

Cross-section Paint Microscopy Report

Room 100 Interior Paints Historic Sandusky, Lynchburg, Virginia

Funded by the Sackett-Graves Fund of the Greater Lynchburg Community Trust

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Room 100 Entry



Purpose:

The goal of this project is to use cross-section microscopy analysis to identify the sequence of coatings on the overpaint removal exposure on interior of the Entry door of ca. 1810-12 Historic Sandusky. The exposure was created by Chris Mills in July 2014, and the primary question was whether this door might have been oak grained to match the Parlor door during the 1849 interpretation period.

Procedures:

Travis McDonald visited the site with the author on December 12, 2014 to review the findings and discuss the areas for further sampling. The focus of this investigation was to sort out the chronologies in the Entry prior to repainting, but it was agreed that rooms 102, 104 and 105 would also be sampled while at the site. These samples will be saved for future research. All the samples were placed in labeled baggies after examination of the surfaces at 10X magnification with an illuminated loupe (Dermlite DL100).

At the lab, the baggies containing samples from four important locations in the entry were examined at 45X magnification under a binocular microscope to screen them for duplicates and to reduce the total number of samples analyzed to meet the budget constraints. The samples that retained the most complete stratigraphies were cast into polyester resin cubes for permanent mounting. The cubes were ground and polished for cross-section microscopy analysis and photography. The sample preparation methods and analytical procedures are described in the reference section of this report.

The cast samples were analyzed with a Nikon Eclipse 80i epi-fluorescence microscope equipped with an EXFO X-Cite 120 Fluorescence Illumination System fiberoptic halogen light source and a polarizing light base using SPOT Advanced software (v. 4.6) for digital image capture and Adobe Photoshop CS for digital image management. Digital images of the best representative cross-sections are included in this report. Please note that the colors in the digital images are affected by the variability of color capture and do not accurately represent the actual colors.

Background to Paint Research in Room 100:

The first two phases of paint analysis research were compiled in a report which described and comparatively dated the paint treatments, and provided a timetable for the paint stratigraphies in the Entry (room 100) and the Parlor (room 101).¹ The description of the findings and a table showing the comparative paints in room 100 that are relevant to this focused investigation are included below for reference.

There is enough early oil-based paint evidence remaining on the original entry woodwork to suggest that when it was first painted the entry was a monochromatic gray. At the same time there appears to have been a gray-painted faux finish on the plaster walls below the chair rail and cream-colored distemper paint above the chair rail in this space.

The second generation of woodwork paint in the entry (possibly 1826) was a light blue-gray paint with the same type of mahogany graining on the doors as the parlor. In generation 3 the evidence suggests that the entry and parlor woodwork were painted in a monochromatic manner with the same cream-colored, oil-bound paint. There is more wall paint

¹ Susan L. Buck, “Cross-section Microscopy Report: Interior Paints, Historic Sandusky, Lynchburg, Virginia”, unpublished report for Historic Sandusky Foundation, May 31, 2013.

evidence remaining in the entry, and some of the early coating sequences above and below wainscot level on the walls seem to represent decorative painting.²

The analysis results suggested that the 1849 interpretation period paints on the Entry woodwork consisted of cream-colored paint with grain-painted doors, likely to resemble figured oak, as noted in the table below. However, it was not possible to determine the graining pattern without overpaint removal tests.

Comparative Paint Findings By Period in the Entry³

Room/Element	1810-12	1826-41	1849	1877	Observations
Entry					
Woodwork	Gray	Light blue-gray	Cream color	Tan	
Walls, above and below chair rail level	Cream-colored distemper above/gray faux finish below	Lavender/thin red distemper above/glossy pinkish-tan below	Wallpaper above/tan below	Wallpaper above/tan below	Layer-by-layer overpaint removal required to reveal decorative painting on the walls
Doors	Gray	Grained, possibly mahogany	Grained, possibly oak	Dark glossy brown (possible graining)	Layer-by-layer overpaint removal required to reveal graining patterns on doors
Baseboards	Gray	Grained, possibly marbled	Cream color	Likely tan	Layer-by-layer overpaint removal required to reveal marbled pattern on baseboards
Sash	Gray	Light blue-gray	Likely cream color	Likely tan	

² Buck, 2013, 57-8.

³ Ibid.

Room 100 Paint Analysis Results:

One sample from the main door and ten samples from the staircase and landing were taken during the December 2014 site visit. The edge of the overpaint removal exposure on the main door was sampled to better understand the grayish paint with the remnants of a tannish glaze. At Travis McDonald's request, additional staircase and landing elements were sampled to identify how different areas of woodwork were painted during the 1849. To limit the budget for analysis, samples from the stair riser, the window architrave and the fascia below the second-floor landing were selected for cross-section analysis to identify how they were painted in about 1849. The findings from the door paint analysis is discussed and illustrated first in this section of the report.

Room 100 Staircase and Rear Door



Selected Room 100 Sample Locations

- 100-5SB. South wall door, on outer edge of Chris Mills exposure, that seems to be oak graining.
- 100-9SB. Top edge of riser below landing.
- 100-14SB. North wall window architrave, left side.
- 100-15SB. North-facing fascia below second-floor landing, left side of cut-out section

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100-5SB



100-9SB



100-14SB



100-15SB

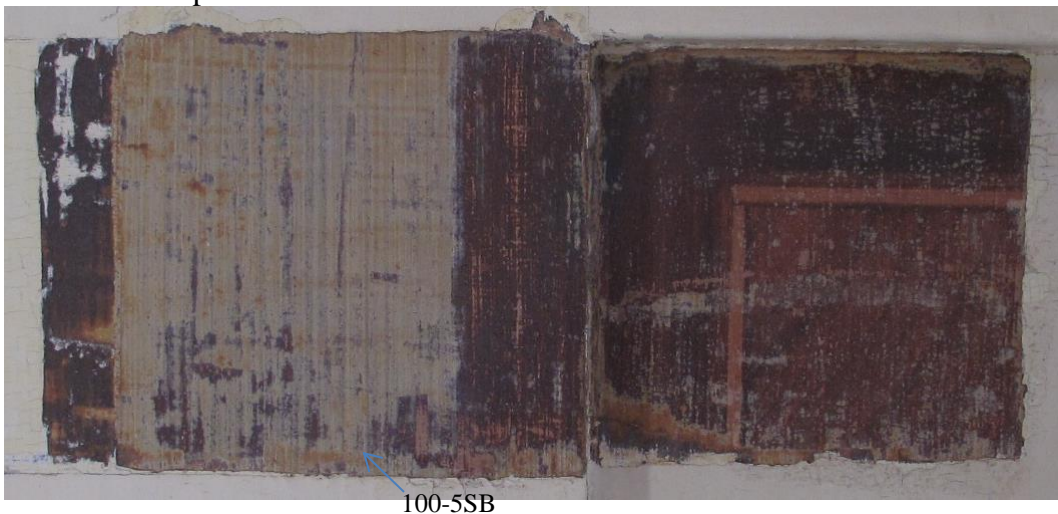


Front Door and Exposure of Door Paints:

When Chris Mills created his exposures on the doors in the Entry he noted that all three doors in the space seemed to have had the same paint treatments.⁴ He identified the first graining generation as mahogany with faux-painted inlay (at right in the photograph below). He interpreted the next generation as mahogany graining with a gray sealer, reddish-brown base coat and dark brown graining. However, he was concerned that this second generation of graining might not have been accurately revealed and asked that it be rechecked with cross-section microscopy analysis.

This exposure was sampled at the lower edge on the left side where there is a brownish glaze on top of the grayish layer to determine whether this might actually be oak graining that could not be consistently revealed (sample 100-5SB). This door was also sampled during an earlier phase of research (sample 100-10) and the evidence in that cross-section suggested that there were actually three generations of graining on the door, consisting of oak graining sandwiched between two generations of mahogany graining.

Chris Mills Exposure on Main Door

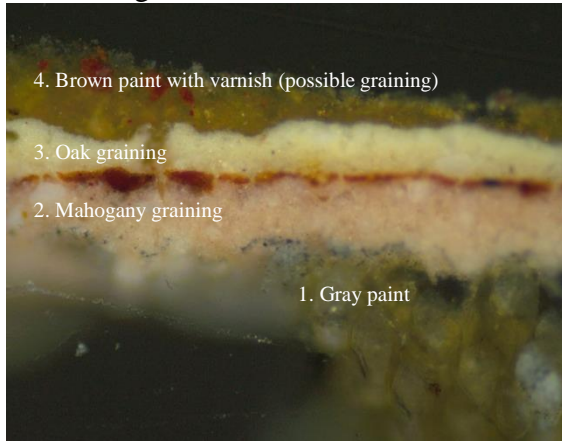


The cross-section evidence in 100-5SB and 100-10 confirm that this door was first painted gray, like the rest of the woodwork. This was followed by the mahogany graining that is now cleanly exposed on the Entry doors. The third generation is oak graining with a very thin brown glaze layer on a cream-colored base coat and a thin plant resin varnish. Generation 4 may also represent mahogany graining with a pinkish-brown base coat. Generation 5 is a brown paint with a varnish. The most recent paints are off-white and gray. If generation 3 is the target period for interpretation of the parlor and entry, then it seems that the parlor door was oak-grained in the same manner on both sides, and the main door may have been oak-grained on both sides as well. Fluorochrome binder analysis confirms that all the paints in this coating sequence are traditional oil-bound paints.

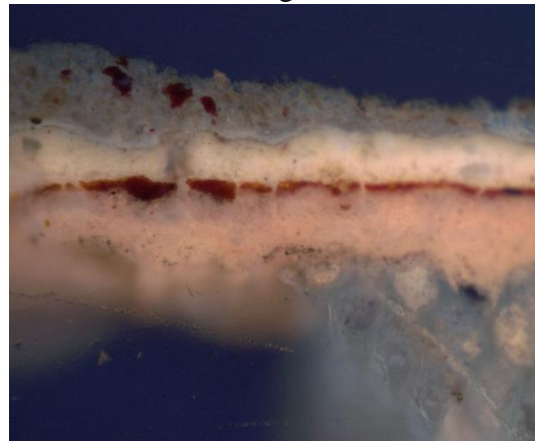
⁴ Christopher Mills, “Treatment Report: Exposures of Interiors Doors Finishes in Center Hallway”, unpublished report for Historic Sandusky Foundation, July 4, 2014.

Sample 100-5SB. South wall door, on outer edge of Chris Mills exposure, that seems to be oak graining.

Visible Light 200X



Ultraviolet Light 200X

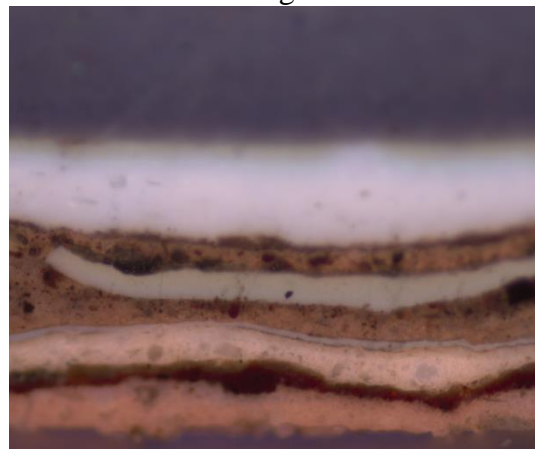


Sample 100-10. Door D1, south wall.

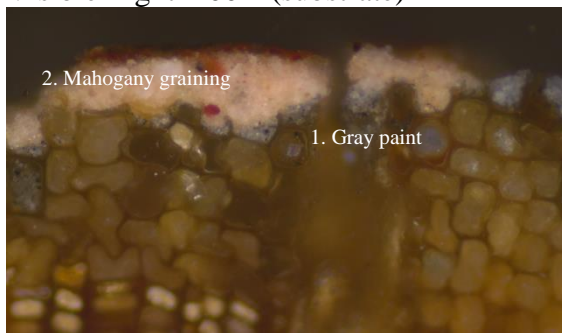
Visible Light 200X



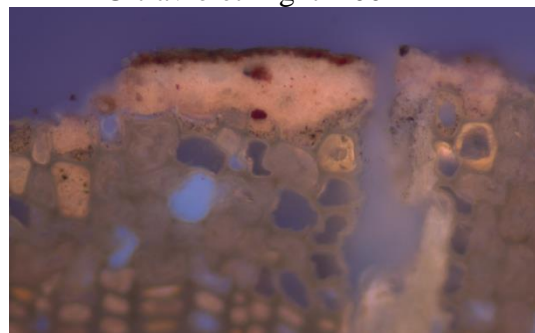
Ultraviolet Light 200X



Visible Light 200X (substrate)



Ultraviolet Light 200X



Staircase and Stair Landing Elements:

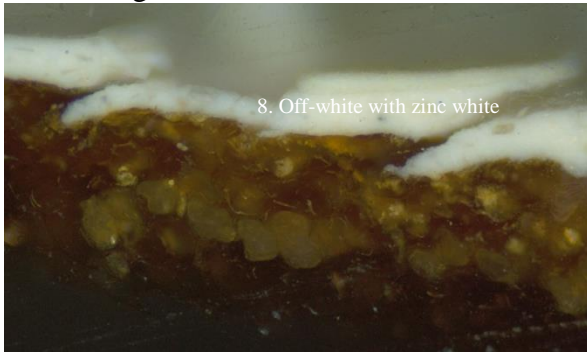
The staircase and landing elements were sampled to determine how they were painted compared to the first-floor woodwork (see sample 100-3SB from the surbase and sample 100-12 from the tripartite doorway for reference). Comparisons of three cross-sections and ten uncast samples suggests that the window sash and architrave (100-14SB), and the balusters, stringer and newel post were all initially painted gray, and the second-generation paint on all these elements was light blue gray. The third generation is missing from some of the samples, perhaps due to surface preparation during later repainting efforts, but it appears to have been the same cream color found during the earlier phases of analysis.⁵ This was identified as the ca. 1849 paint on the woodwork.

During the investigation on-site it appeared that the fascia board below the second-floor landing might have been grain-painted early on. But in cross-section 100-15SB it is apparent that this element was always painted to match the rest of the woodwork, beginning with the original gray paint. This sample was taken from the east side of this board, where it abuts the wall. There is a slight overlap of sandy plaster from the wall in the cross-section, but no early wall paints were discovered in this cross-section.

No grain-painting was found on any of the staircase elements. But the limited evidence in sample 100-9SB from the stair riser suggests that the wood was originally stained red-brown and varnished. Sadly, the risers seem to have been mostly stripped of their paint evidence before toff-white paint was applied in generation 8. Examination of the uncast portions of samples from the handrail and treads indicates that these elements were also stained and varnished, although the earliest varnish coatings are compromised by later stripping and revarnishing efforts.

Sample 100-9SB. Top edge of riser below landing.

Visible Light 200X



Ultraviolet Light 200X

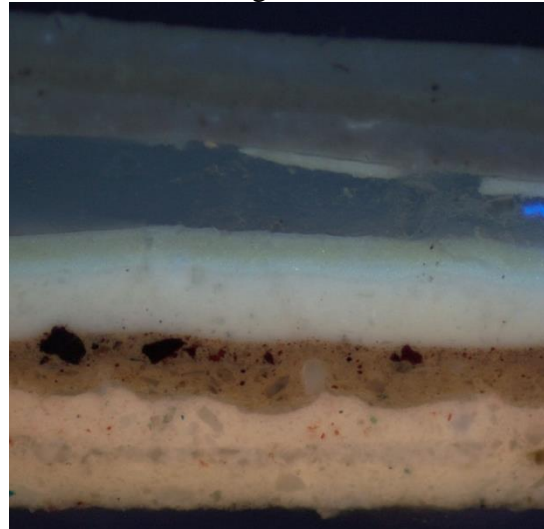
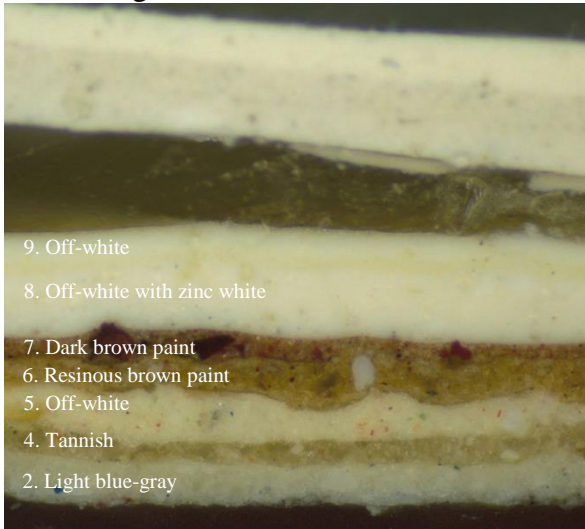


⁵ Buck, 2014, 28.

Sample 100-14SB. North wall window architrave, left side.

Visible Light 200X

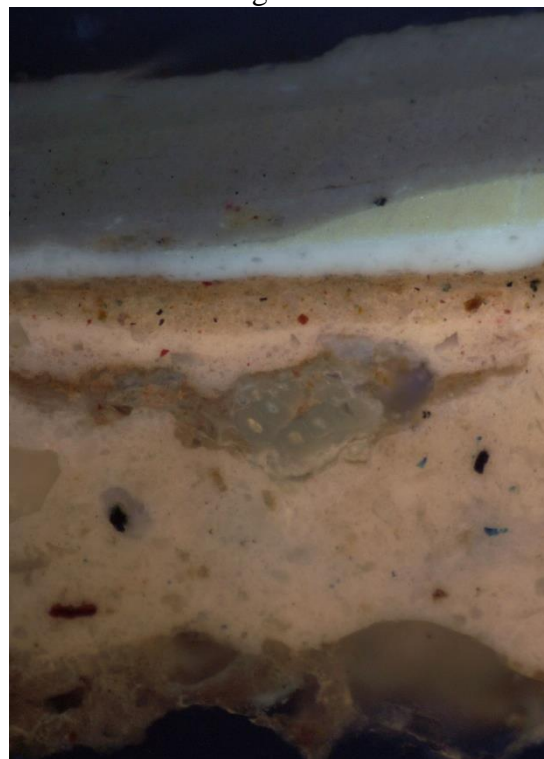
Ultraviolet Light 200X



Sample 100-15SB. North-facing fascia below second-floor landing, left side of cut-out section.

Visible Light 200X

Ultraviolet Light 200X

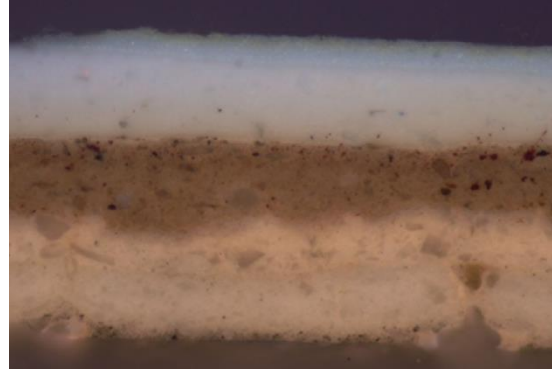


Sample 100-3SB. Surbase, west wall, right of door.

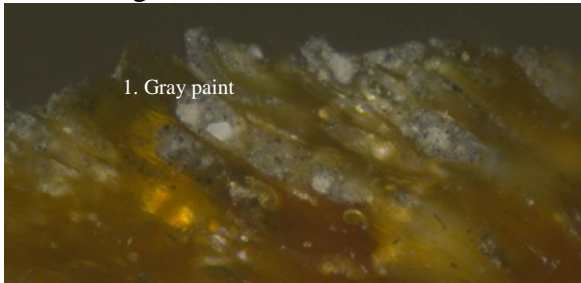
Visible Light 200X Separated flake



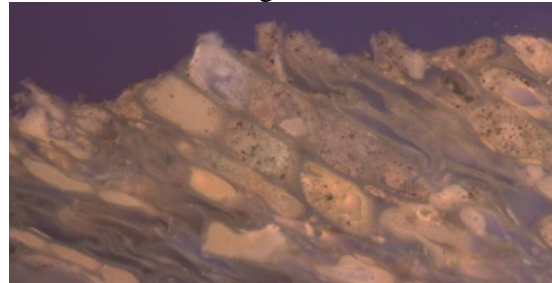
Ultraviolet Light 200X



Visible Light 200X Substrate

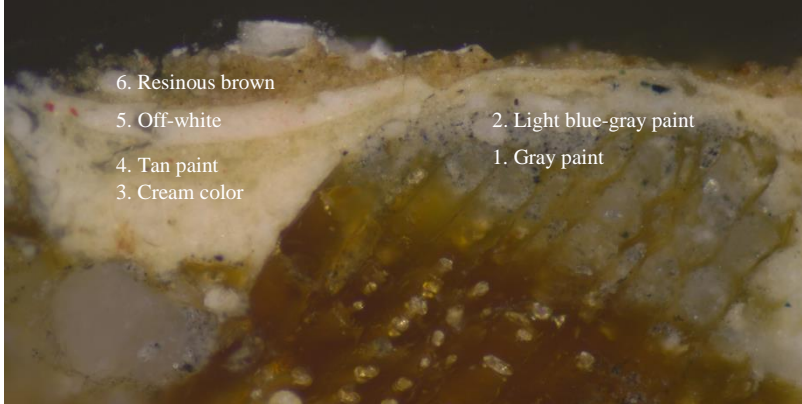


Ultraviolet Light 200X

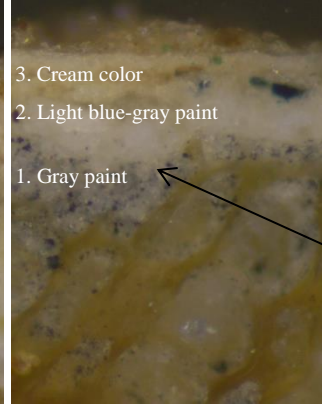


Sample 100-12. South wall, part of tripartite doorway with sidelight (similar to 11 and 18).

Visible Light 200X

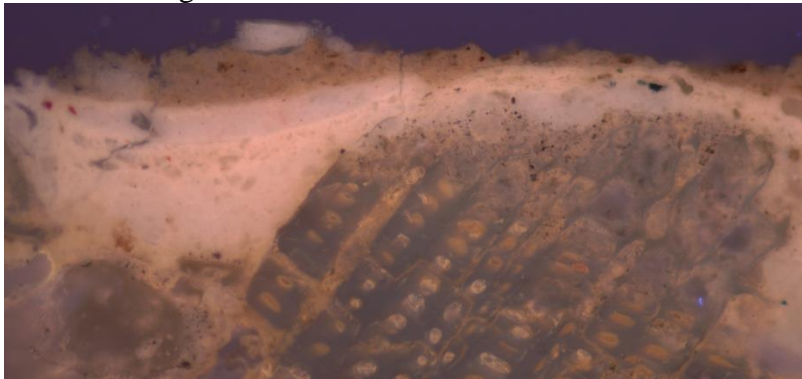


400X

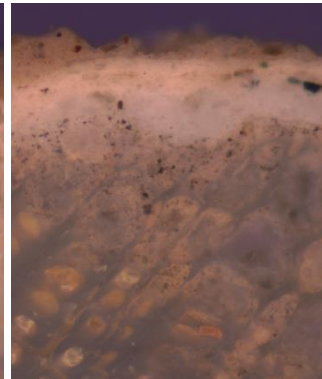


Gray paint is eroded and cracked

Ultraviolet Light 200X



400X



Conclusion:

The most recent paint investigation in the Entry, and the evidence in the modest group of samples removed for analysis, confirms the earlier findings. Most importantly in terms of planning for restoration work in this space, the comparative evidence on the doors confirms that they were oak-grained during the 1849 interpretation period. This oak graining was applied on top of an elegant mahogany graining treatment, which was skillfully revealed by Chris Mills. However, by the mid-nineteenth century oak graining would have been considered more stylish than the mahogany graining with a faux inlay pattern.

Samples from the woodwork in this space helped to confirm that when the doors were oak-grained, the woodwork was painted with a warm cream-colored, oil-based paint. The only staircase elements that appear to have been originally stained and varnished, and then subsequently revarnished, are the treads, the moldings below the treads, and the handrails. The risers were originally been stained and varnished, but by 1849 it appears they were painted cream-colored. Other stair elements like the balusters, newel post, and stringer were always painted to match the rest of the woodwork in the room.

REFERENCES

Cross-section Preparation Procedures:

The samples were cast into 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.

Cross-section microscopy analysis was conducted with a Nikon Eclipse 80i epi-fluorescence microscope equipped with an EXFO X-Cite 120 Fluorescence Illumination System fiberoptic halogen light source and a polarizing light base using SPOT Advanced software (v. 4.6) for digital image capture and Adobe Photoshop CS for digital image management. Photographs and digital images of the best representative cross-sections are included in this report. UV photographs were taken with the UV-2A filter in place (330-380 nanometers excitation with a 400 nm dichroic mirror and a 420 nm. barrier filter). Please note that the colors in the printed photomicrographs may not accurately reflect the actual color of the samples because the colors in the digital images are affected by the variability of color printing.

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

Alexafluor 488 (ALEXA) 0.02% in water, pH 9.0, with 0.05M borate and 5% DMF. Positive reaction for proteins is yellowish-green under the B-2A filter.

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.

N-(6-methoxy-8-quinolyl)-p-toluenesulfonamide (TSQ) 0.2% in ethanol to mark the presence of Zn in the cast cross-section. Positive reaction color is bright blue-white.

The best cross-section photographs for each area were included in this report. Photographs were taken at 100X, 200X and 400X magnifications.

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 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.

Historic Sandusky

West Parlor, East Parlor, Main Entry, Side Entry and Dining Room Sample Locations

Samples removed November 13, 2012 by Travis McDonald

Samples removed April 26, 2013 by Susan Buck

Samples removed December 12, 2014 by Susan Buck

Room 101 Parlor

1. West window trim, north wall.
2. West window trim, south wall (similar to 1).
3. South wall base molding below east window (compare to 4).
4. West wall baseboard in alcove to see if alcove pilaster is first period.
5. East wall, small applied molding on wainscot.
6. South wall, flat field of wainscot, southwest corner.
7. East wall, one sample from unpainted top of door, other samples from painted face of door, door may have originally been varnished.
8. Pilaster of north alcove (similar to 9).
9. Pilaster of south alcove (similar to 8).

101-1SB. Door on east wall, upper left corner, middle left panel.

101-2SB. Wainscot, northwest corner, inner panel, upper left corner.

101-3SB. Wainscot, northwest corner, other panel, right of applied molding.

101-4SB. North wall east window, upper sash, upper right corner, upper panel (not much paint).

Room 100 Entry

10. Door D1, south wall, possible varnish under layers of paint.
11. North wall, back door architrave (similar to 12 and 18).
12. South wall, part of tripartite doorway with sidelight (similar to 11 and 18).
13. South wall, surbase east of doorway.
14. East wall, base molding below stair (similar to 3 or 4?).
15. West wall, door to room 101, might have been varnished (similar to 7 or 10?).
16. North wall door, might be like 10 and 15.
17. Loose window putty on shelf above door from lunette window. Might be similar to architrave trim 11, 12, 18.
18. Front door architrave, might be similar to 11, 12, 17.

100-1SB. Plaster wainscot, east wall along stair, early plaster?

100-2SB. Tripartite window, left architrave of left sidelight, about 5-feet up.

100-3SB. Surbase, west wall, right of door.

100-4SB. West wall, baseboard below location of 100-3SB.

100-5SB. South wall door, on outer edge of Chris Mills exposure, that seems to be oak graining.

100-6SB. Staircase stringer, below 8th step up at leading edge.

100-7SB. Staircase, molding below 7th tread up on west face.

100-8SB. Staircase, rear edge of baluster, above 7th tread up.

- 100-9SB. Top edge of riser below landing.
- 100-10SB. Newel post at landing, south edge.
- 100-11SB. Underside of handrail at landing on east side.
- 100-12SB. Right side of stair tread below landing.
- 100-13SB. North wall window sash, lower sash, lower left corner of middle top panel.
- 100-14SB. North wall window architrave, left side.
- 100-15SB. North-facing fascia below second-floor landing, left side of cut-out section.

Room 102 East Parlor (samples taken by S. Buck)

- 102-1. East wall, closet door left of fireplace, upper corner, inside applied molding, middle left panel (where was this door moved from?).
- 102-2. North wall closet door, upper left corner, panel inside applied molding, middle left panel.
- 102-3. North wall, closet door architrave, left side, middle molding, about 5-feet up.
- 102-4. North wall, closet door architrave, left side, backband, about 5-feet up.
- 102-5. West wall, gray-painted plaster below wallpaper.
- 102-6. West wall, cap of wainscot (early mahogany graining).
- 102-7. West wall, surbase of chair rail, below 6.
- 102-8. West wall, painted panel of wainscoting.
- 102-9. West wall, plinth of baseboard.
- 102-10. North wall, inside closet, dark olive-green paint.
- 102-11. South wall, east window, left side, backband molding.
- 102-12. South wall, window architrave, left side, reveal, about 5-feet up.
- 102-13. South wall, window architrave, left side, middle molding, about 5-feet up.
- 102-14. South wall mantel, top of pilaster right side. (Old mantel from another house.)
- 102-15. South wall, plaster with dark green paint above mantel.
- 102-16. South wall, plaster on back wall of closet.
- 102-17. West wall, wainscoting right of door (early oak graining?).

Room 104 East Entry

- 104-1. East wall door, upper left corner, middle left panel.
- 104-2. East wall, backband for door architrave, about 5-feet up.
- 104-3. East wall, plaster surround for door, left side, early washes?
- 104-4. Baluster, south face.
- 104-5. Board wall below stairs, south face.
- 104-6. South wall door architrave, left side.
- 104-7. North wall door architrave, right side of backband molding, about 5-feet up.
- 104-8. Baseboard, south wall, left of door opening.
- 104-9. South wall plaster left of door opening.

Room 105 Dining Room

- 105-1. East wall window architrave, left side (early gray paint).
- 105-2. East wall, chair board cap, left of window.
- 105-3. East wall, chair board plinth, left of window.
- 105-4. East wall, baseboard plinth, left of window.
- 105-5.

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105-6. East wall, paneling below window, left side.

105-7. North wall, inside former closet, west side of chimneybreast, yellow paint above chair board level.

105-8. North wall, inside former closet, west side of chimneybreast, blue-green paint below chair board level.

105-9. East wall, plaster above chair board.

105-10. East wall, plaster below chair board left of window.

105-11. South wall, door architrave, left edge of backband molding.