of transparent copper resinate is mentioned in one of the first modern treatises on painting materials: that of Gettens and Stout [1945]:

“Copper resinate is a green compound formed by dissolving copper cetate, verdigris or other copper salt in Venice turpentine, balsam or similar resinous solution.”

The analytical result would be similar in that a pine resin and linseed oil would be indicated.

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APPENDIX

Carter House Mansion

Figure 1: XRF spectrum of Carter Mansion Vial 1 (red spectrum) overlaid with the weigh paper the sample was placed on (green spectrum)

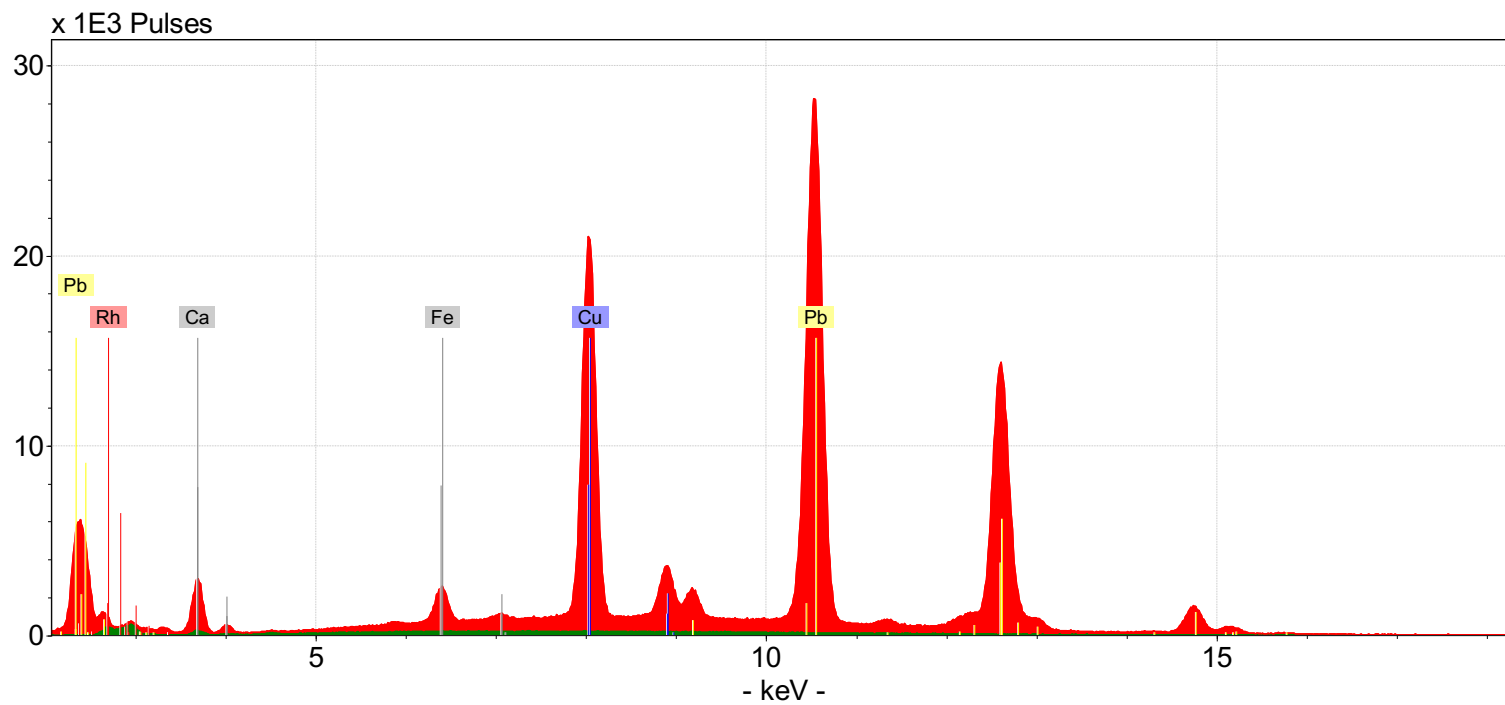


Figure 2: XRF spectrum of Carter Mansion Vial 2 (red spectrum) overlaid with the weigh paper the sample was placed on (green spectrum)

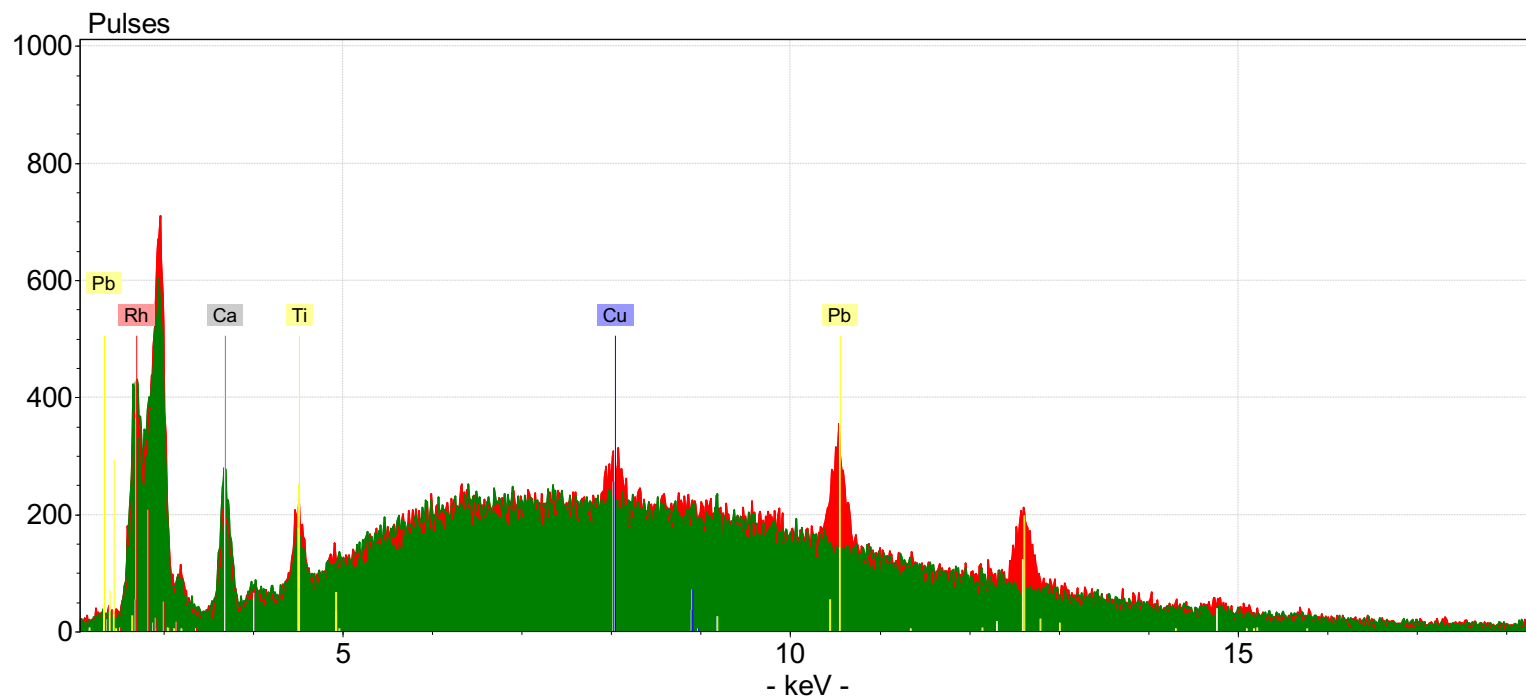


Figure 3: FTIR spectrum of Carter Mansion Vial 1 (red spectrum) overlaid with reference spectra for copper stearate (blue spectrum), lead white (turquoise spectrum), pine resin (green spectrum), and linseed oil (purple spectrum).

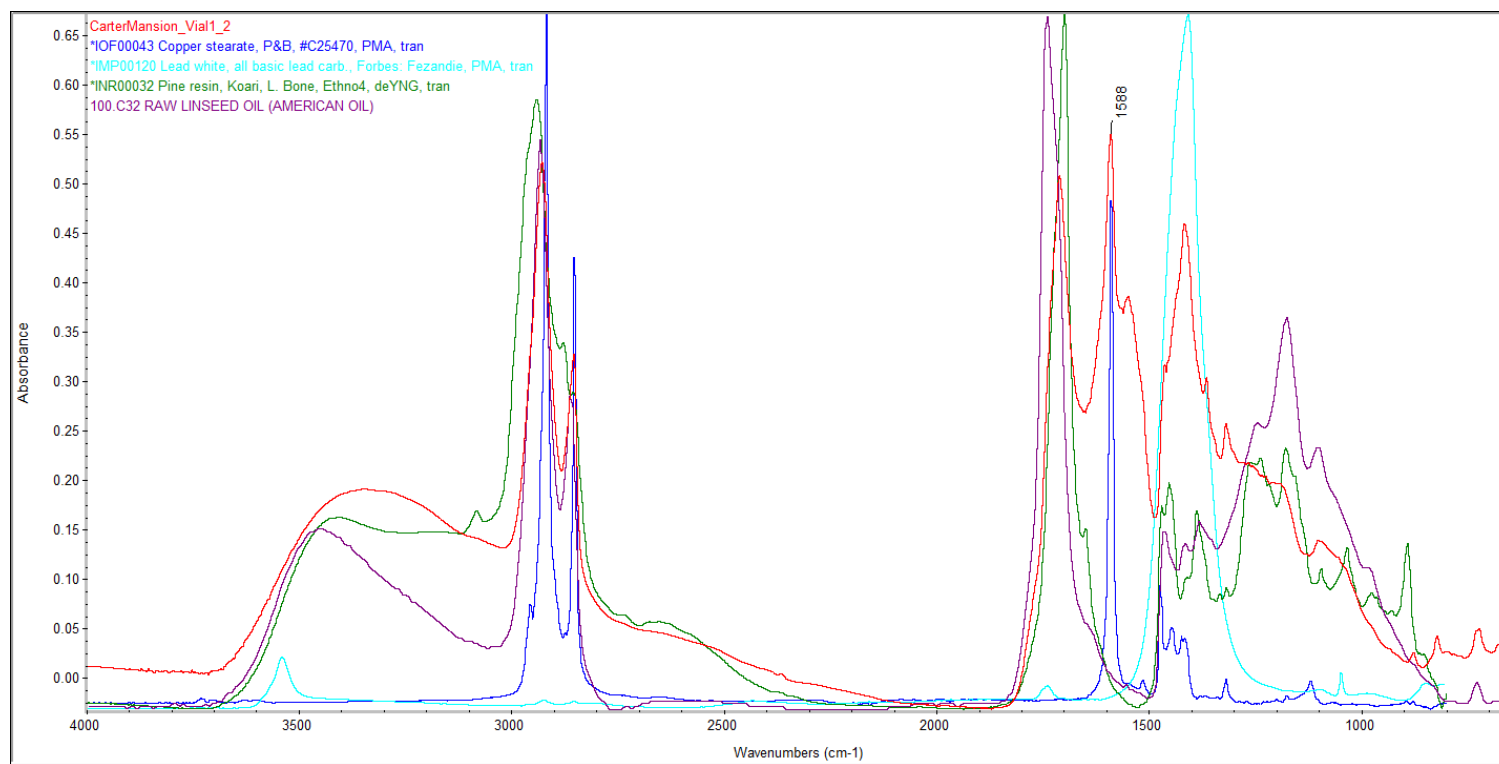


Figure 4: FTIR spectrum of Carter Mansion Vial 1 (red spectrum) overlaid with reference spectra for pine resin (green spectrum), and linseed oil (turquoise spectrum).

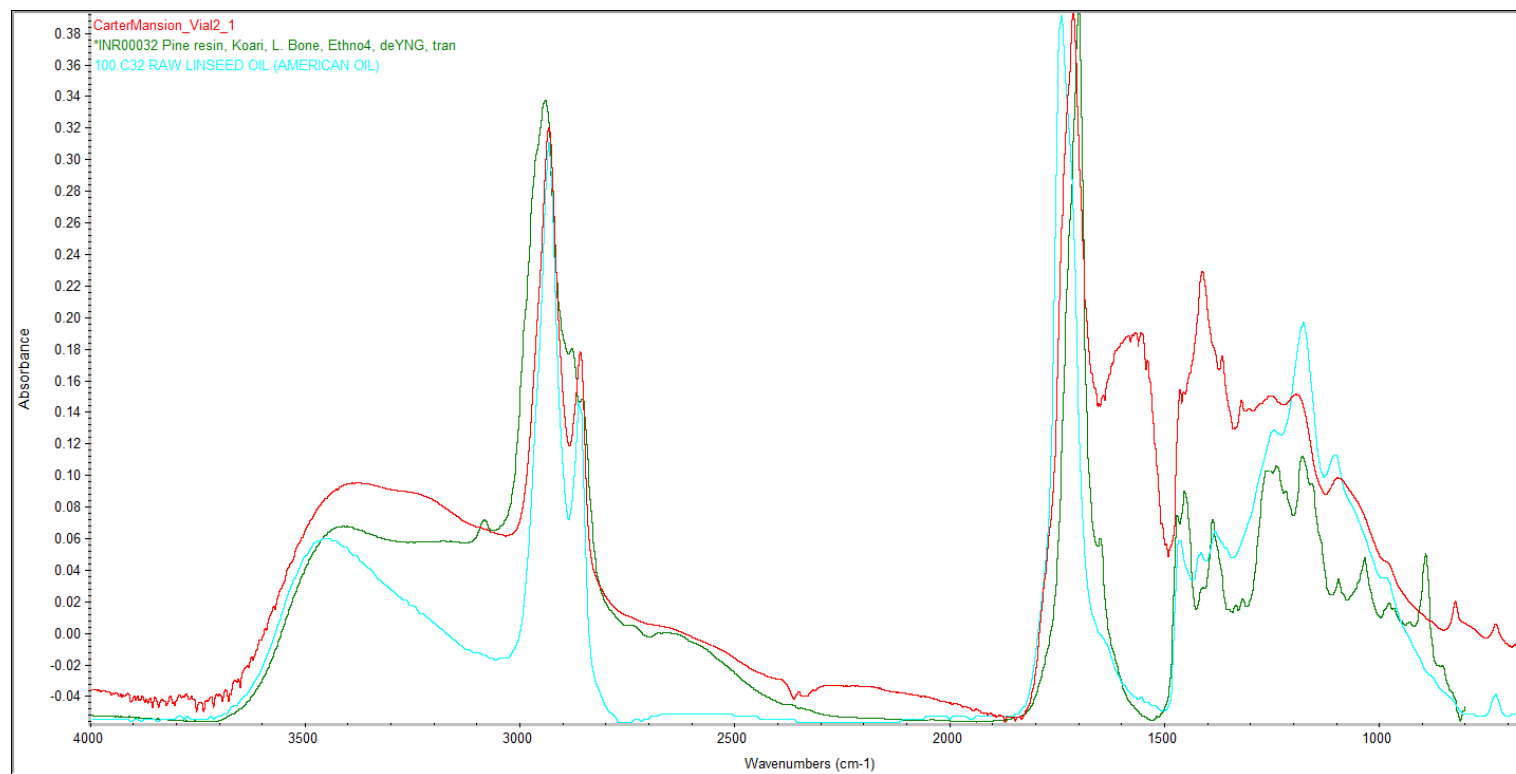


Figure 5: Gas chromatogram of Carter Mansion Vial 1. The peak numbers correspond to compounds identified based on their mass spectra, and are denoted in Tables 2 and 3 of the Appendix.

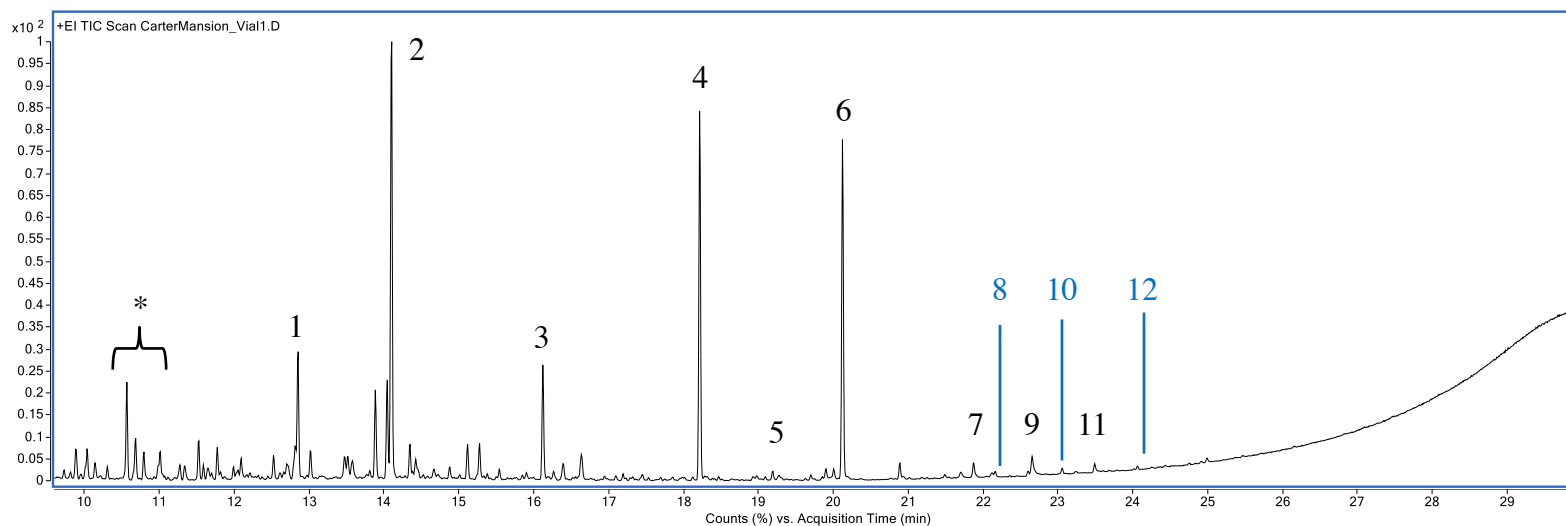


Figure 6: Gas chromatogram of Carter Mansion Vial 2. The peak numbers correspond to compounds identified based on their mass spectra, and are denoted in Tables 2 and 3 of the Appendix.

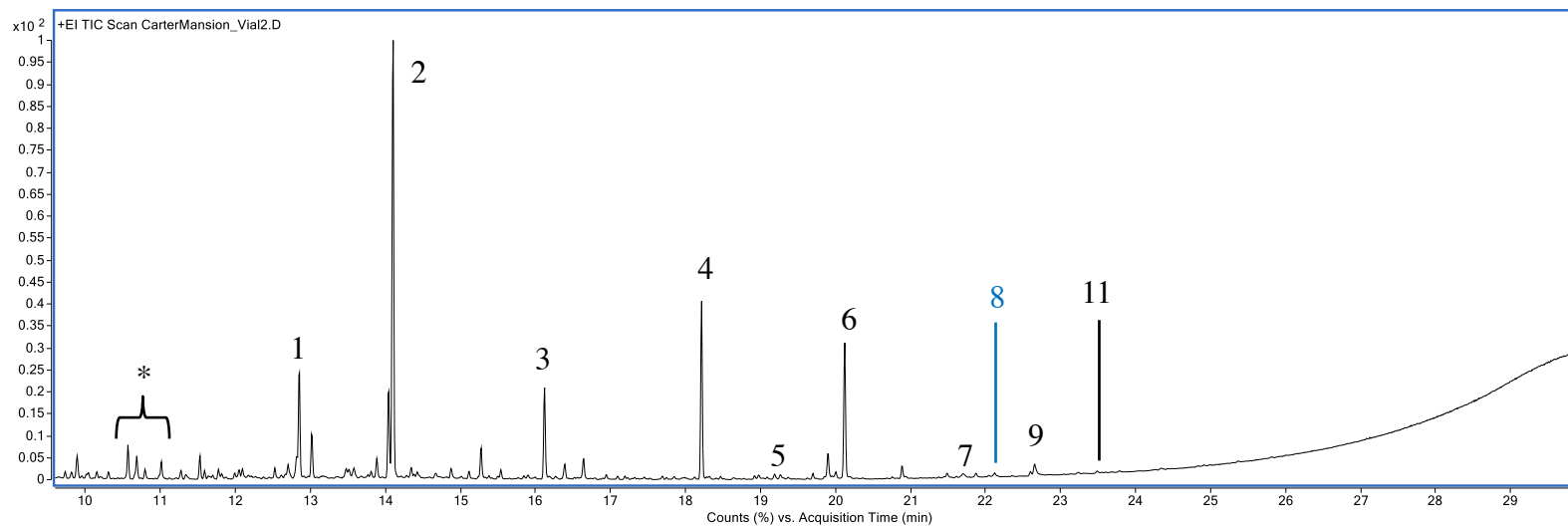


Figure 7: Gas chromatogram of Carter Mansion Vial 1 (black) overlaid with Vial 2 (red). The peak numbers correspond to compounds identified based on their mass spectra, and are denoted in Tables 2 and 3 of the Appendix.

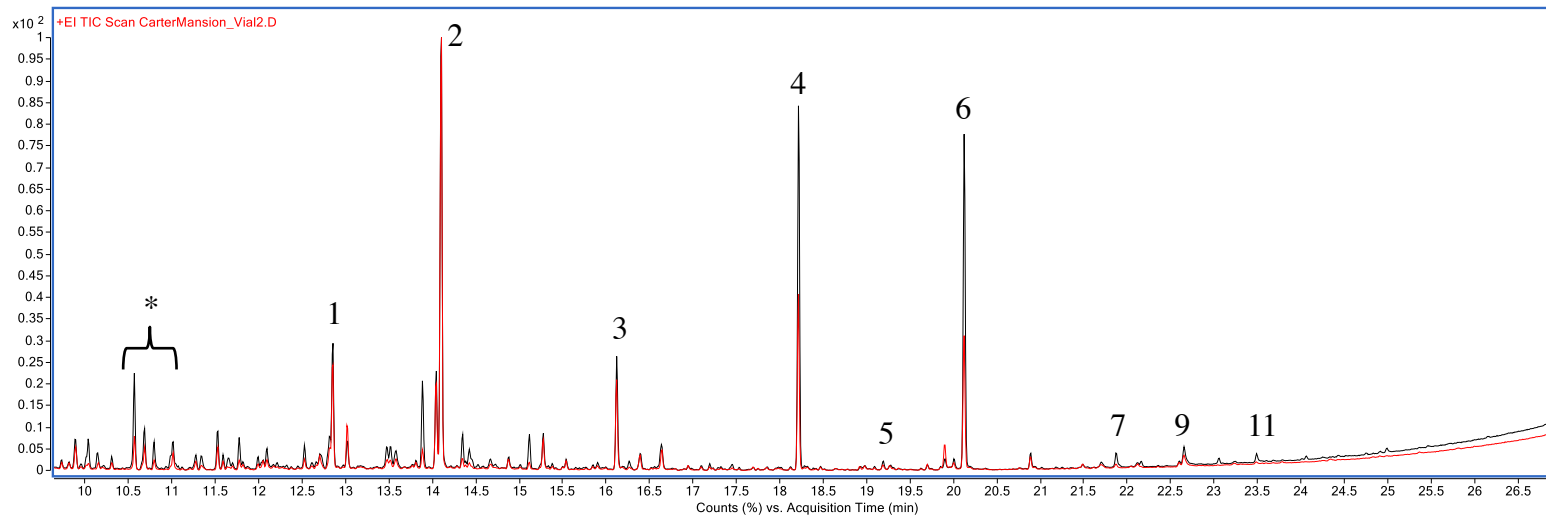


Table 2: Identification of gas chromatogram peaks in Figures 5-7 that correspond to components of a drying oil.
MethPrepII artifacts, denoted with an asterisk, are from the methylating reagent added to the samples.

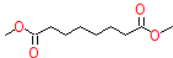
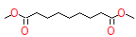
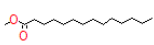
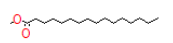
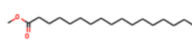
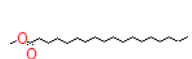
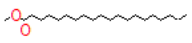
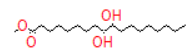
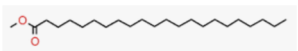
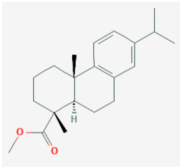
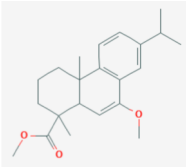
Peak Number	Approximate Retention Time (minutes)	Compound Name	Structure
*	10.57, 10.69, 10.79, 11.01	MethPrepII artifact	—
1	12.85	Suberic acid, dimethyl ester	
2	14.10	Azelaic acid, dimethyl ester	
3	16.12	Myristic acid, methyl ester	
4	18.22	Palmitic acid, methyl ester	
5	19.19	Heptadecanoic acid, methyl ester	
6	20.13	Stearic acid, methyl ester	
7	21.87	Eicosanoic acid, methyl ester	
9	22.66	Octadecanoic acid, 9,10-dihydroxy-, methyl ester	
11	23.49	Docosanoic acid, methyl ester	

Table 3: Identification of gas chromatogram peaks in Figures 5-7 that correspond to components of pine resin.
MethPrepII artifacts, denoted with an asterisk, are from the methylating reagent added to the samples.

Peak Number	Approximate Retention Time (minutes)	Compound Name	Structure
*	10.57, 10.69, 10.79, 11.01	MethPrepII artifact	—
8	22.17	Methyl dehydroabietate	
10	23.06	7-methoxy-tetradhydroabietic acid, methyl ester	
12	24.06	7-oxo-dehydroabietic acid, methyl ester	