Captain Oliver Filley House
Bloomfield, Connecticut

Cross-Section Microscopy Report

For: Eloise Marinos
Architect
P. O. Box 303
North Canton, Connecticut 06059

Conservator: Susan L. Buck, Conservator
Historic Paint and Architectural Services
A Division of West Communications Inc.
28 Sumner Street
Newton Centre, MA 02459

Date: December 2, 1999

Signed: Susan L. Buck

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Purpose:

The goal of this project is to use cross-section microscopy techniques to identify the sequence, color and composition of paints and varnishes on six exterior elements and fourteen interior elements from the Captain Oliver Filley House in Bloomfield, Connecticut. The results of the analysis will hopefully contribute to a better understanding of the evolution of the building and its appearance during different building periods. Micro-colorimetry techniques will be used to determine the original color of one of the exterior windows and/or frames and provide one match with currently available commercial paints. The balance of the samples will be saved for future color matching when additional funds are available.

Procedures:

Twenty samples were taken from interior and exterior elements by Eloise Marinos, AIA, Edward Stanley and Judith Sitkin. The samples were mailed to Historic Paint and Architectural Services in labelled baggies, accompanied by a list of the sample locations.

Portions of each sample were cast in polyester resin cubes for cross-section microscopy analysis and photography. The balance of each sample was set aside for examination under a binocular microscope and for color matching. The sample preparation methods and analytical procedures are described in the reference section of this report.

All of the cast samples were examined in cross-section under reflected visible and ultraviolet light at 50X, 125X and 250X magnifications. The samples were then stained to detect the presence of carbohydrates, proteins and oils in the binding media of the paint layers. The best photomicrographs of representative samples from each type of surface are included in the following section along with descriptions of the coating sequences. Please note that the colors in the photomicrographs do not precisely match the colors in the samples due to the inherent variability of color film and its processing.

Background Information:

In her memorandum describing the goals of this paint analysis project, Eloise Marinos provided a general description of the house and the relevant periods of renovation. This description is included here for reference.

> The original property (south wing) was constructed in 1834, and is Greek Revival in style. Exterior walls are load bearing granite (local) field stone. All windows, doors, trim and wall/floor/roof framing are wood. The east wing may have been constructed at the same time as the south wing – in 1834, or it may have been a slightly later addition, as there are numerous details in common, as well as a floor level height difference at both the second floors and the basement. There clearly was a Victorian period renovation affecting the second floor south wing as well as the first and second floors of the east wing. There were also numerous later functional renovations, mostly insignificant in terms of style and historic significance.

Paint Analysis Results:

The twenty samples were individually analyzed and then the paint sequences were compared based on the following criteria and questions set out by Eloise Marinos:

1. SAMPLES 101-104; E01-E02
   Establish baseline paint history for 1834 period south wing samples (or note that relative sample does not reflect earliest paint history as anticipated); establish earliest finish i.e. Shellac, varnish, paint, and paint color history for purposes of relating types and colors to later periods of work.

2. SAMPLES 201-202; E05-E06
   Establish paint history for east wing probable 1834 construction or later mid-1800's construction (at present, I am not able to definitively conclude whether the east wing was constructed simultaneously with the south wing, or whether it was constructed slightly later); it is my hope that the paint analysis will help to relate actual remaining finish layers with time periods within several decades (maximum).

3. SAMPLES 105; 203-205
   Establish paint history for elements of Victorian period work – there should be no prior paint history matching that from the 1834/mid 1800's period on these trim items.

4. SAMPLES 107-108; 206; E04
   Establish paint history for miscellaneous elements such as exterior arch column (E04), first floor kitchen renovation work (107, 108), 4-panel door at second floor south wing (206).

In this section the coating sequence in each of the samples is described, along with photomicrographs showing the paint and varnish layers from the substrate at the bottom to the most recently applied paint layer at the top. The table in the conclusion of the report shows how the different samples relate to each other, based on the dates established by Eloise Marinos for each sampled element. Three of the twenty samples do not contain coherent paint histories, either due to paint stripping or to extreme weathering resulting in paint erosion.

Interior Samples

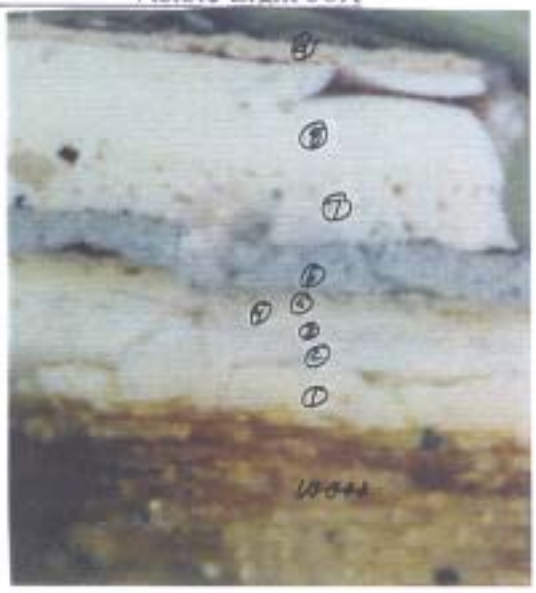
Sample 101: South Wing, South Room/Base – NE Corner ca. 1834. The paint sequence in this sample consists of ten generations of paint beginning with an off-white layer directly above the wood substrate. The thickness of the layers varies considerably over time, but the first off-white generation is comparatively thick and intact. It is oilbound and has a yellowish autofluorescence color in reflected ultraviolet light, which appears to be consistent with aged oil paints containing the pigment white lead.

The majority of the layers in this sample are off-white or cream-color, although in the sixth paint generation this element was painted blue-gray. This paint sequence may represent the complete paint history in this room since 1834, as there are no signs of stripping or paint flaking in this sample.

Sample 101 Paint Sequence

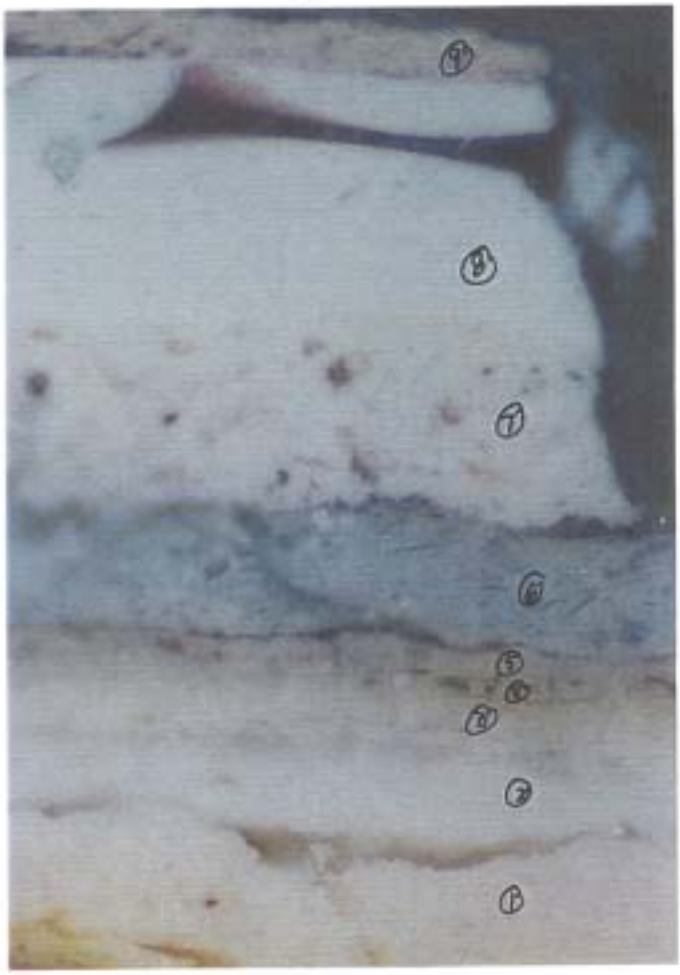
Layer	Generation
Modern white	10
Thin beige paint	9
Thick off-white paint	8
Coarse cream color	7
Thick blue-gray	6
Thin dark cream color	5
Thin dark cream color	4
Cream color	3
White paint	2
Off-white paint	1
Wood	

Visible Light 50X



Sample 101: South Wing, South Room/Base – NE Corner ca. 1834

Visible Light 125X

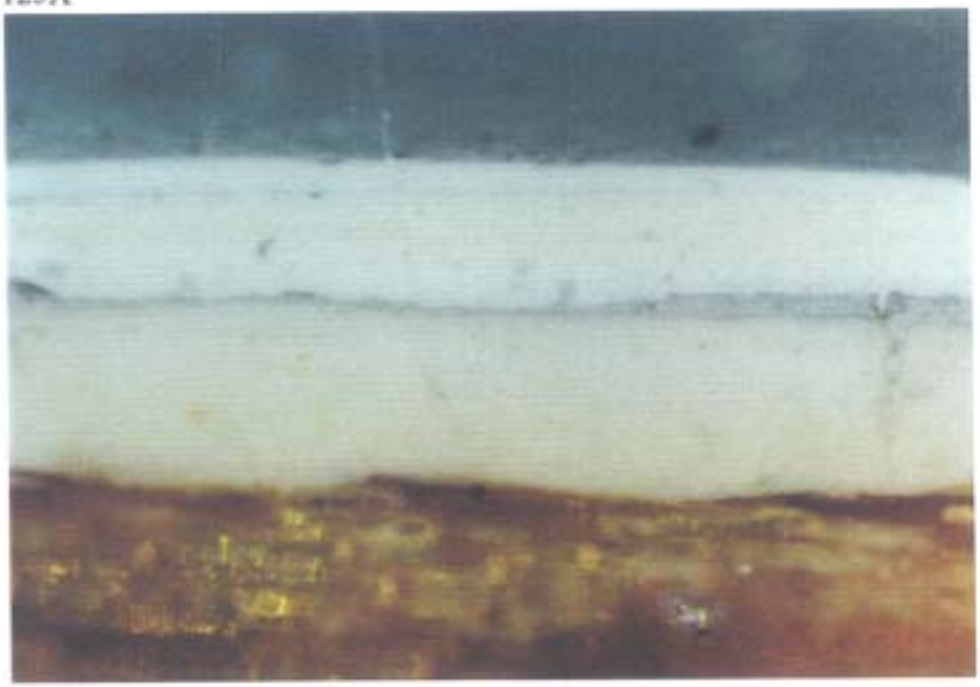


Ultraviolet Light 125X

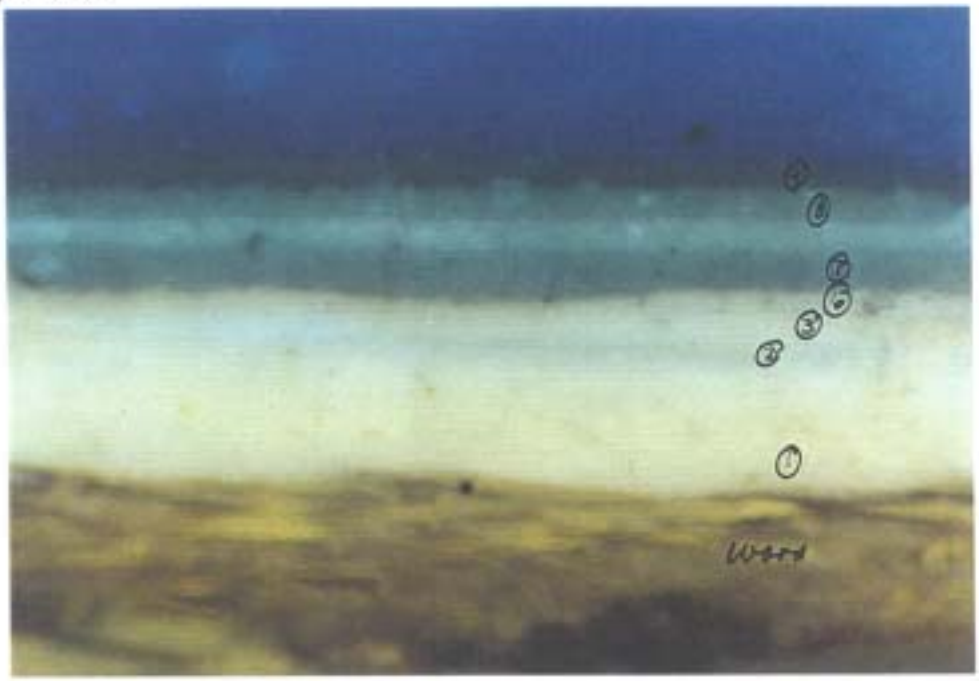
Sample 102 – South Wing, South Room/Sash (6/6) SE ca. 1834. This sample can be directly compared to sample 101 from the same room. There are seven generations of paint in this sample, beginning with the same three layers of off-white, white, and cream-color paint identified in sample 101. This paint sequence is missing generations 4 and 5 (thin dark cream-colored paints). The comparative paint histories suggest the base and sash in this room date to the same period.

Sample 102 – South Wing, South Room/Sash (6/6) SE ca. 1834

Visible Light 125X



Ultraviolet Light 125X

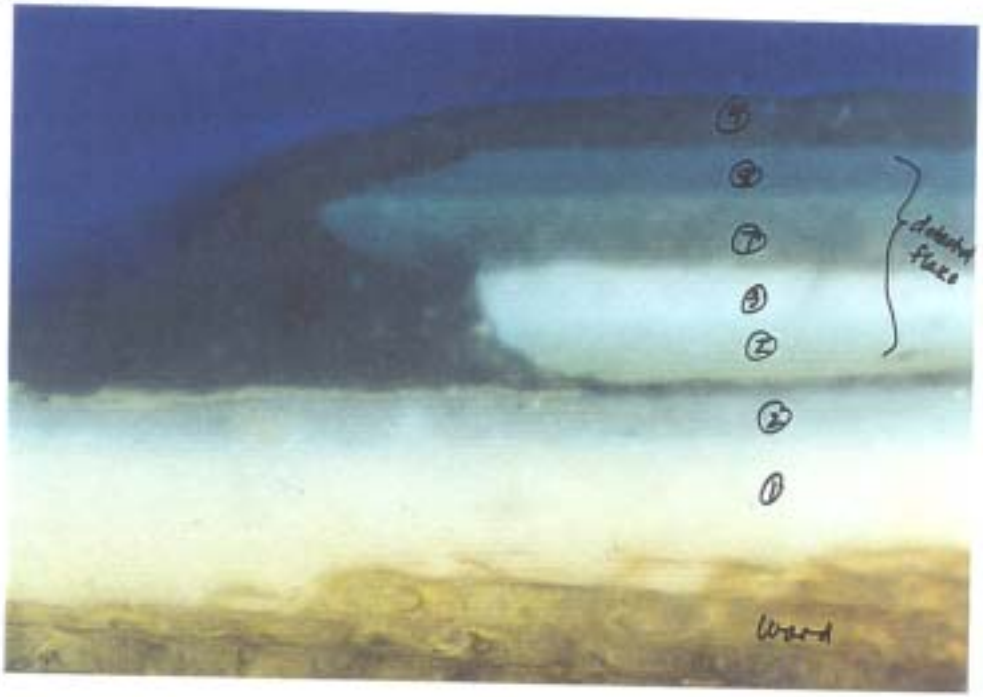


Sample 103 – South Wing, South Room/Window trim SW ca. 1834. The paints in this sample are somewhat more disrupted than in the other samples from this room, but the evidence suggests the window trim was initially painted the same off-white as the baseboard and the sash. Compared to sample 101 this sample contains generations 1, 2, 3, 7, 8 and 9. The paint sequence in the photomicrographs shows a flake of paint containing generations 2, 3, 7, and 8 that is out of position and trapped by the most recent white paint layer applied to the window trim.

Sample 103 – South Wing, South Room/Window Trim SW ca. 1834

Visible Light 125X

Ultraviolet Light 125X

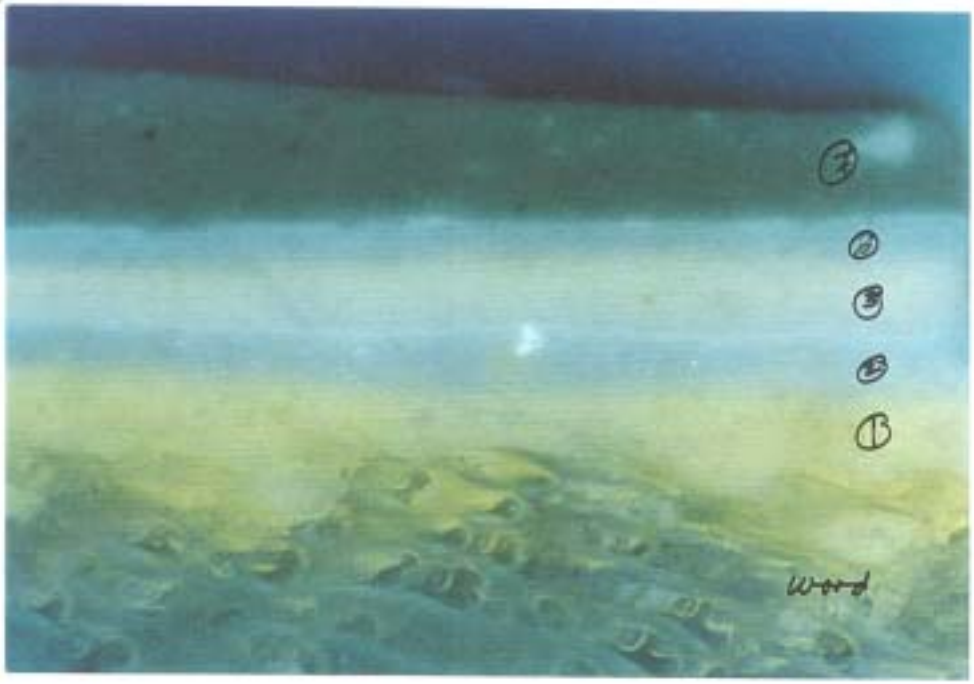


Sample 104 – South Wing, South Room/Mantel NE ca. 1834. There are five generations of paint in this sample, beginning with the same off-white paint found as the first generation in the other three samples from this space. When this cross-section is compared to sample 101 from the baseboard, it appears to contain generations 1, 2, 3, 6 and 7. Generation 6 is blue-gray in sample 101 but it is a very pale gray in this sample.

Sample 104 – South Wing, South Room/Mantel NE ca. 1834

Visible Light 125X

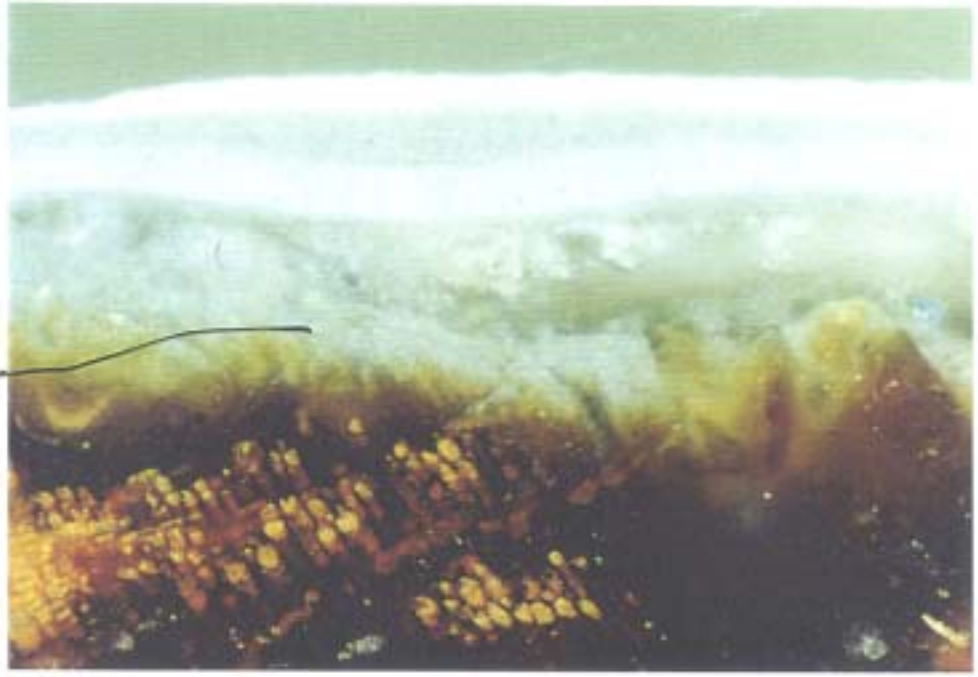
Ultraviolet Light 125X



Sample 105 – Main Entry Stair/Rail N, late Victorian. The evidence in this sample is quite disrupted, perhaps due to chemical stripping. However, it appears the earliest coating on the rail still survives. The first coating on the wood appears to be an unpigmented plant resin varnish coating, based on its whitish autofluorescence in ultraviolet light and translucent tan appearance in visible light. The surface of this varnish is uneven and inconsistent, perhaps as a result of being partially stripped or sanded. There is a modern, incomplete gray paint above the varnish remnants, followed by two generations of modern white paint. This limited paint chronology is not helpful for comparative dating purposes, but it does suggest the rail was originally varnished, not painted.

Sample 105 – Main Entry Stair/Rail N, late Victorian

Visible Light 125X



Ultraviolet Light 125X

Sample 106 – Main Entry Hall/Door Frame SE, late Victorian. This sample contains approximately eleven generations of paint beginning with a leanly oilbound cream-colored paint. This door frame is identified as late Victorian by Eloise Marinos, however, it appears not to contain any of the paint layers found on the earlier elements in the south wing, so it is not possible to determine how many paint generations were applied between 1834 and the time when this door frame was installed.

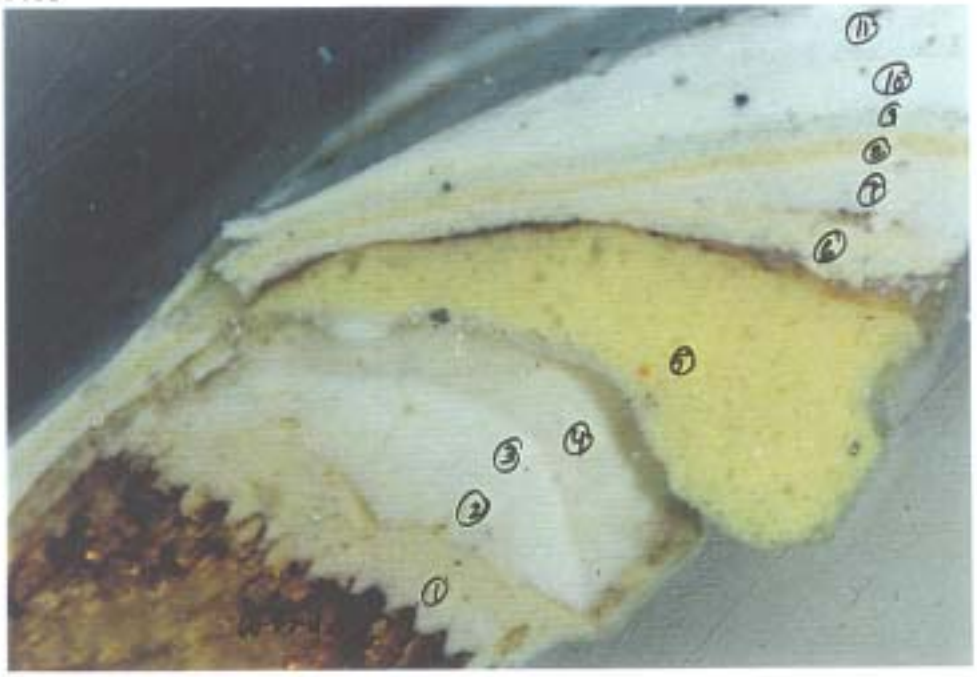
Generation 5 in this sample consists of a yellow base coat and a red-brown glaze, which may represent a graining treatment applied in the twentieth century. A similar graining treatment was identified as the fourth paint generation in sample 206 from a four-panel door in the south wing north room. This door was identified as possibly dating to 1834. The relative position of this graining treatment on an earlier door may indicate that the second floor was not repainted as frequently as the first floor, or perhaps the earlier door was removed from its original position.

Sample 106 Paint Sequence

Layer	Generation
White paint	11
White paint	10
Thin light blue paint	9
Thin yellow finish coat	8
White primer	8
White paint	7
Cream-colored paint	6
Red-brown glaze	5
Thick, coarse yellow paint	5
Varnish	4
Off-white paint	4
White paint	3
Off-white paint	2
Thick cream-colored paint	1
Wood	

Sample 106 – Main Entry Hall/Door Frame SE, late Victorian.

Visible Light 50X



Ultraviolet Light 50X

Sample 107 – East Wing Kitchen/Door Frame SE facing, later. This sample contains approximately eleven generations of paint, beginning with a gray paint layer that appears to be partially stripped off. There is evidence of a shellac sealant (orange autofluorescent material trapped in the wood fibers) applied to the wood before the door frame was painted. The second generation consists of cream colored primer and a pale tan-orange finish. The third generation of paint was applied on top of a thick cream-colored filler layer and it consist of a white primer, a yellow base coat and a brown glaze with a plant resin varnish coating. This third generation may represent a grain-painting sequence. In the fourth generation the door frame was painted with a thin layer of brown paint.

The first generation gray paint appears to be the same type of paint identified as the sixth paint generation in samples 101 and 102, both original 1834 elements from the south wing.

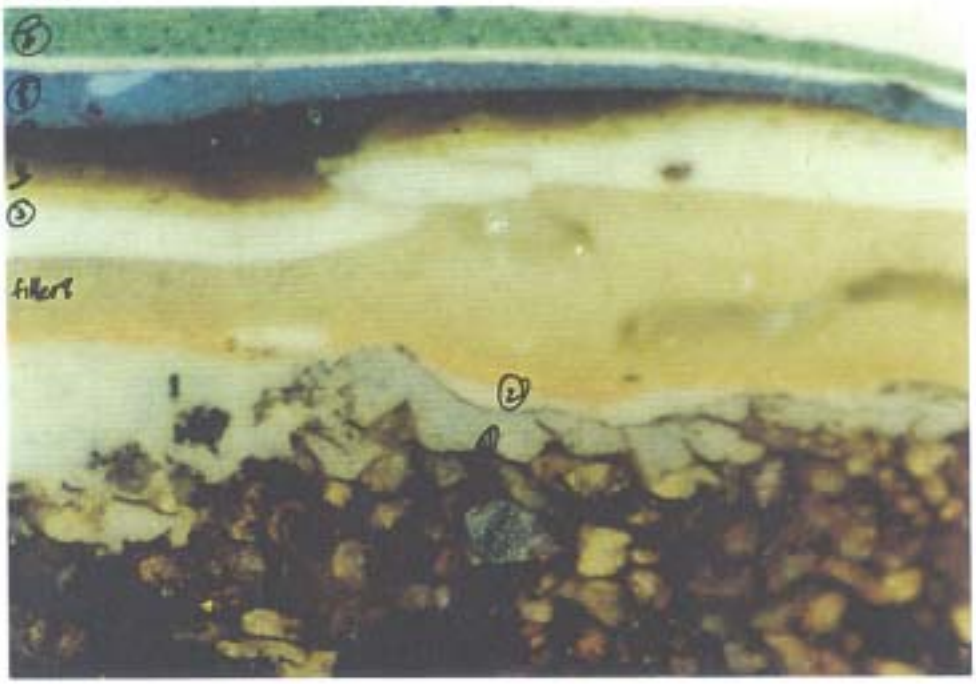
Sample 107 Paint Sequence

Layer	Generation
Off-white paint	11
Off-white paint	10
Thick white paint	9
Thick white paint	8
Pale pink paint	7
Bright green paint	6
White primer	6
Turquoise blue paint	5
Thin red-brown paint	4
Plant resin varnish	3
Brown glaze	3
Yellow base coat	3
White primer	3
Thick cream-colored filler	3
Tan-orange finish coat	2
White primer	2
Light gray paint	1
Shellac sealant	1
Wood	

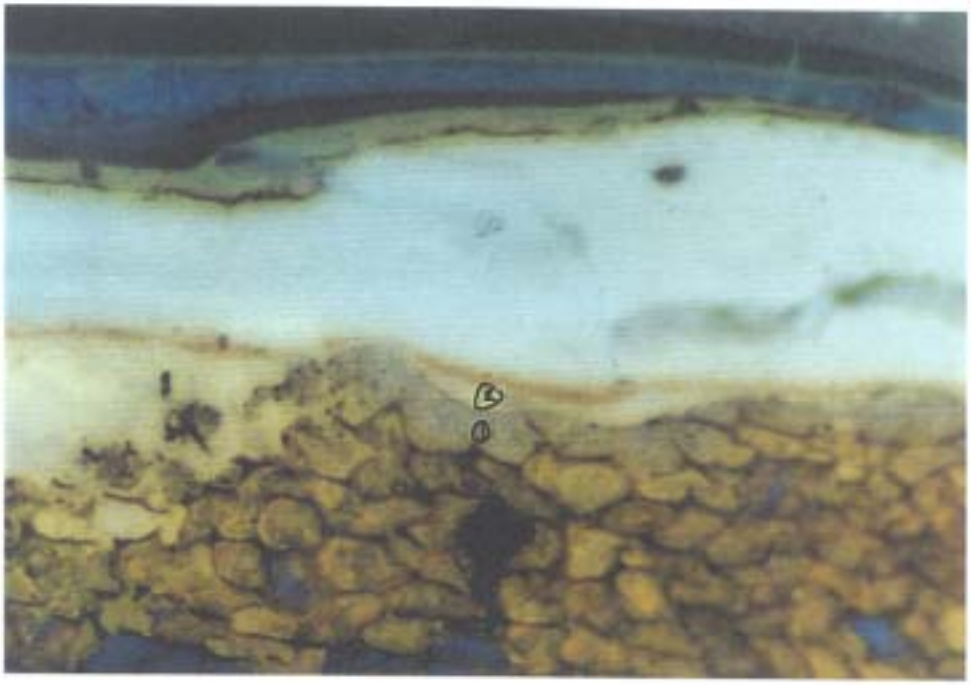
Visible Light 50X

Sample 107 – East Wing Kitchen/Door Frame SE facing, later.

Visible Light 125X



Ultraviolet Light 125X



Sample 108 – East Wing Kitchen/Base NE facing, later. The wood substrate in this sample is blackened and the wood cells are crushed. This suggests this particular element was exposed to fire and the first paint generation was lost. The likelihood of fire damage is reinforced when the paint sequence is compared to sample 107 from the door frame in the same room. The paint layers in sample 108 can be lined up to match seven of the nine paint generations in sample 107, but the first gray paint found on the door frame is missing in the sample from the base.

It is possible that the first paint layer on the base is missing simply due to abrasion. But the charred appearance of the wood does suggest fire damage early on. According to the "Paint Sample Key" marked with the sample locations, sample 108 was taken from an area that is not near a fireplace.

Sample 108 Paint Sequence

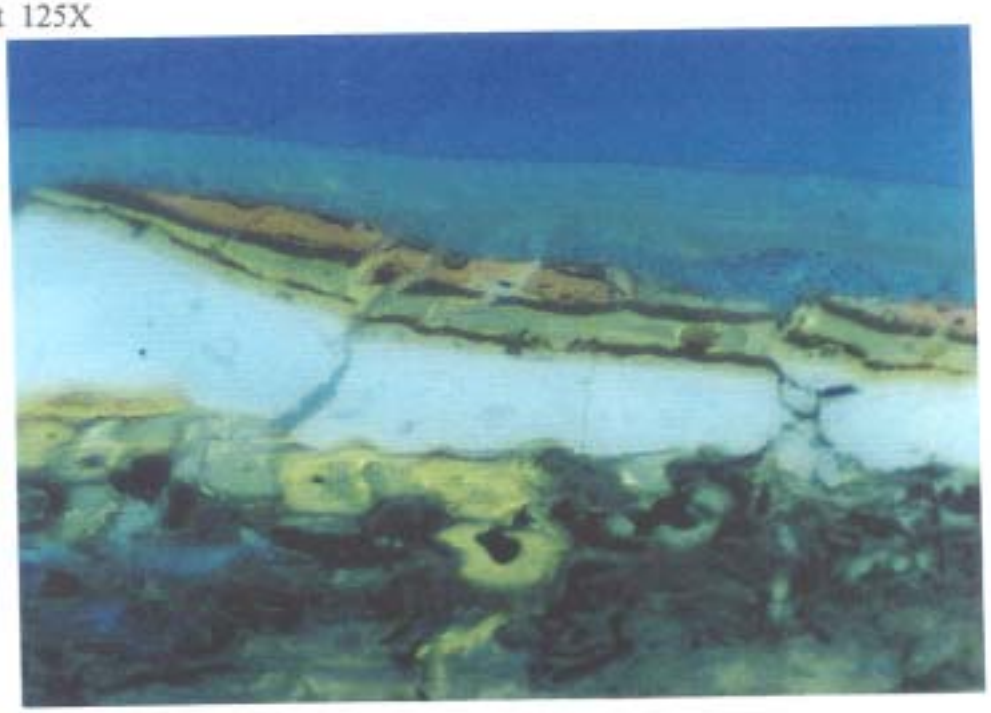
Layer	Generation
Thick white paint	10
Cream color	9
Black paint*	8
Fragments of bright green paint	7
Turquoise blue paint	6
Shellac	5
Thin red-brown paint	4
Plant resin varnish	3
Brown glaze	3
Yellow base coat	3
White primer	3
Thick cream-colored filler	3
Tan-orange finish coat	2
White primer	2
Generation 1 gray paint missing*	
Blackened wood substrate	

* Not visible in the photomicrograph but present in the uncast sample.

Sample 108 – East Wing Kitchen/Base NE facing, later.

Visible Light 125X

Ultraviolet Light 125X



Sample 201 – East Wing Southwest Room/Sash (12/8) NE, 1834-mid1850s. The evidence in this cross-section indicates the sampled area of sash does not retain early paint evidence. This may be due to the paint having been scraped off as there is an off-white paint (perhaps a primer) trapped in the wood fibers, but this paint is not present as an intact layer above the wood. The wood substrate also has a weathered appearance, suggesting it was left unpainted for a long period of time. There are five generations of modern, finely ground, nonfluorescent paint layers above the wood substrate.

Sample 201 – East Wing Southwest Room/Sash (12/8) NE, 1834-mid1850s

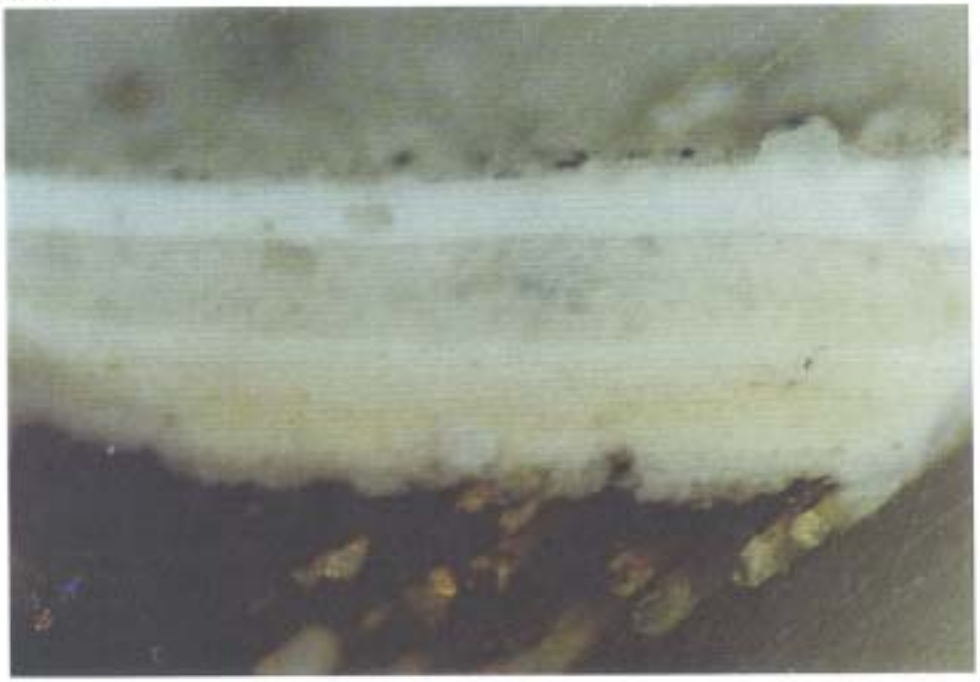
Visible Light 125X

Ultraviolet Light 125X

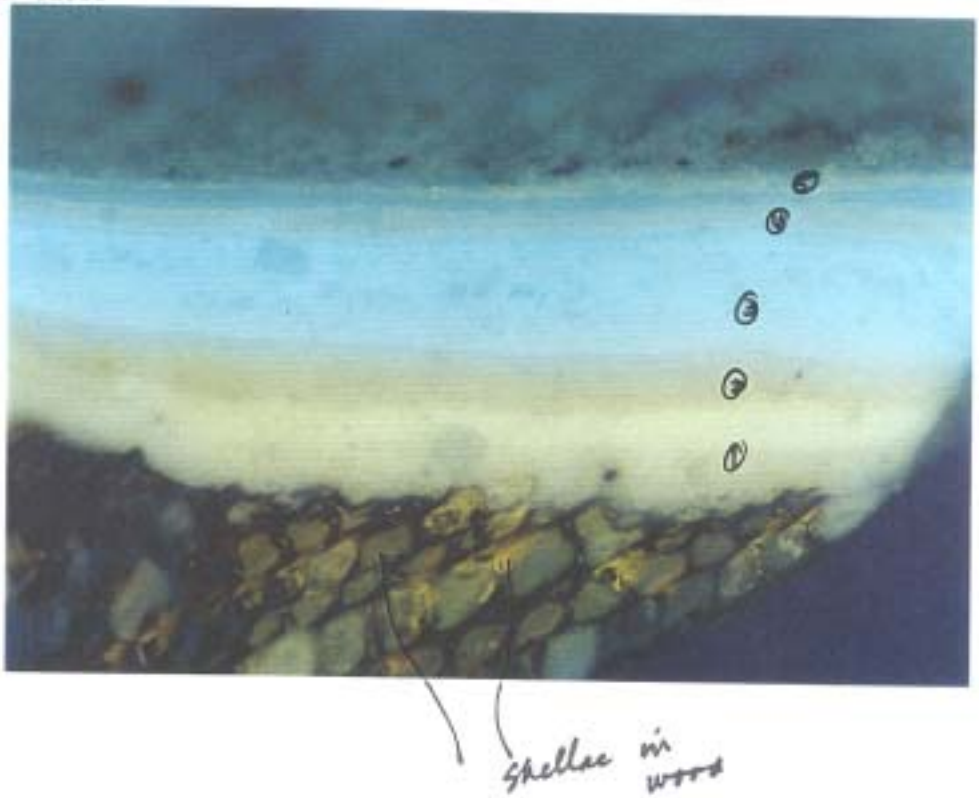
Sample 202 – East Wing East Room/Base @ Dividing Wall W, 1834-mid 1850s. This sample contains five generations of paint above a wood substrate that was sealed with shellac before painting. The first layer above the wood is a cream color followed by four generations of off-white. There is no clear evidence that earlier coatings have been removed, but the five paint layers appear surprisingly clean and unweathered for the projected age of this element. Compared to other samples taken from the second floor, this cross-section sample contains considerably fewer paint generations, but the first two oilbound paint layers in this sample do appear similar to the early paints found on other base elements examined in this study.

Sample 202 – East Wing East Room/Base @ Dividing Wall W, 1834-mid 1850s.

Visible Light 125X



Ultraviolet Light 125X



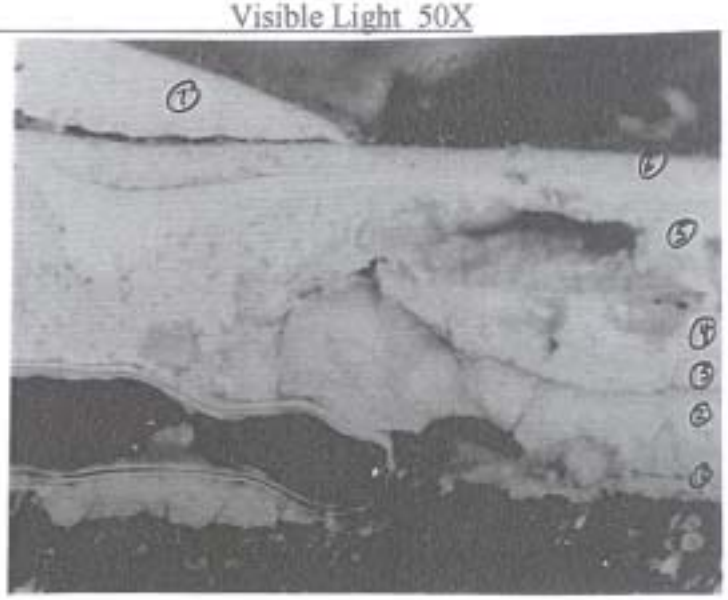
Sample 203 – South Wing South Room/Door Trim SE facing, late Victorian. There are seven generations of paint on the door trim, beginning with a cream-colored paint, followed by six generations of white and off-white paint. It is somewhat difficult to distinguish between these layers in visible light, but the layers have distinctive autofluorescence colors in ultraviolet light that makes them more decipherable. The earliest layer appears to be a traditional oilbound paint. The paint sequence is disrupted as though the trim had been partially scraped before applying the fifth generation off-white paint.

When this paint sequence is compared to sample 202, it appears that the first generation cream color in this sample lines up with the second generation cream color in sample 202, a base identified as dating from 1834 to the 1850s.

Sample 203 Paint Sequence

Layer	Generation
White (dark in the UV)	7
White (dark in the UV)	6
Off-white (dull autofluorescence)	5
Off-white (dull autofluorescence)	4
Light cream color (dull autofluorescence)	3
Off-white (sparkly blue autofluorescence)	2
Cream colored paint (yellowish autofluorescence)	1
Shellac sealant	
Wood	

Visible Light 50X



Sample 203 – South Wing South Room/Door Trim SE facing, late Victorian

Visible Light 125X

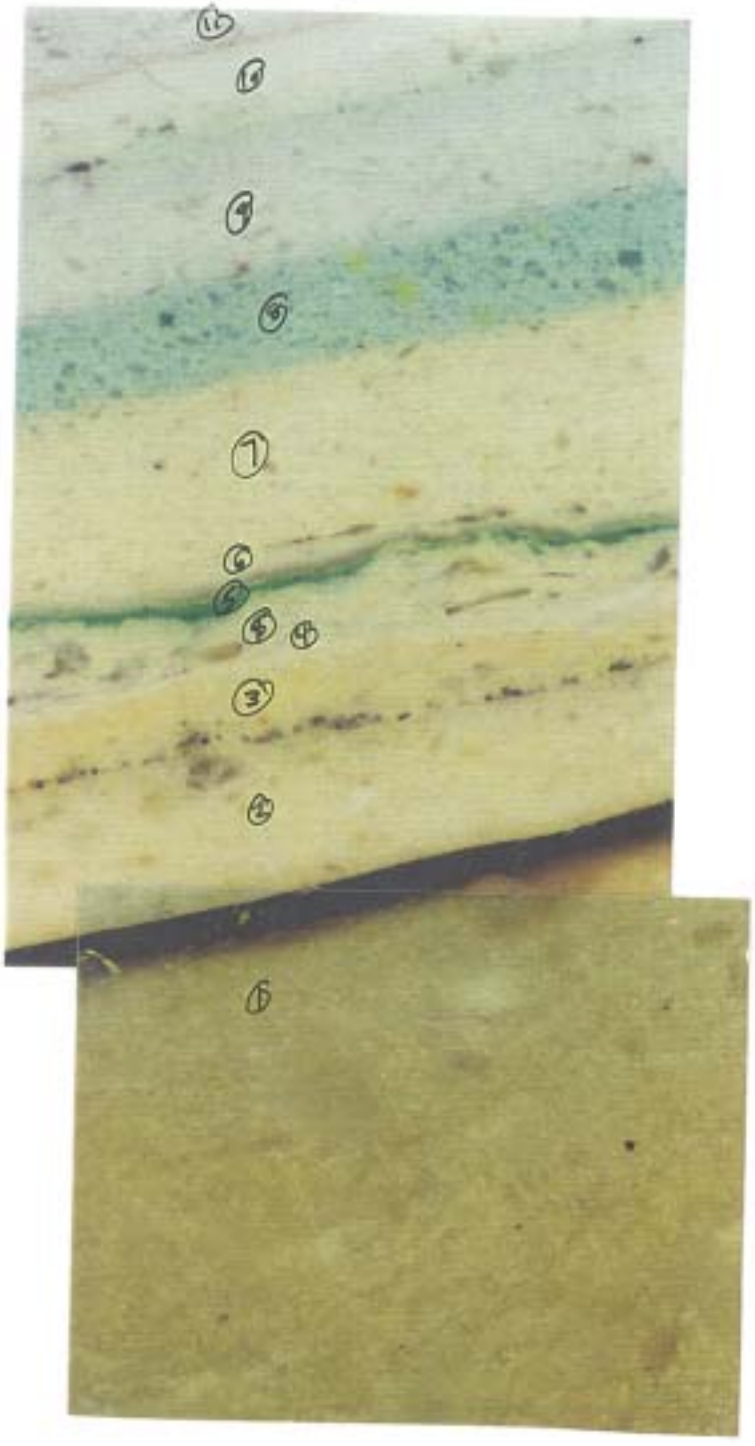
Ultraviolet Light 125X

Sample 204 – South Wing South Room/Base SE, late Victorian. The cross-section from the base contains approximately twelve generations of paint, but the paint layers on this base element do not appear to relate to the paints found on the door trim (sample 203) or on the sash (sample 205). The sequence begins with a thick cream-colored paint layer, which has a varnish coating. The second and third generations are also cream-colored paints, followed by a coarse off-white paint. Generations five (bright green) through twelve (white) appear to be comparatively modern, finely ground, nonfluorescent paint layers.

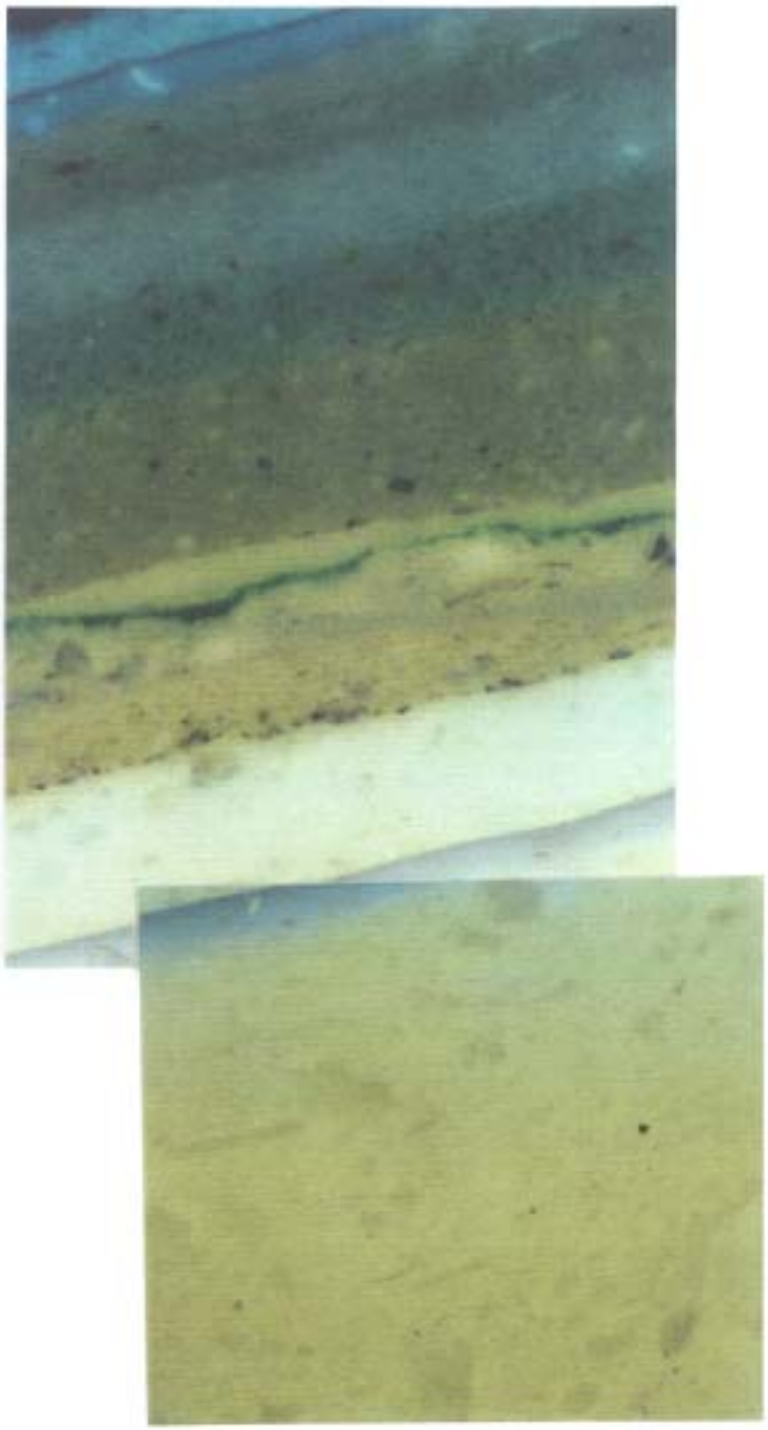
Sample 204 Visible Light 50X

Sample 204 – South Wing South Room/Base SE, late Victorian

Visible Light 125X

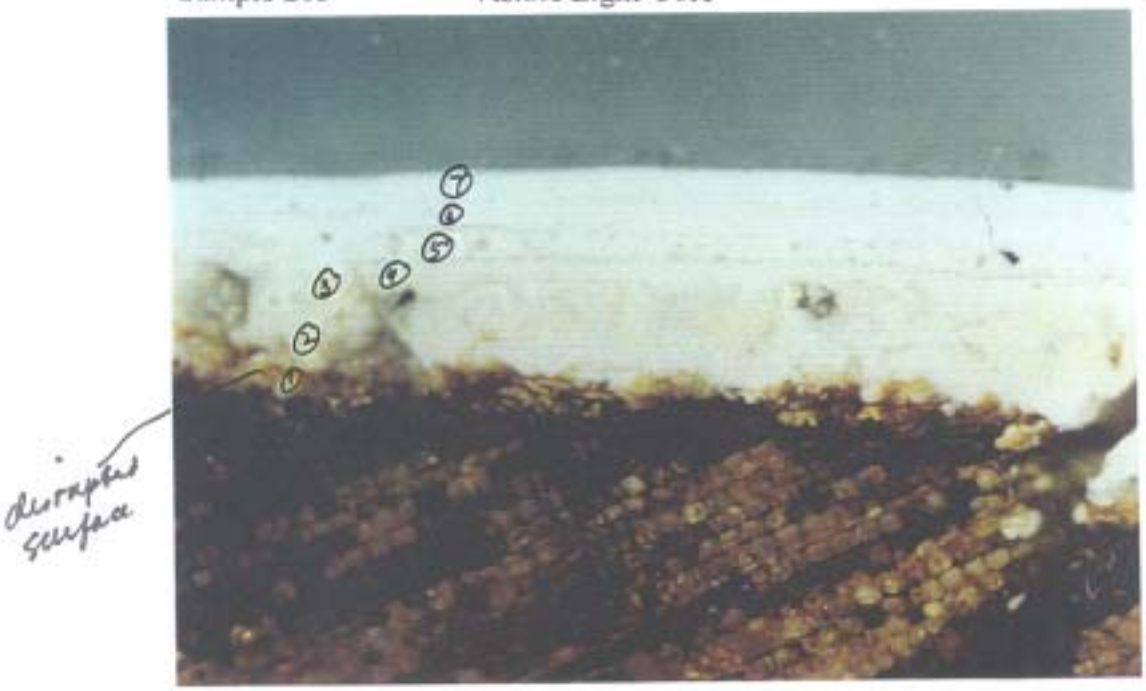


Ultraviolet Light 125X



Sample 205 – South Wing South Room/Sash (6/6) SE, late Victorian. The wood substrate in this sample is slightly disrupted and uneven, suggesting the early paints may have been partially scraped away. Despite this disruption, there is fragmentary evidence that the sash was first painted with the same cream-colored paint identified in sample 203 from the door trim. When the paint histories in samples 203 and 205 are aligned, it appears these two elements were painted the same colors each time the room was repainted.

Sample 205 Visible Light 50X



Sample 205 – South Wing South Room/Sash (6/6) SE, late Victorian

Visible Light 125X

Ultraviolet Light 125X

Sample 206 – South Wing North Room/4 panel door NW, 1834? The cross-section from the north room door appears to represent a complete paint history with eight generations of paint. The paint sequence begins with a leanly oilbound cream-colored paint layer that is similar to the first cream-colored paint layer in sample 202 from the east wing (dated 1834-1850s). The second paint generation is off-white, followed by white paint in the third generation. The fourth generation appears to be a graining treatment similar to the graining identified as the fifth paint generation in sample 106, taken from a late Victorian door frame on the first floor.

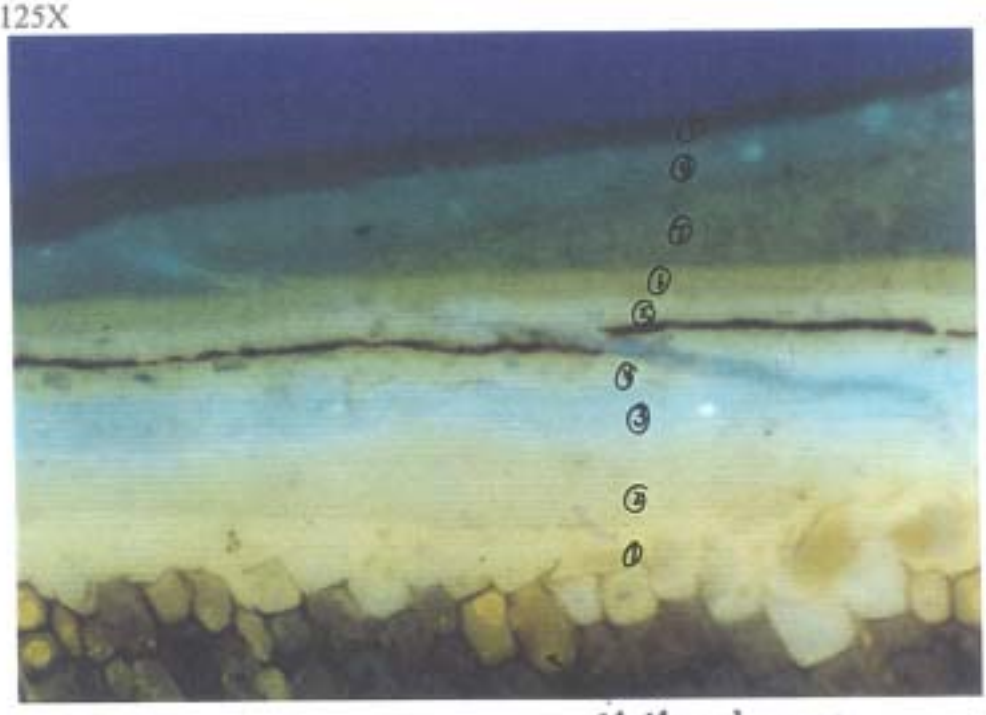
Sample 206 Paint Sequence

Layer	Generation
Modern white paint	8
Modern white paint	7
Modern white paint	6
Cream-colored finish coat	5
Off-white primer	5
Reddish-brown glaze	4
Yellow base coat	4
White paint	3
Off-white paint	2
Cream-colored paint	1
Shellac sealant	1
Wood	

Sample 206 – South Wing North Room/4 panel door NW, 1834?

Visible Light 125X

Ultraviolet Light 125X



Exterior Samples

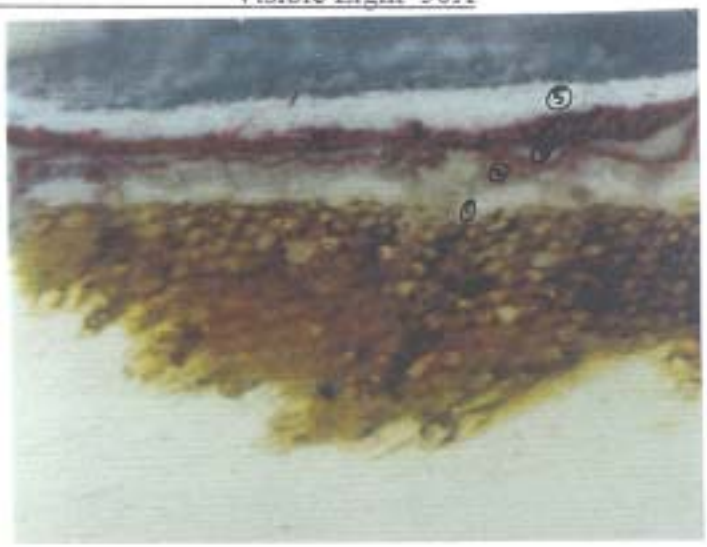
Sample E01: South Wing First Floor/Southeast Sash SE, 1834. It is generally difficult to obtain sash samples with complete paint sequences, in part due to the extreme weathering and condensation conditions which sashes are exposed to, and in part because the paint layers on sashes in regular use tend to be abraded or to flake off because of movement of the wood substrate. This sash sample contains only five generations of paint, which is not enough to represent a full exterior paint sequence from 1834, particularly when compared to the more intact paint sequence in sample E04 from the arch column with sixteen generations of paint. The arch column was identified by Eloise Marinos as a later architectural element.

The first generation of paint in this sample is off-white, which does appear consistent with the earliest paints found in sample E05 from an east wing upper sash. Sample E05 contains eleven generations of paint, and importantly, the second, third and fourth generation paints in sample E01 line up with the third, fifth and seventh paint generations in sample E05.

Sample E01 Paint Sequence

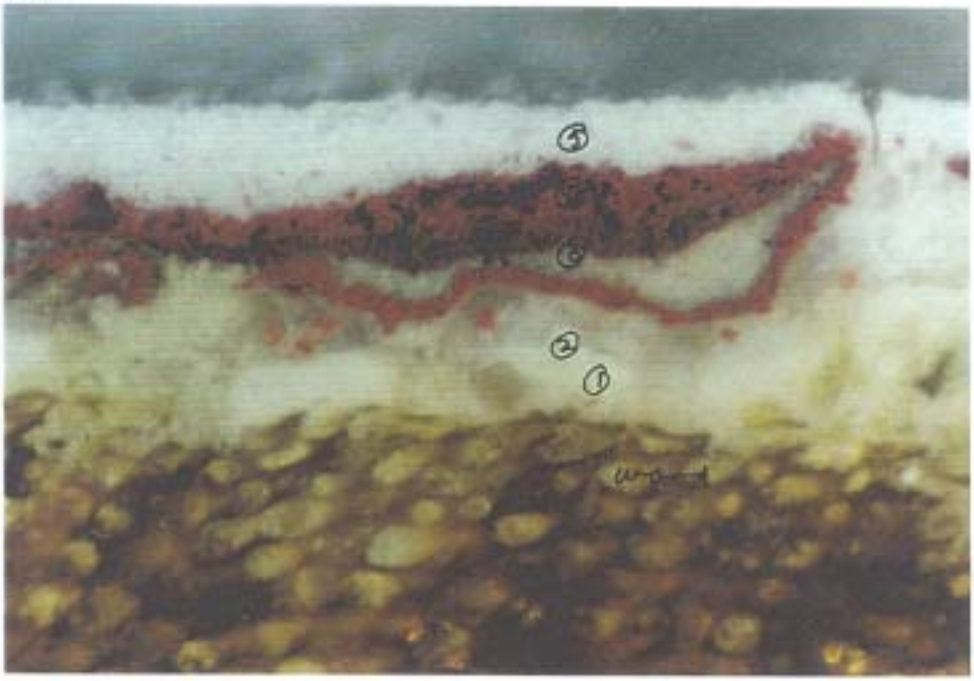
Layer	Generation
Modern white paint	5
Thin dark red	4
Thin dark red-brown paint	3
Off-white primer	3
Thin dark red paint	2
Off-white primer	2
Fragmented off-white layer	1
Wood	

Visible Light 50X



Sample E01: *South Wing First Floor/Southeast Sash SE, 1834.*

Visible Light 125X



Ultraviolet Light 125X

Sample E02: South Wing First Floor/Southeast Window Frame SE, 1834. The evidence in this cross-section suggests there is no early paint remaining on this element, but there does appear to be residues of an early resinous coating on the wood. The surface of the wood substrate is darkened, dirty and there are mold spores trapped in the resinous coating. Perhaps this resinous coating (a plant resin varnish) was applied as a sealant or a waterproofing agent before the frame was painted. The cross-section evidence indicates the early paint on this window frame weathered completely away and the window frame was left unpainted for a long period of time. There are remnants of a more recent off-white paint, followed by a pinkish-tan paint, and then a modern white paint layer with an off-white primer as the current coating.

Sample E02 Visible Light 50X

Sample E02: South Wing First Floor/Southeast Window Frame SE, 1834

Visible Light 125X

Ultraviolet Light 125X

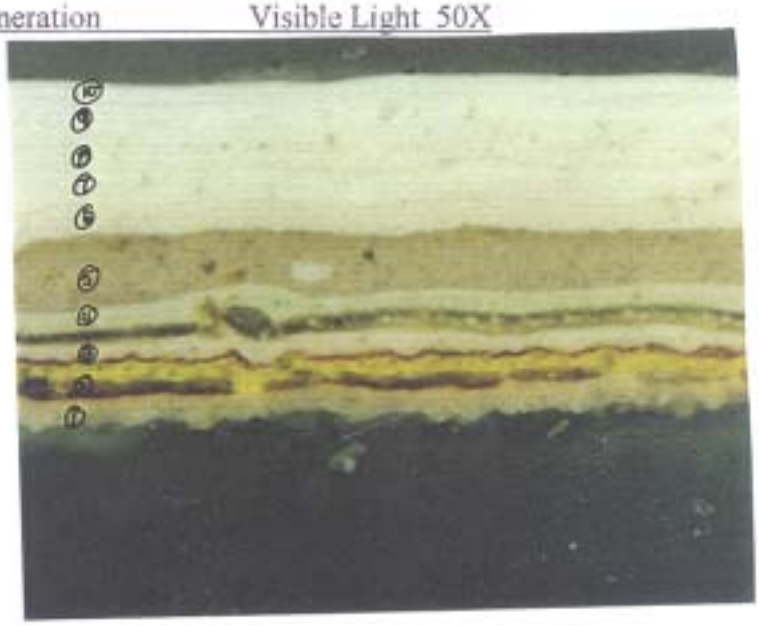
Sample E03: East Wing First Floor/Kitchen Door Jamb Panel SE, 1834. This cross-section contains ten generations of paint, beginning with graining treatments in the first and second generation. The first generation consists of an off-white primer, a pinkish base coat, a brown glaze and a plant resin varnish coating. This could represent a graining treatment to imitate a wood such as mahogany or cedar. The second graining treatment has a yellow base coat, a red-brown glaze and a plant resin varnish coating, and it may be an imitation of a lighter colored wood such as oak.

Generations five through ten appear to be modern paints as the pigments are finely ground and evenly dispersed, and the layers are nonfluorescent in reflected ultraviolet light.

Sample E03 Paint Sequence

Layer	Generation
White	10
White	9
White	8
White	7
White finish coat	6
Off-white primer	6
Thick pinkish tan paint	5
Off-white paint	4
Plant resin varnish	3
Off-white paint	3
Plant resin varnish	2
Red-brown glaze	2
Yellow base coat	2
Plant resin varnish	1
Brown glaze	1
Pinkish base coat	1
Off-white primer	1
Wood	

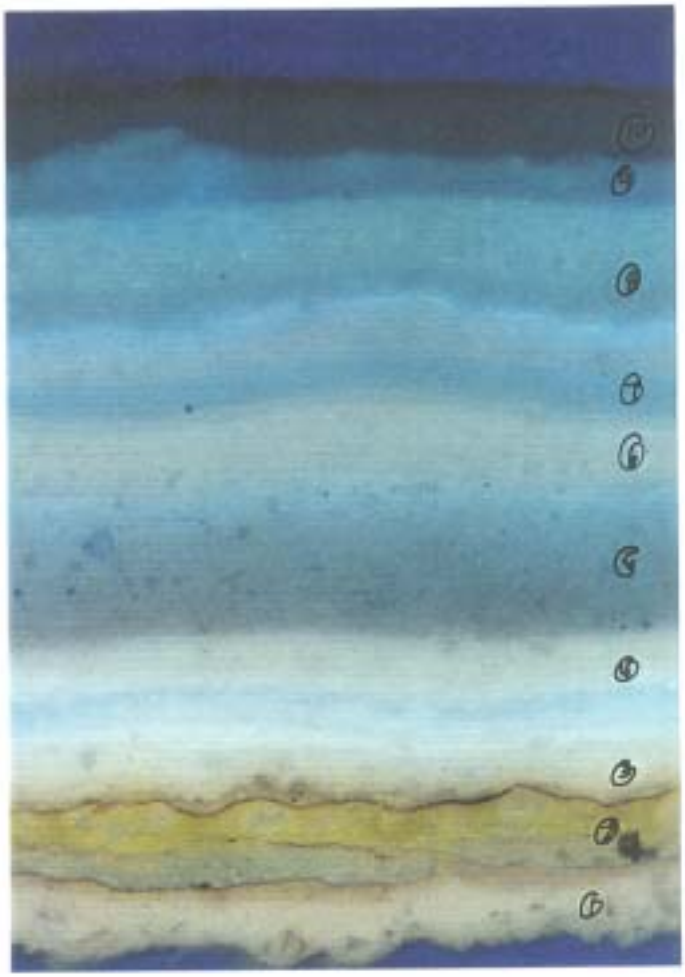
Visible Light 50X



Sample E03: East Wing First Floor/Kitchen Door Jamb Panel SE, 1834

Visible Light 125X

Ultraviolet Light 125X



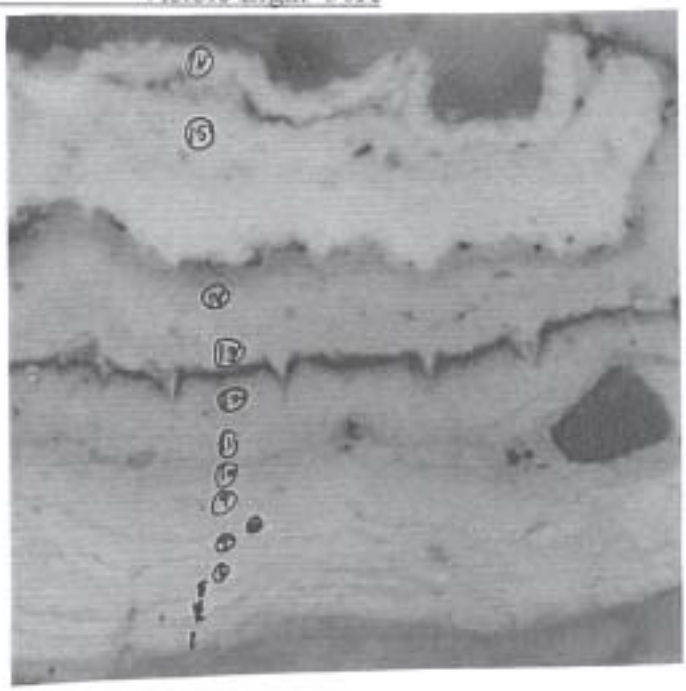
Sample E04: East Wing First Floor/Arch Column SE, later. The column was identified by Eloise Marinos as being a later element, yet the paint history in the cross-section from the column contains considerably more paint layers than the other five exterior elements sampled for this study. There are approximately sixteen generations of paint beginning with nine generations of white and off-white paint.

The only comparatively early paint layer that can be lined up with the paint sequence in sample E03 from the 1834 kitchen door jamb is the coarse off-white paint in generation 11 in sample E04. This appears to be the same layer (with a sparkly appearance in the UV) as the off-white paint identified as generation 4 in sample E03. This suggests there are many earlier paint layers missing from sample E03 since the kitchen door jamb presumably predates the column, it should contain more early paint layers.

Sample E04 Paint Sequence

Layer	Generation
Modern white paint	16
Thick modern white paint	15
Coarse white paint	14
Peach color paint	13
Varnish	12
Thick, coarse cream color paint	12
Coarse off-white paint*	11
Thin cream color paint	10
Thick cream color paint	9
Off-white paint	8
Thin off-white paint	7
Thin off-white paint	6
Thin white paint	5
Thin white paint	4
Thin white paint	3
Thin off-white paint	2
Thin white paint	

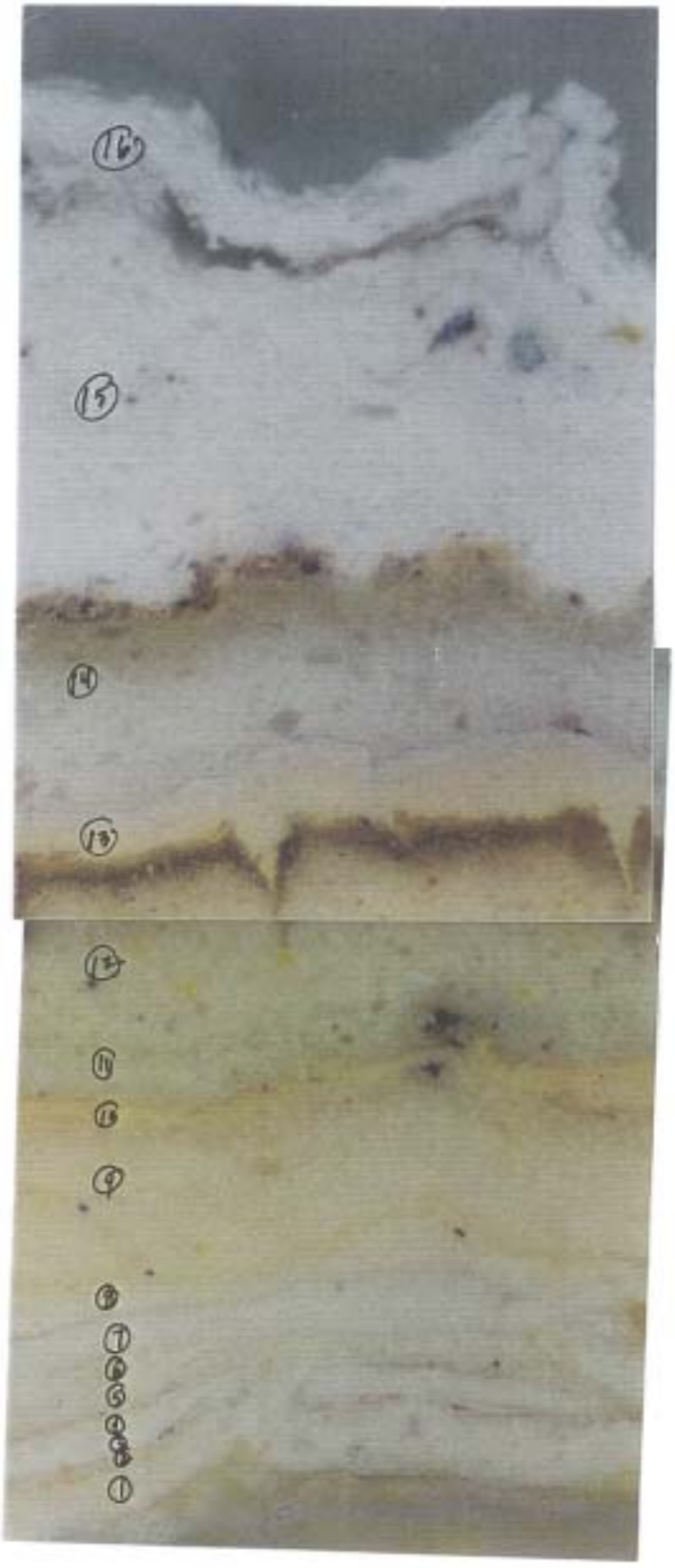
Visible Light 50X



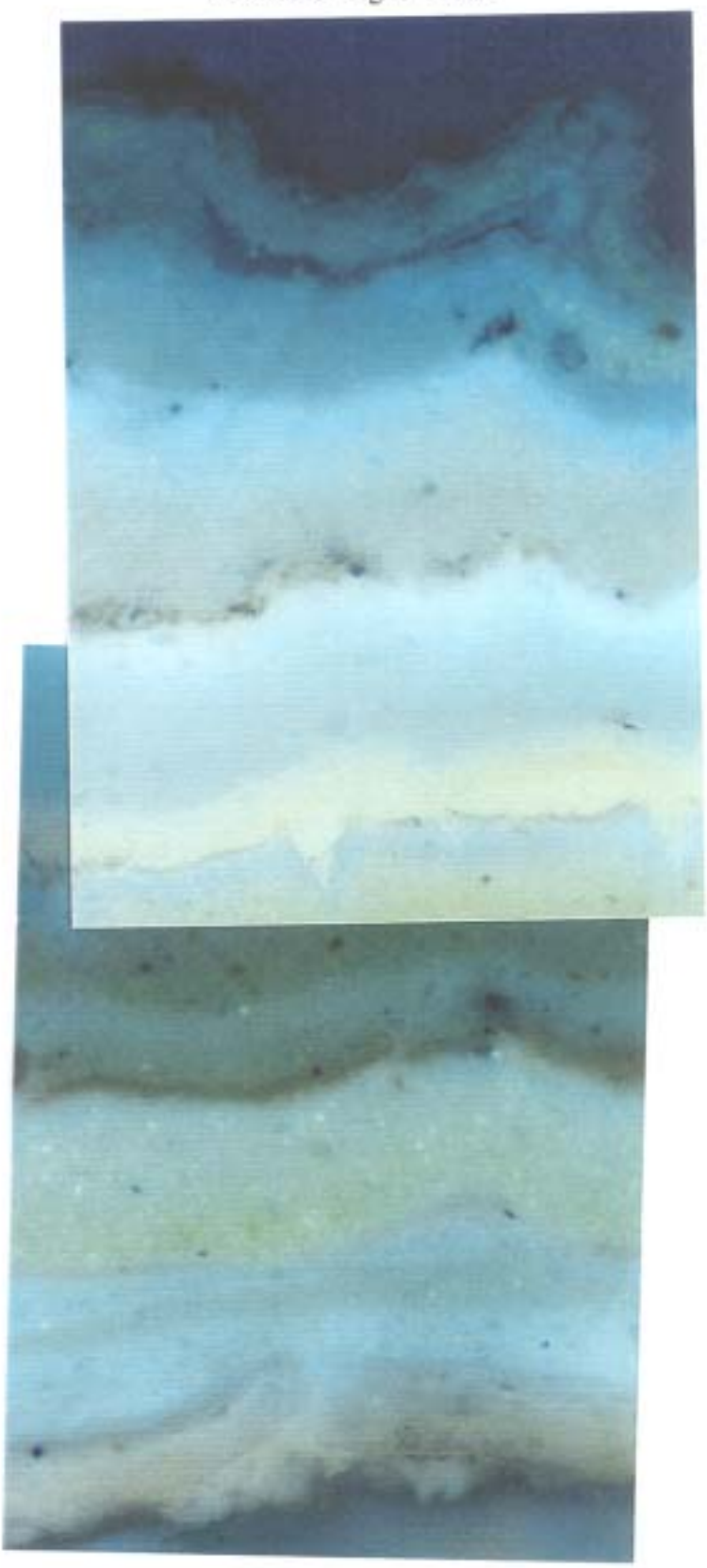
* Lines up with generation 4 in sample E03 from the door jamb panel.

Sample E04: East Wing First Floor/Arch Column SE, later.

Visible Light 125X



Ultraviolet Light 125X



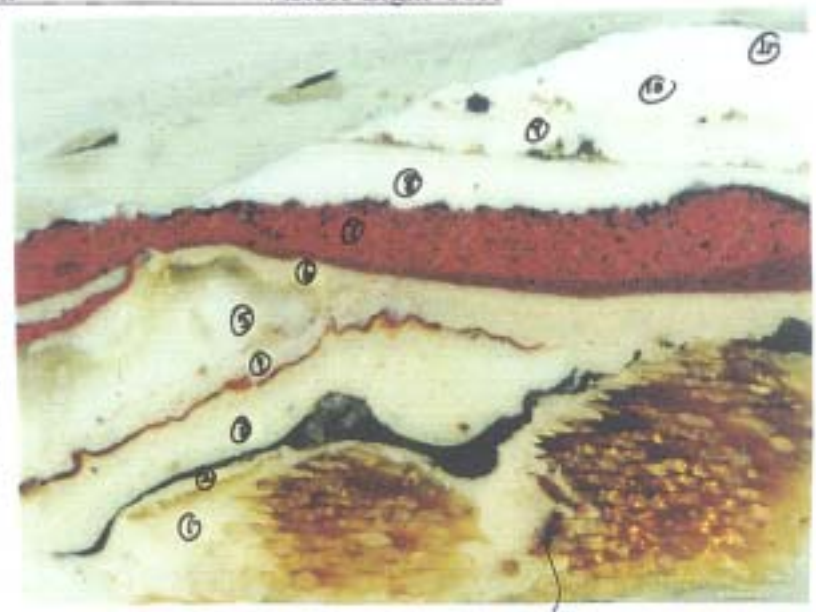
Sample E05: East Wing Second Floor/Upper Sash (12/8) SE 1834-mid 1850's. This sample contains approximately eleven generations of paint, beginning with what appears to be a remnant of the first off-white paint layer with a thin plant resin varnish layer that is trapped in a recess in the wood. The varnish may have been added to increase the durability of the paint surface, as well as to increase the level of gloss. This may be the original paint treatment on the sash, but because of the disturbed nature of the wood substrate, it is difficult to say with certainty that the original paint from the period of 1834 to the mid 1850s survives here. There also seem to be bits of the same type of resinous sealant or varnish trapped in the wood fibers that was found in sample E02 from a south wing window frame.

In the second generation it appears the sash was painted black over a cream-colored primer. The third generation consists of a reddish-brown glaze over cream-colored primer. The sash was also painted red-brown in the sixth and seventh generations. This is the only sample from an exterior frame or sash that provides enough information for color matching. The color match for the first off-white colored paint is included at the end of this report.

Sample E05 Paint Sequence

Layer	Generation
Modern white paint	11
Modern white paint	10
Modern white paint	9
Modern white paint	8
Thick, coarse red-brown paint	7
Red-brown finish coat	6
Cream-colored base coat	6
Plant resin varnish coating	5
White paint	5
Cream-colored paint	4
Red-brown glaze	3
Off-white base coat	3
Black finish coat	2
Cream-colored primer	2
Thin plant resin varnish	1
Off-white paint	1
Resinous coating or sealant	1
Wood	

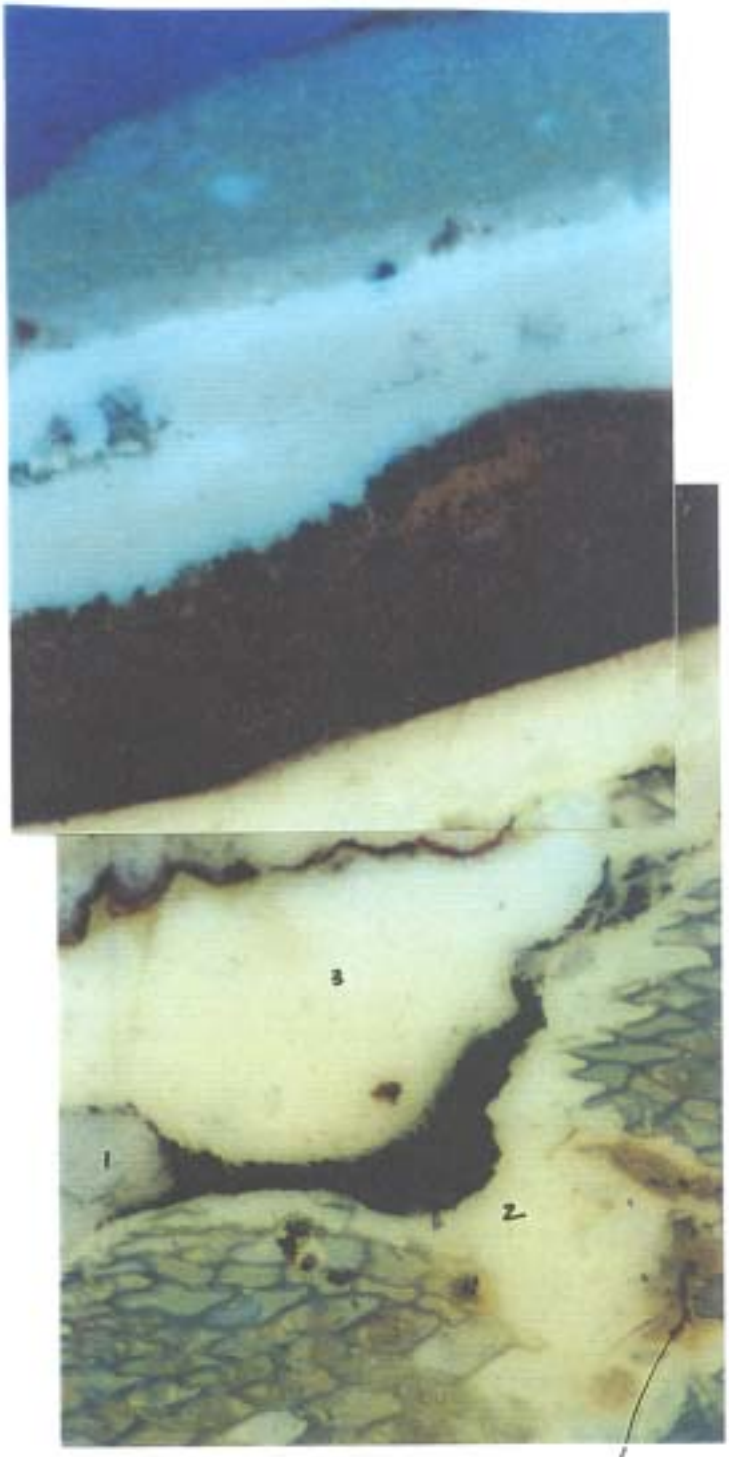
Visible Light 50X



Sample E05: East Wing Second Floor/Upper Sash (12/8) SE 1834-mid 1850's.

Visible Light 125X

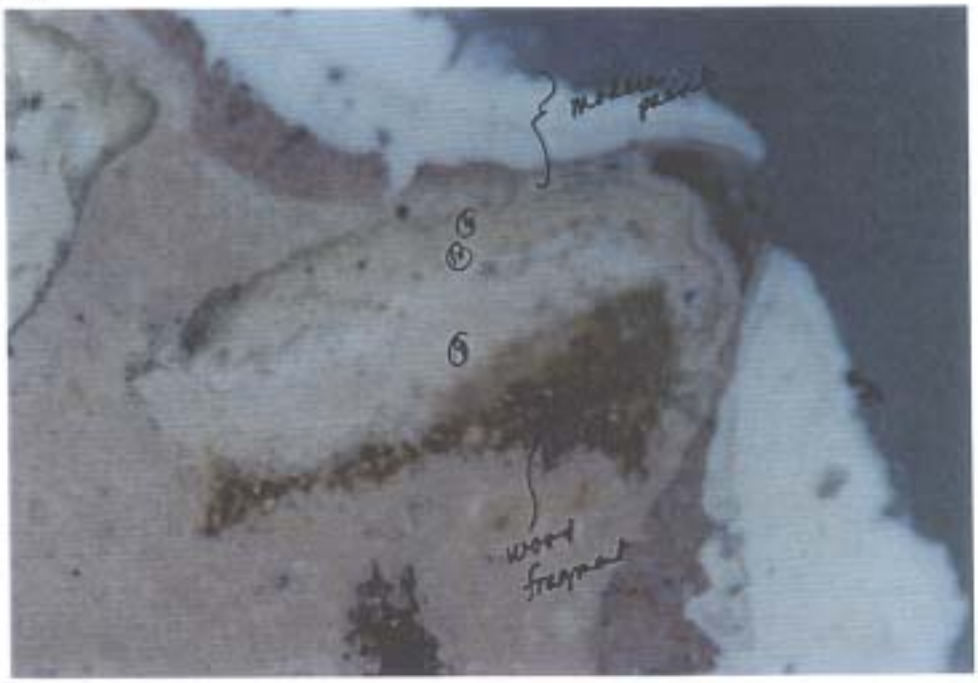
Ultraviolet Light 125X



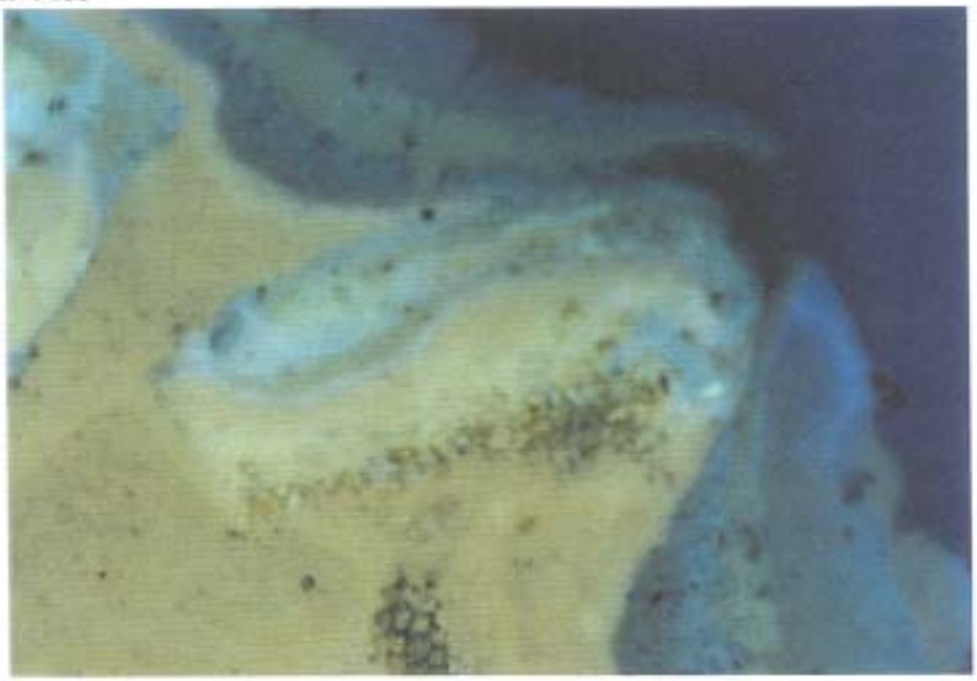
Sample E06: East Wing Second Floor/Window Frame SE, 1834-mid 1850's. The paint sequence on the window frame is disrupted and discontinuous. When the paint sequence in this sample is compared to sample E04 it appears that generations 9, 10 and 11 are preserved above a fragment of wood surrounded by modern paints. This sample does not provide helpful information about the early paint history of this window frame on the east wing.

Sample E06: East Wing Second Floor/Window Frame SE, 1834-mid 1850's.

Visible Light 50X



Ultraviolet Light 50X



COLOR MATCHING

Sample E05 – East Wing Second Floor/Upper Sash SE 1834-mid 1850s

Benjamin Moore # 941

Color System*	Coordinates		
	Hue	Value	Chroma
Munsell	6.3Y	8.6	1.9
	Black to White	Green to Red	Blue to Yellow
CIE L*a*b*	L*86.52	a*-2.53	b*+13.74

This match was made by eye as the first surviving off-white paint layer was too tiny to fit into the 0.3mm measurement area of the color measurement instrument. The evidence suggests the first surviving paint layer on this sash was originally glossy, based on the presence of a thin plant resin varnish coating.

Benjamin Moore # 941

Conclusion

This small group of samples from six exterior elements suggests there is very little early paint evidence surviving on the areas of both wings sampled for this analysis project. The most complete sample containing sixteen generations of paint was taken from an element Eloise Marinos identified as "later". Future sampling for exterior trim paints might include other protected (but less accessible) locations, such as the soffit of the cornice, where the paints could have been more protected from weathering, and are less apt to be stripped or sanded prior to repainting. Despite the disrupted paint evidence on the windows, it appears the earliest off-white paint layer still remains in sample E05.

The interior paints analyzed for this project do not conclusively answer the question of whether the two wings are contemporary. The most intact sample from the south wing is sample 101 with nine paint generations, while sample 202 from the east wing contains five paint generations. It is difficult to relate the first and second floor paints from the two wings, in part due to the limited survival of full paint chronologies, but also, because the first and second floors do not appear to have been repainted as the same times. More extensive sampling of similar elements in both wings, on both floors, may help to more conclusively date the two wings and the alterations.

Pigment analysis was not conducted during this phase of initial paint research, but should be considered for any future paint analysis work. This analysis will contribute to a more complete understanding of the composition of the various paint layers found on the building.

The following chart summarizes the paint sequences identified in the samples, and where possible, notes relationships between the paints on different elements in the various spaces.

Interior Paint Samples

Sample #	Date	Paint History
101	1834	Nine paint generations beginning with off-white.
102	1834	Seven paint generations, lines up with sample 101 but missing generations 4 and 5.
103	1834	Six paint generations, lines up with sample 101 but missing generations 4, 5 and 6.
104	1834	Five paint generations, lines up with sample 101, but missing generations 4, 5, 8, 9.
105	Late Victorian	Disrupted sample, earliest finish appears to be plant resin varnish.
106	Late Victorian	Eleven paint generations, beginning with cream-colored paint. The fifth generation graining layer appears to line up with the fourth generation layer in sample 206 from the four-panel door in the south wing north room.
107	Later	Nine paint generations. Begins with gray paint, which relates to the sixth generation gray in samples 101 and 102.
108	Later	Charred substrate, lines up with generations 2 through 9 in sample 107.

201	1834-1850s	Stripped surface, no early paint layers.
202	1834-1850s	Five paint generations, beginning with a cream-colored paint
203	Late Victorian	Six paint generations beginning with a cream-colored paint that could line up with the second-generation paint in sample 202.
204	Late Victorian	Eleven paint generations beginning with a thick cream color paint and varnish.
205	Late Victorian	Seven paint generations, possibly beginning with the same cream-colored paint identified as the first generation paint in sample 203.
206	1834?	Eight paint generations beginning with a cream-colored paint. The fourth generation graining may line up with the fifth generation graining in sample 106, a late Victorian door on the first floor.

Exterior Paint Samples

Sample #	Date	Paint History
E01	1834	Incomplete sequence, begins with off-white paint. The second, third and fourth generations in this sample line up with the third, fifth and seventh generations in sample E05.
E02	1834	Remnants of a resinous sealant or coating on the wood, but early paint evidence does not survive.
E03	1834	Ten paint generations beginning with a graining treatment, possibly to imitate mahogany.
E04	Late	Sixteen generations of paint, beginning with a thin white paint.
E05	1834-mid 1850s	Eleven generations of paint beginning with a cream-colored paint with a plant resin varnish. The third, fifth and seventh generations in this sample line up with the second, third and fourth generation paints in sample E01.
E06	1834-mid 1850s	No coherent paint history remains.

APPENDIX

COLOR MEASUREMENT PROCEDURES

The target layer for color matching was identified through the cross-section analysis of the cast paint samples, but the measurements were made using an uncast portion of the sample that was carefully examined under a binocular microscope to locate clean, relatively even areas for matching. The measurements for color matches were made with a Minolta Chroma Meter CR-241, a tristimulus color analyzer that has an internal, 360-degree pulsed xenon arc lamp and provides an accurate color measurement in a choice of five different three-coordinate color systems. Its focus area of 0.3mm allows measurement of extremely small paint samples.

Measurements were first generated in the Munsell color system (a color standard used in the Architectural Preservation field), and then in the CIE L*a*b* color space system, currently one of the most widely accepted industry color measuring systems.

The Munsell measurements were then compared to the values of the closest Munsell color swatches in the standard Munsell Book of Color (gloss paint standards). The match was then double-checked by eye by comparing the Munsell swatches with the paint samples under 30X magnification. The closest Munsell swatches were then compared by eye with a range of the closest commercial color swatches in the master catalogs for Benjamin Moore and/or Sherwin-Williams paints. The Chroma Meter was then employed to zero in on the commercial swatch with the closest Munsell and CIE L*a*b* values. All measurements are provided in the report and closest commercial paint color swatches are supplied for each target paint layer.

*** COLOR SYSTEMS – Derived from the Minolta CR-241 Instruction Manual and Minolta Precise Color Communication**

Chroma Meter CR-241 offers five different color systems for measuring absolute chromaticity: CIE Yxy (1931), L*a*b* (1976), and L*C*H* (1976) colorimetric densities DxDyDz; Munsell notation and four systems for measuring color differences.

For two colors to match, three quantities defining color must be identical. These three quantities are called tristimulus values X, Y, and Z as determined by CIE (Commission Internationale de l'Eclairage) in 1931.

Color as perceived has three dimensions: hue, chroma and lightness. Chromaticity includes hue and chroma (saturation), specified by two chromaticity coordinates. Since these two coordinates cannot describe a color completely, a lightness factor must also be included to identify a specimen color precisely.

Munsell Color System: The Munsell color system consists of a series of color charts which are intended to be used for visual comparison with the specimen. Colors are defined in terms of the Munsell Hues (H; indicates hue), Munsell Value (V; indicates lightness), and Munsell Chroma (C; indicates saturation) and written as H V/C.

CIE Yxy (CIE 1931): In the Yxy (CIE 1931) color system, Y is a lightness factor expressed as a percentage based on a perfect reflectance of 100%, x and y are the chromaticity coordinates of the CIE x, y Chromaticity Diagram.

CIE L*a*b*: Equal distances in the CIE x,y Chromaticity Diagram do not represent equal differences in color as perceived. The CIE L*a*b* color system, however, more closely represents human sensitivity to color…Equal distances in this system approximately equal perceived color differences. L* is the lightness variable; a* and b* are the chromaticity coordinates

ΔE: ΔE (Delta E) is the industry measure used to determine how closely two colors match in the CIE L*a*b*. The symbol Δ means "the change in". It is based on calculating the sum of the differences between each measure. The calculation is: $\Delta E = \sqrt{(\Delta L^*)^2 + (\Delta a^*)^2 + (\Delta b^*)^2}$ or, the color difference equals the square root of the squared sums of the differences between each of the three L* a* b* tristimulus values. Industry color standards indicate a ΔE of 1 is barely perceptible to the human eye, and ΔE of 6 to 7 is acceptable for color matches in the printing industry.

REFERENCES

Cross-section Preparation Procedures:

The samples were cast in mini-cubes of polyester resin (Excel Technologies, Inc., Enfield, CT). The resin was allowed to cure for 24 hours at room temperature and under ambient light. The cubes were then ground to expose the cross-sections, and dry polished with 400 and 600 grit wet-dry papers and Micro-Mesh polishing cloths, with grits from 1500 to 12,000.

The cross-section samples were examined under visible and ultraviolet light using an Olympus BHT Series 2 ultraviolet light microscope at 125X and 250X magnifications. The samples were also stained with four fluorescent stains to characterize the binding media in the various layers and to provide a better comparison between the different materials present in the layers.

The following fluorescent stains were used for examination of the samples:

> Fluorescein isothiocyanate (FITC) 0.2% in anhydrous acetone to identify the presence of proteins. Positive reaction color is yellow-green.
>
> Triphenyl tetrazolium chloride (TTC) 4.0% in ethanol to identify the presence of carbohydrates (starches, gums, sugars). Positive reaction color is dark red or brown.
>
> 2, 7 Dichlorofluorescein (DCF) 0.2% in ethanol to identify the presence of saturated and unsaturated lipids (oils). Positive reaction for saturated lipids is pink and unsaturated lipids is yellow.
>
> Rhodamine B (RHOB) 0.06% in ethanol to identify the presence of oils. Positive reaction color is bright orange.

The cross-sections were photographed with Kodacolor Gold Plus ASA 200 color print film, and the resulting photographs were labeled and laid out in sequence to allow direct visual comparisons. The best cross-section photographs for each area were mounted and labeled and are included with this report. Photographs were taken at 125X and 250X, and all the UV photographs were taken with the UV filter in place (300 to 400 nanometers excitation with a 420 nm. barrier filter).

Information Provided by Ultraviolet Light Microscopy:

When viewed under visible light, cross-sections which contain ground, paint and varnish may often be difficult to interpret, particularly because clear finish layers look uniformly brown or tan. It may be impossible using only visible light to distinguish between multiple varnish layers. Illumination with ultraviolet light provides considerably more

information about the layers present in a sample because different organic, and some inorganic, materials autofluoresce (or glow) with characteristic colors.

There are certain fluorescence colors which indicate the presence of specific types of materials. For example: shellac fluoresces orange (or yellow-orange) when exposed to ultraviolet light, while plant resin varnishes (typically amber, copal, sandarac and mastic) fluoresce bright white. Wax does not usually fluoresce; in fact, in the ultraviolet it tends to appear almost the same color as the polyester casting resin. In visible light wax appears as a somewhat translucent white layer. Paints and glaze layers which contain resins as part of the binding medium will also fluoresce under ultraviolet light at high magnifications. Other materials such as lead white, titanium white and hide glue also have a whitish autofluorescence.

There are other indicators which show that a surface has aged, such as cracks which extend through finish layers, accumulations of dirt between layers, and sometimes a diminished fluorescence intensity, especially along the top edge of a surface which has been exposed to light and air for a long period of time.

ELOISE MARINOS
ARCHITECT
AIA ● NCARB

THE CAPTAIN OLIVER FILLEY HOUSE
Bloomfield, CT
No: 98-200
Paint Samples List - 20 Total

Collected: 5/20/99 U.O.N.
By: Eloise Marinos, AIA; Edward Stanley; Judith Sitkin
20 AUGUST 1999

SAMPLE NO.	LOCATION / DESCRIPTION - ORIENTATION	PERIOD (probable)
FIRST FLOOR INTERIOR SAMPLES:		
101	South Wing South Room / Base - NE corner	1834
102	South Wing South Room / Sash (6/6) - SE	1834
103	South Wing South Room / Window Trim - SW	1834
104	South Wing South Room / Mantel - NE	1834
105	Main Entry Stair / Rail - N	late Victorian
106	Main Entry Hall / Door Frame - SE	late Victorian
107	East Wing Kitchen / Door Frame - SE facing	later
108	East Wing Kitchen / Base - NE facing	later
SECOND FLOOR INTERIOR SAMPLES:		
201	East Wing Southwest Room / Sash (12/8) - NE	1834 -mid1850's
202	East Wing East Room / Base @ Dividing Wall - W	1834 -mid1850's
203	South Wing South Room / Door Trim - SE facing	late Victorian
204	South Wing South Room / Base - SE	late Victorian
205	South Wing South Room / Sash (6/6) - SE	late Victorian
206	South Wing North Room / 4 panel door - NW	1834 ?

P.O. BOX 303 ● NORTH CANTON, CONNECTICUT 06059 ● TEL. 860-693-9099

NO: 98-200 PAINT SAMPLES LIST
8/20/99

EXTERIOR SAMPLES - SOUTH ELEVATION:

E01	South Wing First Floor / Southeast Sash - SE (Collected 8/7/99)	1834
E02	South Wing First Floor/Southeast Window Frame-SE (Collected 8/7/99)	1834
E03	East Wing First Floor / Kitchen Door Jamb Panel-SE	1834
E04	East Wing First Floor / Arch Column - SE	later
E05	East Wing Second Floor / Upper Sash (12/8) - SE	1834 - mid 1850's
E06	East Wing Second Floor / Window Frame - SE	1834 - mid 1850's