

National Park Service
U.S. Department of Interior
Region 1



Historic Architecture, Conservation, and Engineering Center

**Weir Farm National Historic Site
Weir House**

Record of Findings: Investigation of Exterior Finishes



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2019

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Cover: Weir house, 1940s. Detail of photo. [Mahonri Young II Collection]

I. Introduction

The Weir House was the summer home of Julian Alden Weir and later, of his daughter, Dorothy, and her husband, Mahonri Young; it is a principle building of the Weir Farm National Historic Site (Weir Farm NHS). In preparation for the rehabilitation of the home to a museum, a study was made of its exterior paint-color history, focusing on the period of Dorothy's tenure and specifically on the south and east doors, the basement door, and the shutters. This report documents the findings of the study which was made over the course of three years, from 2010 to 2013.

The General Management Plan (GMP) states: "The exteriors of the structures within the Weir complex will be restored to their appearance in about 1940 and interpreted, like the landscape, to reflect their continuous use by Weir and his successors."¹ Dorothy inherited the property from her mother in 1930, splitting her time between Branchville and New York City until her own death in 1947. Dorothy's paint scheme is documented in the 1995 draft Historic Structures Report (HSR);² findings for the south and east doors, the basement door, and the shutters are revisited here.

II. Research and Documentation

The GMP and HSR were prepared in the 1990s, and provide a good introduction to the construction and paint-color history of the house. This history is augmented by historic photographs (mostly from the collection of Weir Farm NHS), Weir's letters, and Dorothy's records of expenses that were not available to researchers in the 1990s. Select photographs and excerpts from written records are presented in Appendix A of this report.

Photomicrographs of select samples are presented in Appendix B; "figure" numbers in the report refer to this appendix. A list of paint samples extracted from the house is presented in Appendix C. In 2012, Susan Buck (Williamsburg, VA) examined paint samples from the shutters; her report, "Cross-section Paint Microscopy Report," is presented in Appendix D.

All project notes and digital images are filed in Region 1's New York City office. A copy of this report has been transmitted to Weir Farm NHS and to the Denver Service Center's Technical Information Center's electronic database (eTIC). Extracted paint samples have been accessioned into the Weir Farm NHS collection (Accession No. WEFA-00192).³

¹ National Park Service, North Atlantic Region, Division of Planning, "Weir Farm National Historic Site: General Management Plan/ Environmental Impact Statement," September 1995, p. 26.

² Marie L. Carden, Richard C. Crisson, and Maureen K. Phillips, "Weir Farm Historic Structures Report; Weir Farm National Historic Site; Wilton, Connecticut," Building Conservation Branch, Northeast Cultural Resources Center, National Park Service, U.S. Department of the Interior, Lowell, Massachusetts, draft report, 1995; revised draft report, 1998.

³ Paint samples extracted for the preparation of the draft HSR are in the Northeast Region's office in Lowell, MA.

III. Examination of Extracted Paint Samples

A total of forty paint samples were extracted from the house and shutters. Samples were examined microscopically and those with the most clearly defined stratigraphies were cast in clear polyester resin for further examination and photography. Visible and ultraviolet light sources were used to characterize layers; no attempt was made to identify pigments or binders.

Photomicrographs of six samples are included in this report. Paint layers, both clearly defined and ill-defined, are identified and assigned color names. Dates are assigned to layers when they are known or hypothesized. (Note: when this report is viewed as a printed document, colors of images will vary depending on the printer used; when viewed on a computer monitor, colors will also vary.)

At the onset of the project, all shutters (with the exception of those of the blind window on the east side of the house) were stored in the barn. Shutters from other, unknown, locations were stored alongside these shutters and fortunately, could be easily identified as such. One paint sample from a shutter was sent to S. Buck for color matching the layer believed to be that dating to c.1940.

IV. History of Paint Colors

A. General History

A summary history of colors for the exterior of the Weir House is based on historic photographs and family documents (presented in Appendix A), and extracted paint samples. The history follows that of nineteenth-century house-paint colors in New England.

The first house documented on Weir's property (1781) fronted Pelham Lane. If it was painted upon completion, or even in the next few decades, it was likely painted in oil colored with earth pigments: dark red, ochre, brown.

In the 1830s, the house was enlarged with the front entrance moved to the gable end on Nod Hill Road. Following the enlargement, complete with a fashionable Greek-temple portico, it is likely that existing dark color(s) were covered over with white paint: oil and lead-white pigments.

In 1882, Weir purchased this house. Whether there were alterations in the intervening fifty years is not known. The few layers of paint on samples extracted from a portion of the siding covered in 1911 suggest it was fairly new and not of eighteenth-century vintage, or even of 1830s vintage (layers of white paint would have been expected for a 1830s date). Photographs show crisp edges of boards and trim that further suggest a re-siding campaign. For this report, the date of siding and trim (but not door and window surrounds), is conjectured to be sometime in the 1870s or 1880s.

Weir wrote of an addition in 1888, but provided no details of the undertaking; there are no photographs that document this work or the house before the work. In 1900, the architect Charles A. Platt designed an expansion and in 1911, the architecture firm McKim, Mead & White designed yet another expansion. The general color pallet for this period—through both expansions—remained the same. The body of the house was painted Venetian red (dark red). Trim and columns

were painted various shades of dark gray and dark green. Window sash were painted white. Shutters were painted a dark gray-green. Extracted paint samples and photographs of the house show these dark color schemes, schemes that were perfectly in keeping with the pallet of late-nineteenth-century New England.

The Venetian red that Weir selected in 1900 remained constant through his tenure, his daughter's tenure, and the Andrews' tenure (Figure 1). Perhaps the house had been painted this color when he purchased it. Weir's trim was always dark and these colors may also have been in place at the time of purchase. A trim board that was covered in 1911 was first painted dark gray and then dark blue-green (Figure 2). Following 1911, trim was painted various shades of dark grays and greens, and because of such dark colors, and because of frequent painting campaigns, distinguishing between individual layers in samples is difficult (Figure 3). No attempt was made to identify individual campaigns.

In 1934, Dorothy altered her father's scheme by painting clapboards backing the east porch, door trim, window trim, and porch and portico, white. This change is clearly seen in a paint sample extracted from the window casing of the east entrance. The earliest layers of paint from the 1830s (and onward for an unknown period of time) are white. These are followed by a series of dark gray and dark green paints marking Weir's tenure, and then the first white campaign of Dorothy's tenure (Figure 3). South and east doors were painted medium green, as were the basement door and shutters (see Appendix D). Because Dorothy's greens are fairly close in hue and shade, and because not all similar elements were necessarily painted at the same time, identifying individual campaigns within her tenure was not attempted.

In 1958, Sperry and Doris Andrews purchased the Weir house and maintained Dorothy's paint-color scheme. By the early 1980s, shutters had been removed from the house for storage.

In 1993, a year after the National Park Service acquired the property, the house was again painted, keeping the scheme established by Dorothy. In 2012-2013, painting was repeated and again, with the scheme established by Dorothy.

B. South and East Doors

The south and east doors are similar in appearance but not identical, suggesting different installation dates. The south door, likely marking the eighteenth-century entrance, displays one more paint campaign than the east door, indicating an earlier installation date. However, it is unlikely that the one layer dates to the eighteenth century and was not covered in the 1830s. Periods of time between paint campaigns are marked by dirt particles, fractures, and poor adhesion of one layer to the next. None of these conditions are present in the first campaigns of the sample, suggesting that the door was installed sometime in the first third of the nineteenth century. Most likely the east door dates to the 1830s when that entrance was created.

A sample from the top half of the south door displays white and light-orange primers and a finish of orange, similar to a salmon color (Figure 4). The second finish is white and likely marks the 1830s alterations; the earliest finishes on the east door are also white (Figure 5). The allegating and cupping of the white paints indicates a lengthy period of time before being painted over. For the

next campaign, the color was changed to medium green. Subsequent layers are considerably darker, ranging from dark gray to dark blue-green to dark olive green, and cannot be readily distinguished between. At some point, the color was again changed to medium green, and then to medium blue-green which is visible today. The shift to lighter greens may have occurred at the end of Weir's life or more likely, during Dorothy's tenure when she lightened the color pallet of the house. This top layer could feasibly be the discolored version of an original green paint, green being a notoriously unstable color and prone to alteration. It was not possible to determine if only one or both of these layers date to c.1940.

With the exception of the very first paint layers, the paint color history of the south door matches that of the east door.

C. Basement Door

The interior basement doors (not the storm doors) were stained or painted black when they were installed in 1911. They were then painted white—an outlier in the color history of the house—and then dark gray. This color is followed by a medium green and likely dates to c.1940. In 1993, the door was painted with a similar green. Why these doors have so few paint layers is not known.

D. Shutters

The first layer of paint on the shutters is dark gray-green, followed by a green that is even darker. The campaigns that followed lightened the pallet with medium greens and dark blue-green. A 1940s photograph shows the shutters medium green and a 1962 photograph shows them to be a medium blue-green. While green is a notoriously difficult color to capture photographically, and color dyes in photographs are notoriously unstable, paint layers in the samples are remarkably close in color to those depicted in the photographs. A medium green was selected as most likely being the color selected by Dorothy.

V. Restoration Paint Colors

As part of research for the HSR, paint samples were extracted from the house, examined microscopically, and c.1940 paint layers visually color matched to the Munsell Color System⁴ and Benjamin Moore® paints.⁵ This study confirmed the findings presented in the HSR.

The south and east doors were not painted as it was possible that the present finish dates to c.1940. Also, painting would have required extensive removal of existing paint to provide a solid substrate for new paint, an operation that would have obliterated much of the finish history. Instead, surfaces were stabilized and storm doors installed to provide protection from weather.⁶ The basement doors were painted the same color as they were in 1993: medium blue-green. Shutters were taken out of storage, painted medium green, and rehung.

⁴ The Munsell® Color System identifies color in terms of three attributes: hue, value and chroma. The complete Munsell® notation for a chromatic color is written symbolically: H V/C.

⁵ Benjamin Moore® paint-color numbers have remained the same since 1993; names are now associated with numbers.

⁶ Paint on doors was stabilized by Fallon & Wilkinson, LLC (Baltic, CT) in 2015.

Paint types and colors used for the 2013 painting are provided here. All painted surfaces received one coat oil primer and two coats of latex, brush applied.

Clapboards, overhangs, corner boards, skirt boards, gutters & leaders Dark red	Benjamin Moore® Regal® Select Onondaga Clay #1204 Low luster Water-borne acrylic (latex)
Door trim Window trim and sash Storm sash South porch clapboards South porch railings & post East portico ceiling & trim West porch railings & post White	Benjamin Moore® Regal® Select White #403-1 Soft gloss Water-borne acrylic (latex)
Storm doors Basement doors Medium green	Benjamin Moore® Regal® Select Deep Sea Green #735 Soft gloss Water-borne acrylic (latex)
Shutters Medium green	PPG Pittsburg Paints® Country Club #404-6 Soft gloss Water-borne acrylic (latex)
South porch ceiling Light blue	Benjamin Moore® Regal® Select Graceful Sea #767 Soft gloss Water-borne acrylic (latex)
South porch floor East portico floor & stairs West porch floor & stairs Light gray	Benjamin Moore® Floor & Patio Latex Enamel Light gray #70 Low sheen Water-borne acrylic (latex)
South porch wrought iron rail Black	Rust-Oleum® Painter's® Touch Ultra Cover Multi-Purpose Satin Brush-On Paint Canyon Black

Appendix A

Chronology: Documented Building and Painting Campaigns

Dates in **bold** face denote painting campaigns documented in written records.

Abbreviations:

AAA	Archives of American Art, Smithsonian Institution
ADB	Anna Dwight Baker
BB	“Branchville Book,” Dorothy Weir Young’s record of expenses
BYU	Brigham Young University
CESW	C.E.S. Wood
HACE	Northeast Region, Historic Architecture, Conservation, and Engineering Center
HSR	Historic Structures Report (draft)
JAW	J. Alden Weir
JFW	John Ferguson Weir
WEFA	Weir Farm National Historic Site

The following transcriptions and photographs document building and finishing campaigns for the exterior of the Weir House. All photographs are in the Weir Farm NHS collection unless otherwise noted.

Pre-Weir Period

- 1781 “. . . the first reference to a house on the property appears in a deed dated 1781.” [Ellen Paul, “History and Documentation of Weir Farm,” c.1990, p. 1 and fns. 3 & 21, from HSR, p. 23]
- 1788 “. . . the first mention of a dwelling house on the property is found in a deed from James Burchard to Daniel Whitlock, Jr., and Nathan Whitlock.” [HSR p. 3; note discrepancy with above date]
- 1789 “. . . the land and a dwelling house on the northwest corner of Nod Hill Road and Pelham Lane (formerly Knoche Lane) was purchased by Anthony Beers from Ebenezer Abbott.” [HSR, p. 3]
- 1820 Anthony Beers death.
- 1824 Estate of Anthony Beers settled; property left to son Lewis Beers.

“Sometime . . . under Lewis Beers’ ownership, the house was remodeled in the Greek Revival style. Cut nails removed from surviving extant features of these alterations indicate that the remodeling occurred sometime before 1835.” [HSR, p. 27]

Synopsis of alterations: the east end of the house was made the principal façade. The south window was replaced with a door and portico. [HSR]

1861 Lewis Beers death.

“ . . . one barn and cow houses on said land (up north of homestead), small dwelling house, carriage house, dwelling house, wash house, barn and cow houses, and hog house by house.” [Will of Lewis Beers, dated 1860-1, Ridgefield Probate Court Records, File #186]

1880 Property purchased by Gilbert & Bennet Manufacturing Company and subsequently sold to Erwin and Emily Davis.

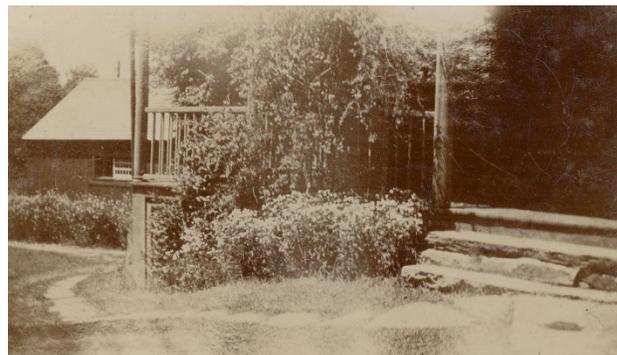


1889 [detail of photo: AHP00230]

J. Alden Weir Period

1882 Property purchased by J. Alden Weir.

“After the Josephs [tenants] get out I shall try & send up a couple of carpenters to put everything in good order. How I would enjoy being there & having the things fixed under my eye, it would be right good fun I should think. . . .” [JAW, New York, NY, to ADB, October 22, 1882, Anna Dwight Baker Weir



Before 1900 [detail of photo: WEFA 9447]



c.1887 [AHP00667]



Before 1900 [original red/white image digitally remastered to black/white image: AHP00233]

Papers (WEFA 191), Box 2, Folder 1]

1888 “We made a great effort to get settled . . . and hope by Friday to finish our addition.” [JAW, Branchville, to JFW, July 1888; AAA reel 125, frame 404]

Photographs show clapboards, trim, and shutters painted in dark colors. Sash are light in color.

1900 Alterations and addition to house by Charles A. Platt.

West end of house extended for living room; small porch constructed adjacent to kitchen door. South piazza replaced with larger structure with columns, balustrade, and stone steps. Multi-pane windows installed in living room, dining room, and front hall (now the library). Door to basement installed on west side.

“Building to be sheathed with N.C. sheathing 8 inches wide with two nails to every bearing and covered with white pine siding. [‘No 1 Bevel siding’ handwritten in].”

“All doors to be furnished by Owner excepting two panel doors in laundry, two outside doors in basement and all closet doors which are to be furnished by contractor.”

“Blinds to be hung . . . painted . . . [‘thick swivel slats with two coats of green paint’ handwritten in].”

“The entire exterior of building to receive two coats of Venetian Red and linseed oil or equivalent, the knots having been previously shellaced [*sic*]. Floor of verandah and porch one coats [*sic*] of shellac and two coats of spar varnish [oil].”

[Drawings: “Alterations in House of Mr. J. Alden Weir, Branchville, Connecticut” (n.d.); and “Specification for Alterations and Improvement to House of J. Alden Weir, Esq., at Branchville, Ct.” (JAW handwritten note attached to specification dated July 16, 1900)]



c.1901 [detail of photo: AHP00288]



After 1900 [detail of photo: Burlingham Collection]

Photographs show clapboards, trim, and shutters painted in dark colors. Sash are painted a lighter color; extracted samples have many layers of white paint.

- 1903 “Last week while we were at dinner . . . our house had been struck by lightning. It tore out one of the pillars of the porch . . .” [JAW, Branchville, to CESW, August 15, 1903; AAA reel 125, frame 955-956]



1915 or 1919 [detail of photo: AHP00206]

- 1911 Alterations and addition to house by McKim, Mead & White.

Additions constructed to enlarge dining room and butler’s pantry, and to add a dressing room and bathroom to first-floor bedroom. Kitchen porch enlarged. [Drawings: “Alteration to house for J. Alden Weir, Esq., Branchville, Conn.,” March 14, 1911]



After 1911 [AHP00059]

“That man Tingley must be very stupid as he mixed the color I wanted for the blinds & Montons sent up enough for 40 pairs of blinds, I cannot imagine what he means about not having the color . . . If there is not enough green, he might to have told me when I was up.” [Ella Baker Weir Papers, Weir Farm NHS Archives (WEFA 192), Box 1, Folder 10]

“Here will we rest and call Content our home” painted onto a board over front (south) door. [JFW, Branchville, to JAW, August 2, 1833 (BYU; AAA reel 125, frame 295); Dorothy Weir Young, *The Life and Letters of J. Alden Weir*, ed. by Lawrence W. Chisolm (New York: Kennedy Graphics, Inc., Da Capo Press, 1971), p. 159]

Photographs show clapboards, trim, and shutters painted in dark colors. Sash are lighter in color.



c.1917 [detail of photo: AHP00194]

Dorothy Weir Young Period

1930 Ella Baker Weir's death, Dorothy Weir inherits property.

1931 Dorothy Weir's marriage to Mahonri Young.

1933 "The [exterior] blinds were painted last winter." [BB, July 31, 1934]

1934 "Started painting the house—this time with white trim in porches and around windows as an innovation" [BB, July 31, 1934]



c.1934 [detail of photo: AHP00150]

Photograph shows clapboards and shutters painted in dark colors, trim painted white, and sash painted white.

1935 "Painted Piazza floor" [BB, March 1935]

1942 "Painted House" [BB, 1942]

Photograph shows clapboards and shutters painted in dark colors; clapboards on south wall beneath porch roof painted white, and trim painted white.

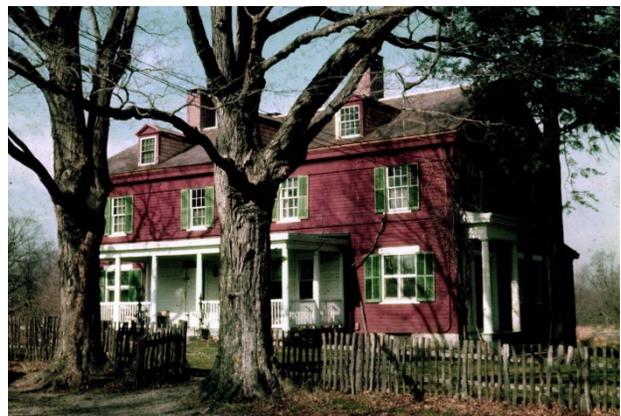


1942 [detail of photo: AHP01109]

1947 Dorothy Weir Young's death; Mahonri Young inherits property.

Photograph shows clapboards painted dark red, clapboards on south wall beneath porch roof painted white, shutters painted green, and trim painted white.

1957 Mahonri Young's death; Mahonri Sharp Young and Agnes Young Lay (son and daughter) inherit property.



Late 1940s [detail of photo: Mahonri Young II Collection]

Sperry and Doris Andrews Period

1958 Property purchased by Sperry and Doris Andrews.

A wood-frame and glass storm shelter built around south porch entry, south porch balustrade removed [Conversation between Andrews and HSR authors between 1990 and 1995]

Photographs show clapboards painted dark red, clapboards on south wall beneath porch roof white, trim white, and shutters dark blue green. By the early 1980s, shutters had been removed.

1988 Property purchased by Connecticut Department of Environmental Protection.



c.1962 [AHP01207]



c.1983 [AHP01144]

National Park Service Period

1992 Property acquired by the National Park Service.

1993 House and trim painted same colors as those existing. [HSR, Appendix E]

- Clapboards
7.5R 3/6 (Munsell)
Moore-O-Matic #1204
- Trim
White, no value given
- Doors and shutters
Munsell 7.5BG 3/4
Moore-O-Matic #735
- South and east doors not painted



2011 [National Park Service]

- South porch ceiling
7.5B 7/6 (Munsell)
Moore-O-Matic #767
- Porch floor
N7.5/ (Munsell)
Moore-O-Matic #1467

2003 Death of Doris Andrews.

2005 Death of Sperry Andrews.

2013 House and trim painted (2012-2013).

Shutters re-installed. Storm doors installed. Kitchen porch enlarged. South porch modified with an access ramp.

Benjamin Moore® Regal® Select paints, unless otherwise noted.

- Clapboards and trim
Onondaga Clay #1204
- Window and door trim, porch and portico
White #403-1
- Basement door
#735
- South and east doors not painted
- Storm doors
PPG Pittsburg Paints®, Country Club #404-6
- Shutters
PPG Pittsburg Paints®, Country Club #404-6
- S. porch ceiling
Graceful Sea #767
- Porch floor, portico floor, and portico stairs
Light gray #70



c.2018 [National Park Service]

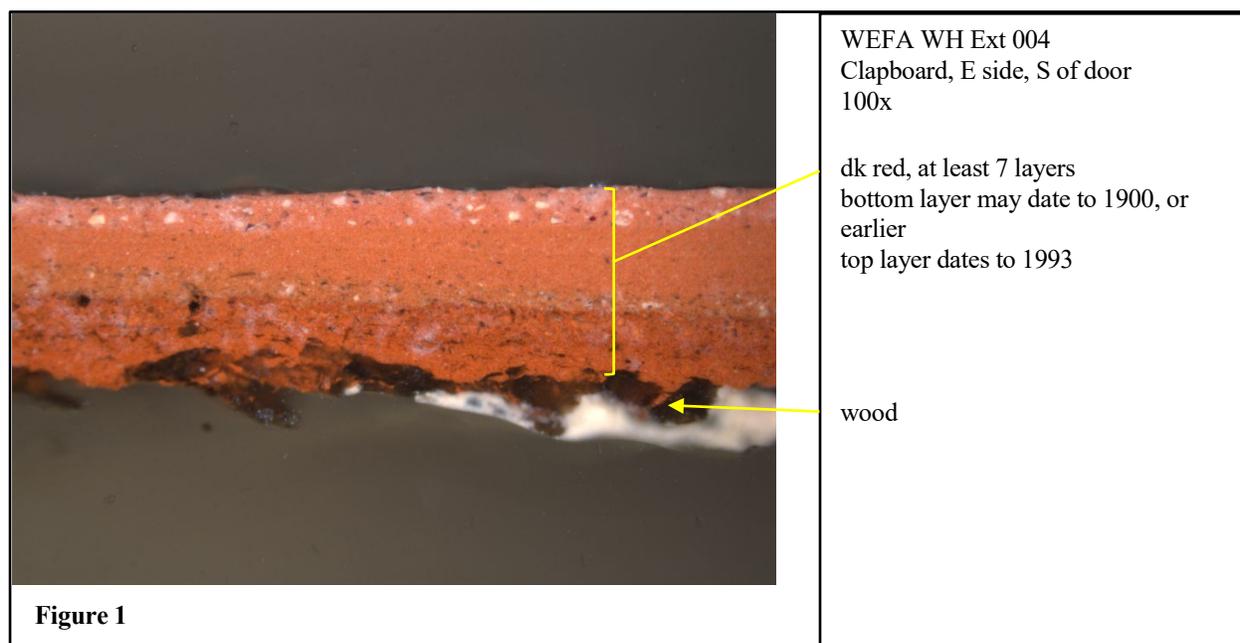
2015 South and east door subject to treatment to stabilize all paint layers. Work performed by Fallon & Wilkinson, LLC (Baltic, CT).

Appendix B

Photomicrographs of Samples

Paint samples with the clearest stratigraphies were cast in clear polyester-resin cubes. Cubes were cut to reveal a cross-section of paint layers, then polished to provide a smooth and flat viewing surface. A compound microscope, with both visible and ultraviolet light sources, was used to identify and characterize individual layers and series of layers. Photomicrographs were made at 100x magnification.¹ All photomicrographs in this report are oriented with the substrate at the bottom of the image and finish layers above; the most recently-applied layers are at the top of the image.

Samples provide information on paint color, as well as on pigment size (finely ground vs. coarsely ground), period of exposure (dirt layers suggest extended periods of exposure), age (cupping, alleghoring), and primer and finish coats (tight bonds). When viewed in ultraviolet light, autofluorescence of layers provides information on pigments and binders. White blobs are air bubbles (from casting) or separations between paint layers that are filled with resin dust created during the polishing process. The background color indicates the thickness of the resin cube and is not related to the samples themselves.



¹ Examination made with an Olympus BX40 compound microscope. Visible light provided by a white LED and ultraviolet (UV) light provided by a mercury arc lamp and an Olympus U-MWU cube EX 330-385, ba 420. Photomicrographs made with a Pixelink PL-B872CU digital camera.

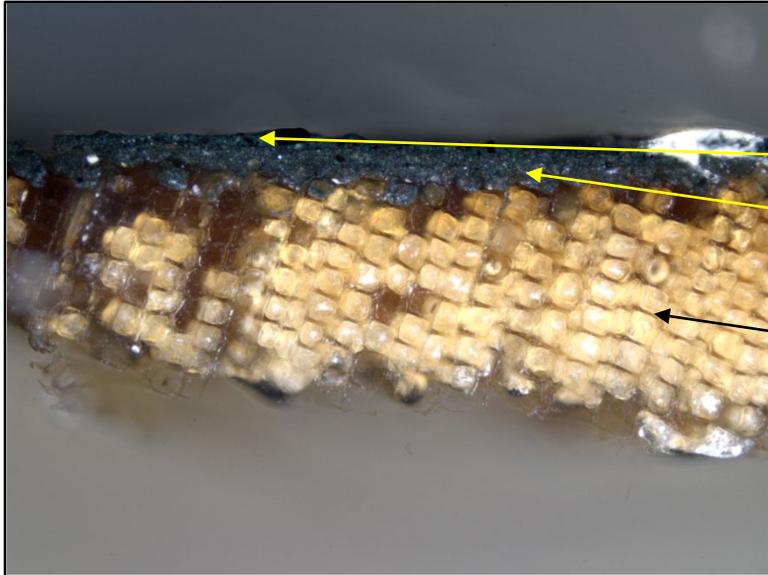


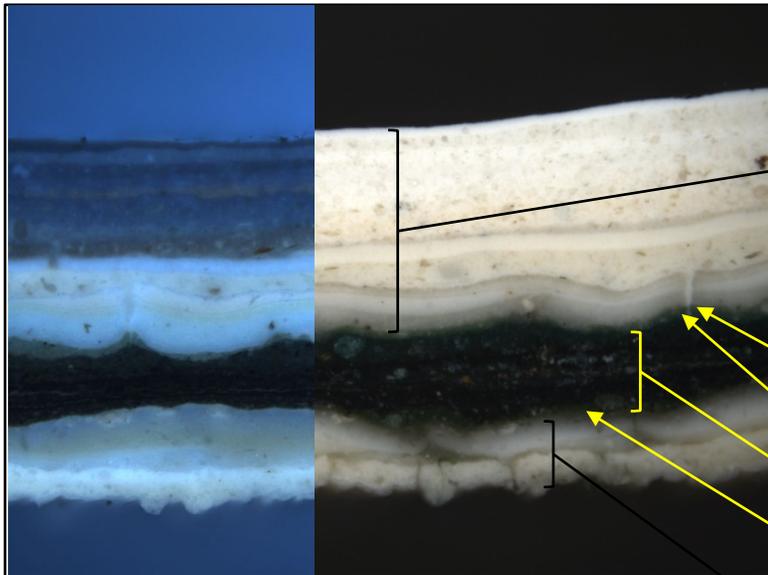
Figure 2

WEFA WH Ext 010
Trim board, N side, within attic space
100x

dk blue green, c.1900

dk gray, 2 layers, c.1880s
penetrates wood slightly, likely a stain

wood



UV light

Figure 3

WEFA WH 017
E entrance, S window casing
100x

white, at least 12 layers
first layer 1934
pale yellow autofluorescence
suggests lead-white pigments in oil
gray (no fluorescence) suggests
acrylic-latex paint

med blue green

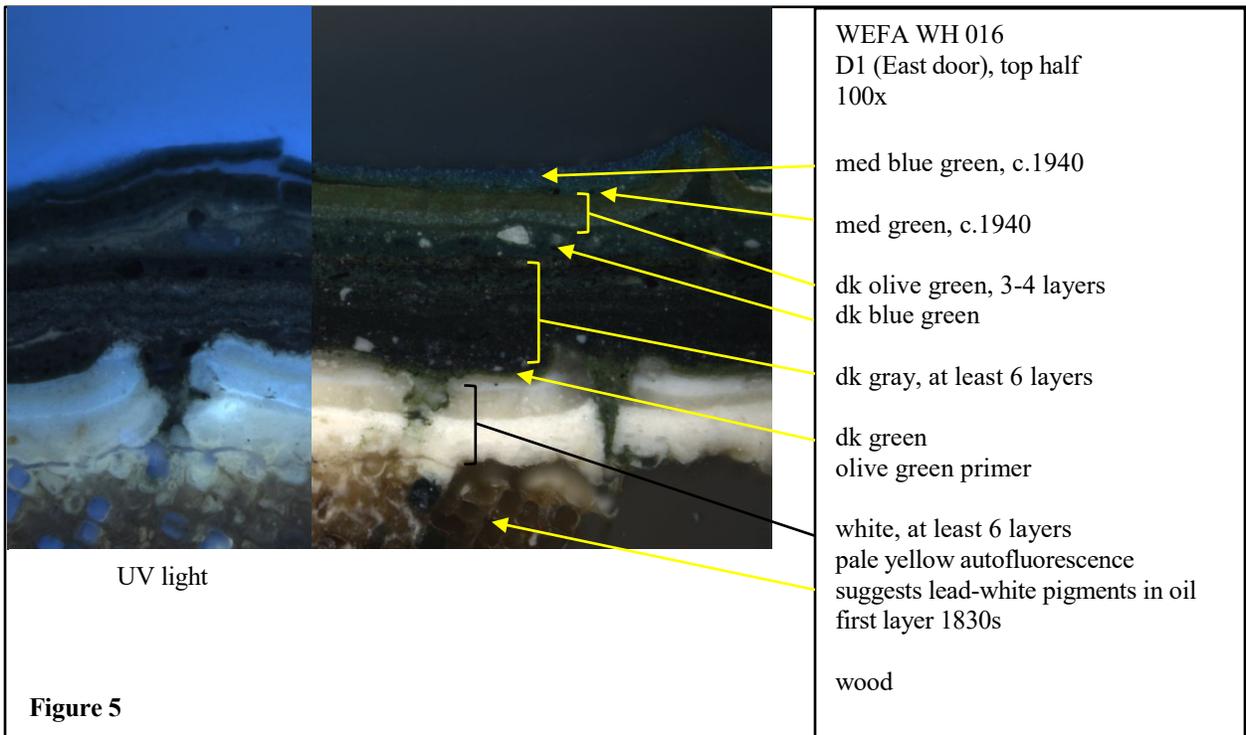
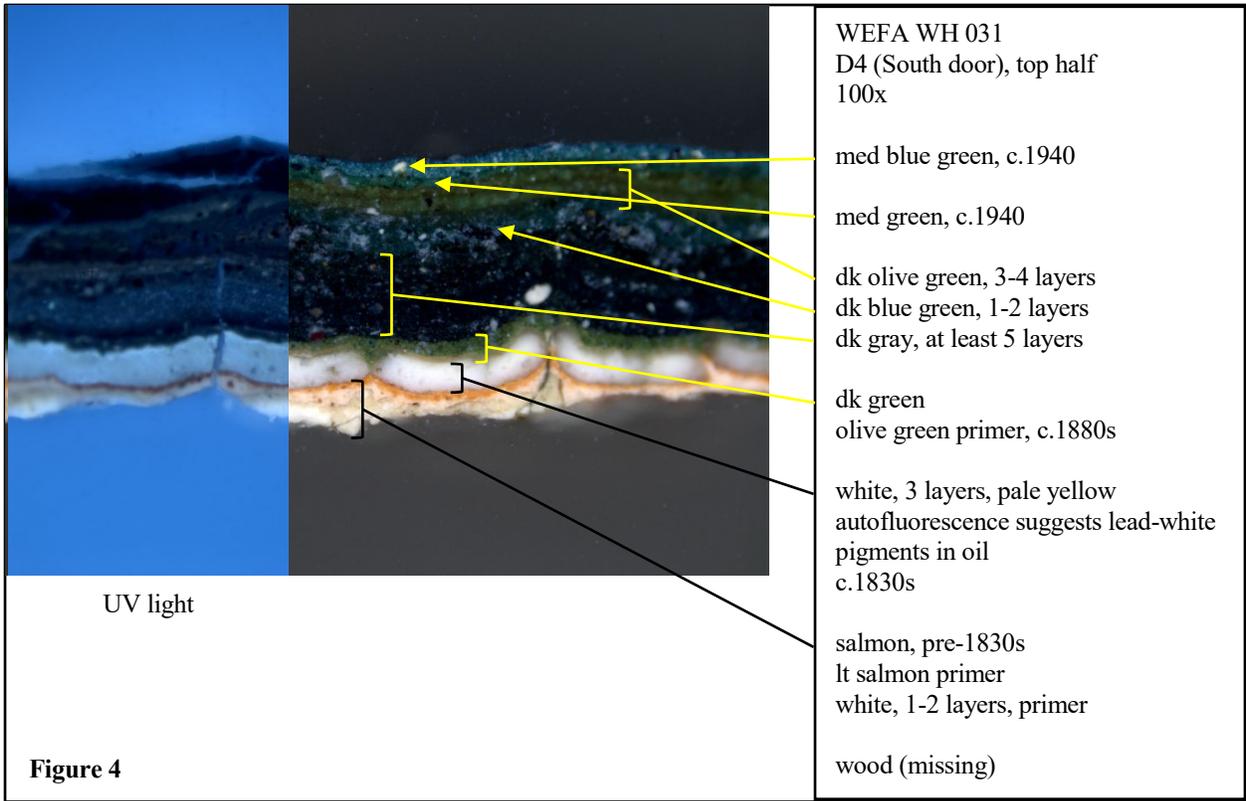
dk blue green

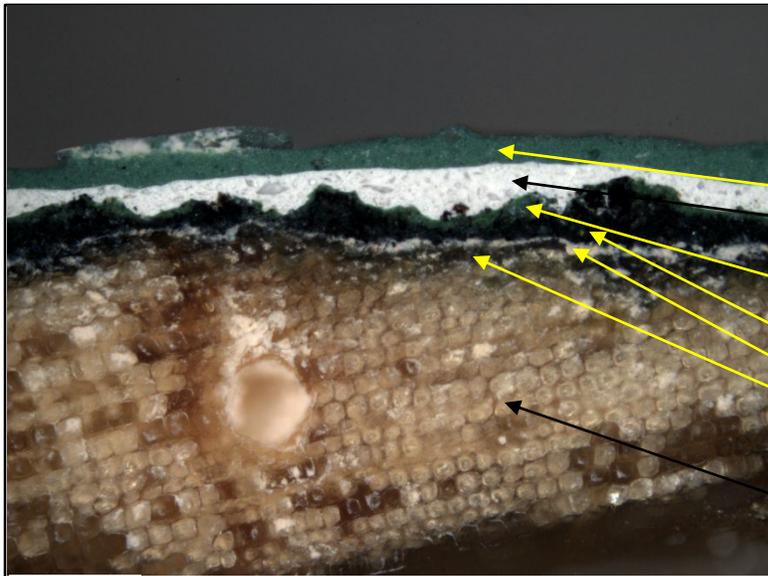
dk gray, at least 5 layers

dk green, c.1880s
olive green primer

white, 5 layers
pale yellow autofluorescence
suggests lead-white pigments in oil
first layer 1830s

wood (missing)





WEFA WH 024
D007 (Interior basement double doors)
100x

med blue-green, 1993
lt gray primer
med green, c.1940
dk gray or black
white
black, penetrates wood, likely a stain, c.1880s
wood

Figure 6

Appendix C

List of Extracted Paint Samples

A total of forty paint samples were extracted from the Weir House for this study; thirty-eight samples from the exterior and two from columns in the basement. Samples with the most clearly defined stratigraphies were mounted in resin cubes for microscopic examination. One sample was sent to S. Buck for additional examination and analysis.

Samples were extracted with a small hobby knife and placed in acid-free-paper pouches which are, in turn, housed in manila coin envelopes. Samples are labeled WEFA WH Ext (Weir Farm NHS, Weir House, exterior) and numbered sequentially from 001-040. A list of samples and their locations is presented below.

Plans of the house were prepared in 1995.¹ Door and window numbers are taken from these plans. These numbers are as follows:

- D1 East door
- D3 Exterior basement double doors, w side
- D4 South door
- D007 Interior basement double doors

Shutters are designated by the number of their associated window or door, with an “R” or “L” noting the right or left side.

Samples with an asterisk (*) are those that were photographed for this report.

Sample #	Sample location
001	Clapboard, S side, E end of porch
002	Clapboard, S side, E of porch
003	Clapboard, S side, E end of wall
004*	Clapboard, E side, S of door
005	Clapboard, E side, N of door
006	Clapboard, E side, N end of wall
007	Corner board, E side, between house and dining-room wing
008	Corner board, E side, N end of dining-room wing wall
009	Sheathing, N side, within attic space over dining room
010*	N side, trim, within attic space over dining room

¹ While the title block of the drawings is that of the Historic American Building Survey (HABS), the drawings were not created by HABS. The plan of the house was created in 1996 by the National Park Service, Northeast Region, Cultural Resources Center, Building Conservation Branch. The four elevations were created by Innovative Architectural Technologies, Inc. under the supervision of the Cultural Resources Center, and are not dated; most likely they were created in the same year as that of the plan.

011	Sheathing, W side, above basement window
012	Column, in basement (appears to have been a former porch column), base
013	Column, in basement (appears to have been a former porch column), shaft
014	E entrance, S column
015	D1, S casing
016*	D1, top half
017*	E entrance, S casing of S window
018	W001A, casing
019	W006, casing
020	W006, sash
021	D3, N casing
022	D3, N casing, sample from former hinge location
023	D3, exterior face
024*	D007
025	S porch, E half column, base
026	S porch, E half column, shaft
027	S porch, soffit, E end, location of former center column
028	D4, E casing
029	D4, W casing
030	D4, B half
031*	D4, T half
032	W117, E casing
033	W117, sill
034	W118, W casing
035	W118, W stop
036	Shutter, W104 (color match by S. Buck)
037	Shutter IV, W118
038	Shutter XIV
039	Shutter XXXI?I
040	Shutter XXXI

Weir House Shutter Color Match

For: Judy Jacob, Senior Conservator
National Park Service
Northeast Region
Architectural Preservation, Engineering and Maintenance Division
26 Wall Street
New York, NY 10005

By: Susan L. Buck, Ph.D. Conservator and Paint Analyst
303 Griffin Avenue
Williamsburg, VA 23185

COLOR MEASUREMENT PROCEDURES

Uncast portions of the intact shutter samples from the Weir House north dining room shutter provided by Architectural Conservator Judy Jacob were measured and matched using a Minolta Chroma Meter CR-241, a tristimulus color analyzer/microscope with color measurement area of 0.3mm. This instrument 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. The color matches were also rechecked at 30X magnification using a color-corrected light source.

The measurements were first generated in the Munsell color system (a color standard used in the architectural preservation field), and after the measurements were taken the closest Munsell color swatches from a standard Munsell Book of Color (gloss paint standards) were compared under 30X magnification to the actual samples. The measurements were also generated in the CIE L*a*b* color space system, which is currently one of the most widely accepted industry color space measuring systems.

The most appropriate commercial match for the 1940s green shutter paint on the Weir House was found in the Pittsburgh Paint color line "The Voice of Color".

Ca. 1840s Green Weir House Shutter Paint Color

Color Match – August 15, 2012¹

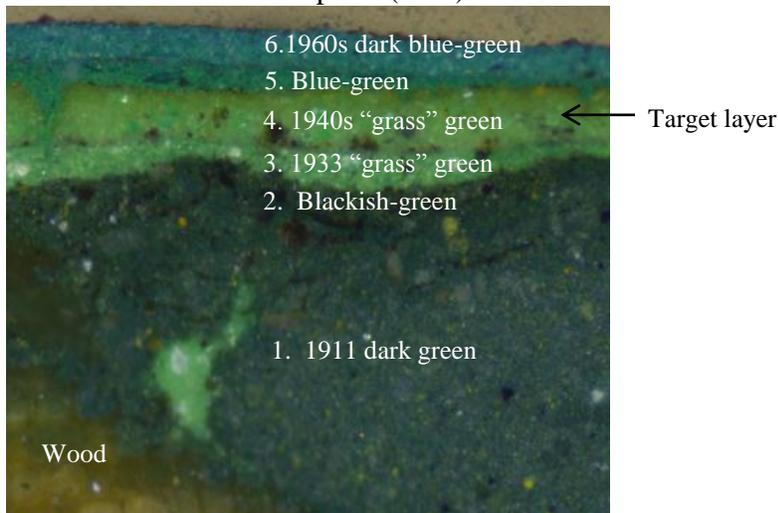
Sample from North Dining Room Shutter

Color System*		Coordinates	
Munsell	Hue	Value	Chroma
	4.6G	3.8	2.9
CIE L*a*b*	Black to White	Green to Red	Blue to Yellow
	40.95	a-18.85	b+7.14

Pittsburgh Paint 404-6 “Country Club”

Color System*		Coordinates	
Munsell	Hue	Value	Chroma
	5.1G	4.0	4.3
CIE L*a*b*	Black to White	Green to Red	Blue to Yellow
	L40.79	a-23.31	b+7.86

Cross-section of shutter paint (xxxix) 100X



The commercial match and the ca. 1940s “grass green” on the shutter are very good numerical matches in the CIE Lab color system. The primary difference is that the commercial match #PP-404-6 is just slightly more green (the “a” value) than the best-preserved areas of the fourth generation green paint. This difference may be partly due to some fading of the paint on the shutter from weathering. The match #PP-404-6 is also an excellent visual match to the best preserved areas of the target layer when examined in full spectrum light both at 30X magnification and unmagnified. The evidence suggests that that this layer was moderately glossy and could be replicated in a “semi-gloss” gloss level.

¹ Color matching conducted after cross-section microscopy analysis by Susan L. Buck, Ph.D., Conservator and Paint Analyst, with a Minolta Colorimeter CR-241.

* **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 Y_{xy} (1931), $L^*a^*b^*$ (1976), and $L^*C^*H^*$ (1976) colorimetric densities $D_xD_yD_z$; Munsell notation and four systems for measuring color differences.

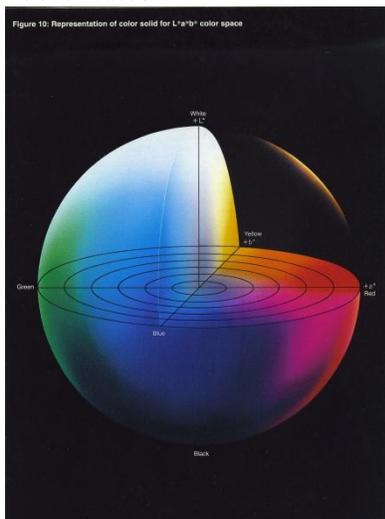
For two colors to match, three quantities defining color must be identical. These three quantities are called tristimulus values X, Y, and Z as determined by CIE (Commission Internationale de l'Eclairage) in 1931.

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 Y_{xy} (CIE 1931): In the Y_{xy} (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 (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: $\Delta E = \sqrt{(L^*)^2 + (a^*)^2 + (b^*)^2}$, 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.