Historic Paint Finishes Study:

The F. W. Fraley Store, Exterior Surfaces

Conducted at the request of The Catoctin Furnace Historical Society, Inc. 12607 Catoctin Furnace Road Thurmont, Maryland 21788

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Historic Paint Finishes Study: Catoctin Furnace

The Exterior of the F.W. Fraley Store Finishes of ca. 1945-1950 the Restoration Period

Technical program

1. Collection of Samples:

Samples were collected from all characteristic surfaces of the F.W. Fraley Store at Catoctin Furnace. Both the original construction of 1906 and the addition of 1928 were subject to collection of samples.

2. Exposures:

Small exposures were made on each surface, and were examined with magnification, up to 30x, at the site. The extremely poor condition of the samples precluded good on site exposures.

Laboratory Examination

3. Stereoscopic and Polarized-light Microscopy, and Microchemistry:

All samples are examined in cross section and obliquely. Most of the samples have been mounted for thin cross sections and polishing. Polishing is done to 8000 micron polishing grit. These samples are mounted in Bio-plastic polymer resin. The samples are ground and polished for examination using top lighting and ultraviolet lighting. The samples were also subjected to spot testing for lead components. The photomicrographs will be the basis for the study of relative number of paint layers, providing archaeological information that can assist in determining the period finish. Additional pigment identification will be done using polarized light microscopy, if necessary. Pigments of interest will be extracted using a tungsten needle and will be mounted for examination using the Olympus BMAX-50 polarized light microscope. The identification of the pigments will follow the system of particle identification from the McCrone Research Institute of Chicago. Examination of the finishes will include the use of shortwave ultraviolet light to reduce the yellowing of the oil binders under controlled conditions.

4. Color matching is done under controlled fiber optics illumination using the Olympus SZ-1145 stereomicroscope, and daylight filtering. The preferred color standards are from the Munsell Color System, however, in view of the wide gaps between Munsell Standards, other color standards have been used. For this study, the Benjamin Moore and Company Color lines were used, which provided excellent matches to the historic finishes.

All color standards other than the Munsell Color Standards will be read by the X-rite SP62 Sphere Spectrophotometer to provide CIE Lab coordinates, coordinates and a Munsell Color Conversion Number. The CIE Lab coordinates provide a tripartite written identification system, making it possible to assign a written equivalent for any color. This is very important for the record, as it is possible to reconstruct the color from the coordinates in the distant future.

5. Photomicrographs:

A very important means of recording chromochronological data is photomicrography: photographs taken through the microscope of particularly informative samples. This allows for clear indications of the conditions seen under the microscope, and how the recommendations were achieved. The report includes photomicrographs that are annotated with information in the report. This report includes many photomicrographs of mounted samples that will provide clear information that indicates the condition of the wood and the paint layers. In addition, some photomicrographs of unmounted samples may also provide significant information on the finishes of interest. The photomicrographs provide the data on the finishes in a manner consistent with current practices. The entire report, including all of the photomicrographs will be in modern digital form.

6. Report preparation:

The report brings together all the aforementioned material in a comprehensible manner and has focused on the first finish period, which would have been exposed in 1889.

The report includes the data on the samples, locations of specific samples, color standards and any other pertinent information, such as that from known documents. As indicated, the photomicrographs provide the basis of the report.

Spectrophotometer readings of color standards are also executed to render all color standards into the CIE Lab System of Color Notation and the Munsell Conversion Number. The color standards are also included.

7. Deliverables:

The report is delivered in two forms: electronic digital form and one hard copy. The electronic digital form has all of the text and illustrations; however, it does not have the actual color standards. The color standards are too subject to change in the process of digital transfer. The color standards are included in the hard copy only.

Respectfully submitted this date: 14 October 2022

Matthew J. Mosca Historic Paint Finishes Specialist Artifex, Ltd.

Introduction

The Catoctin Furnace Store is a large frame structure comprised of two distinct sections. Originally built as the F.W. Fraley Store the long section to the east existed as the entire store from its construction in 1906 until it was enlarged with a large two-story addition to the west in 1928.



The initial thought on the part of the writer was to focus on the first finish period of the 1928 building. This follows general restoration practice in that any finishes that might predate 1928 would create an anachronism. As it turned out, the restoration period is not the ca. 1928 finish period, but a later period, ca. 1945-1950 or the third finish period of the 1928 addition. This was motivated by a recognition of the significance of the collective memory of the people living in and near Catoctin Furnace.

Fortunately, the store building was the subject of a watercolor by Peter Sinclair believe to date to ca. 1960. The watercolor shows paint colors that relate to the **third finish period** of the 1928 addition. This has been used to guide the selection and identification of restoration finish period.

Painting of the Fraley Store by Peter Sinclair



Ca. 1906: The original F. W. Fraley Store:



Historic Photograph: Façade of the F. W. Fraley Store, ca. 1960



The 1906 Store:



Note: Samples extracted from the south and east elevations of the Store show some remnants of the first finish from 1906. Though the 1906 finish will not be used in the restoration of the building, these samples were photomicrographed, for documentation.

The 1906 Section: Siding finish Photomicrograph: South elevation, ca. 1906 section siding

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



Note: The sample has been mounted in polymer resin, cut and polished to 8000 micron grit polishing cloth for additional examination. A fragment of the original wood substrate is seen at the lower left of the photomicrograph. The first finish is clearly seen [1]: this is a yellowish green, prepared with chrome green and other pigments. The second finish is a moderate bluish gray [2], which is worn due to a long term exposure. The third finish [3] probably indicates the

ca. 1928 finish: the first finish on the 1928 section was a lead white also. The fourth finish may be ca. 1940 [?] and the fifth finish [5] is the restoration finish period ca. 1945-1950. The fifth finish above corresponds to the third finish on the 1928 section.



1906: Trim

Note: A piece of the soffit was removed for sampling at the junction of the 1906 section and the 1928 front addition. The soffit/trim sample was part of the 1906 building.

Photomicrograph: South elevation, ca. 1906 section Soffit/Trim

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



Note: The sample has been mounted in polymer resin, cut and polished to 8000 micron grit polishing cloth for additional examination. The original wood substrate is seen at the base of the sample as indicated. The first finish is extremely deteriorated [1]: lead white. The second finish [2] is a dark green that was used repeatedly. Note that the brown finish is also repeated, and it is likely that the fifth finish [5] is the finish of ca. 1945-1950.

All of the layers are very deteriorated due to the heat and sun from the south elevation location.

1906 section: Gable end, East elevation: Board and Batten Door

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



Note: The sample has been mounted in polymer resin, cut and polished to 8000 micron grit polishing cloth for additional examination. The paint layering has delaminated from the wood sample, due to deterioration. The first finish is a moderate yellowish green [1] that is discolored. The second finish is a near-black dark gray finish [2]. The third finish, ca. 1945-1950 is the dark brown seen on other locations. Later the near-black finish paint is used again. The later finishes are also seen: this door appears to have not been painted as frequently as some of the other surfaces.

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

1906 section: Gable end, East elevation: Board and Batten Door, Door Jamb and Frame

Establishing the restoration period finishes: Ca. 1945-1950

The west elevation has been protected from the sunlight by the porch. The principal samples were taken from under the porch.



Note:

- 1. Siding [German Siding]
- 2. Five panel door
- 3. Store front enframement [partial view]
- 4. Shutters

Note: Additional paint layers

The west elevation under the porch would have been the surfaces most easily examined by the customers at the store, and thus it is likely that this area was repainted more often than other surfaces of the Store building.

Samples from under the West Porch



Sample locations from the West Elevation, under the porch



Columns [turned] Outriggers, Nailer boards [A]

Note: Samples were taken from various turnings of the columns: all of the surfaces showed the same sequences, thus the columns were painted with one finish during the ca. 1945-1950 period.

1928 Addition: other elevations

The north side gable end elevation permitted collection of window sash and frame samples:



1928: East elevation, with re-used door



Note: The north extension of the 1928 front addition has a late nineteenth century Italianate door re-used in this location. It was originally finished in an expert walnut graining, with a high gloss varnish finish. It is entirely possible that this is an interior door from a long-demolished residence from ca. 1850-1880. The molding profiles indicate an Italianate style.

Examination of the Samples:

Sample: 1928 West Elevation: Siding

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



Note: The sample has been mounted in polymer resin, cut and polished to 8000 micron grit polishing cloth for additional examination. The wood substrate is seen at the base of the sample. The first finish, a lead white is clearly seen [1]. This was followed by the second finish, a light yellow [2]; note the surface particulate and exposure condition at the surface of finish 2 [2-s]. Finish 2 is the first in a series of yellow finishes. Finish 3 is estimated to be the ca. 1945-1950 period light yellow finish. Note the heavy surface particulate [SP: soot] at the surface. Two later light yellow layers are also seen [4,5]

Sample: 1928 West Elevation: Shutters

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



Note: The sample has been mounted in polymer resin, cut and polished to 8000 micron grit polishing cloth for additional examination. The wood substrate is seen at the base of the sample. The first layer [A] may be a thin lead white primer. The first finish is a chrome green an inexpensive and very popular color for shutters since 1830 [1]. The second finish a bluish green is also prepared with chrome green and other pigments [2]. The third finish [3] is the first brown finish on the shutters, and relates to the Sinclair painting. There is a second brown finish [4]. Finish 5 is the same color as Finish 2; the last finish is a thin chrome green finish [6].

Note: Five panel door Rails and Stiles: were painted the same brown as finish 3 of the Shutters during the restoration period.

Sample: 1928 West Elevation: Five Panel Door: Panel

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



Note: The sample has been mounted in polymer resin, cut and polished to 8000 micron grit polishing cloth for additional examination. The wood substrate is seen at the base of the sample. The first finish is a light yellow applied over a white prime [1a, prime, 1b finish]. The sequence is repeated for the second finish [2a, 2b] but it is possible that the heavy white layer 2a was exposed for a period of time. The restoration period finish is the same light yellow as seen on the siding [3]. The later finishes are also indicated.

Note: The same paint sequence was observed on the following samples:

Store front enframement: Panels below shop windows Store front, Doors: Panels below glass panels

Sample: 1928 West Elevation: Store front enframement

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



Note: The sample has been mounted in polymer resin, cut and polished to 8000 micron grit polishing cloth for additional examination. The store enframement has somewhat unusual paint sequence.

The wood substrate is seen at the base of the sample as is indicated. The first finish is comprised of a lead white primer [1a] and a moderate bluish gray finish [1b]. There is a second darker gray finish [2]. Either gray may be a possible reusing of a gray paint from the second finish on the 1906 section.

The third finish, estimated to be ca. 1945-1950 is the brown finish seen on other trimwork, and relating to the Sinclair watercolor. The fourth finish is a later green finish. The later finishes [5] are also indicated.

Sample: 1928 West Elevation: Porch Bead Board Ceiling

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



Note: The sample has been mounted in polymer resin, cut and polished to 8000 micron grit polishing cloth for additional examination. The wood substrate is seen at the base of the sample. This is a remarkable sample for the indication of the pigments used in the preparation of the earlier finishes.

The first finish is a fine moderate purplish blue [1] prepared with lead white and distinctly seen artificial ultramarine blue [note pigment particle P-1]. The same combination of pigments is used for the second finish [2]. The third finish, which is estimated to date to the restoration period 1945-1950 is clearly seen: the blue pigment is Prussian blue [note particle P-3]. Note the later finishes [5, 6, 7] are all variations on *sky blue* though they show discoloration.

Sample: 1928 West Elevation: Turned columns

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



Note: The sample has been mounted in polymer resin, cut and polished to 8000 micron grit polishing cloth for additional examination. The wood substrate is clearly seen at the base of the sample. The first white finish [1] and the second gray finish [2] are from the period between 1928-ca. 1945-1950. The third finish is the dark brown [3] that relates to the Sinclair watercolor. The later finishes are also recorded and indicated.

Outriggers and Nailers:

These elements, seen on page 30, were not painted as anticipated, that is as the turned columns and lintels were, with the dark brown finish in ca. 1945-1950. The outriggers and nailers were painted with the same light yellow finish as seen on the Siding.

Sample: 1928 addition, East elevation Re-used door, 19th Century Italianate style

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



Note: The view of this sample is looking down onto the finish surface; the sample has been subject to delamination of some of the later paint layers in order to afford this view. The wood substrate is clearly seen and is indicated. The first layer is a primer and ground coat: layer 1-a, that is prepared with lead white and earth pigments: this is the ground for a <u>walnut graining finish</u>. The graining and varnish glaze layer [1-b] is clearly seen: this layer is prepared with burnt umber, raw umber and black pigments. The figuration of the wood that is emulated is seen within this layer. 1-b also shows the varnish coatings that were used to preserve and finish the emulation of the dark walnut. The yellow finish that is clearly seen appears to be from the third finish period [3] estimated to be ca. 1945-1950.

It is entirely possible that this door is from a demolished house of the mid-late 19th century. Doors from early houses have always been salvaged from demolition and reused. This is one such example.

Restoration Finish Schedule:

The finishes of ca. 1945-1950

The Catoctin Furnace Store has been closed and unused for approximately 50 years, thus accounting for the severe condition of the remaining paint finishes. The south elevation has the greatest amount of paint loss. The remaining paint layers do contain lead pigments and must be handled appropriately, particularly since most of the surfaces show that the paint layering is unstable and will require removal before restoration painting.

The colors of the period were matched to modern paint colors, using the Benjamin Moore and Company Color lines.

Peter Sinclair Watercolor, showing the layout of the colors



1945-1950 period colors

- 1. All Siding: Light yellow: Benjamin Moore CW-395 ["Governor' Gold" *Colonial Williamsburg line*] Gloss level: Semi-Gloss
- 2. All Window and Door Frames: Dark Brown: Benjamin Moore HC-71 ["Hasbrouck Brown *Historical Colors line*] Gloss level: Semi-Gloss

- **3.** All Window Sash and Transoms: White: Benjamin Moore OC-61 ["White Diamond" *Off-White Colors line*] Gloss level: Semi-Gloss
- 4. All Shutters: Dark Brown: Benjamin Moore HC-71 ["Hasbrouck Brown *Historical Colors line*] Gloss level: Semi-Gloss
- 5. All Trimwork: Soffits, Fascia boards, Corner boards: Dark Brown: Benjamin Moore HC-71 ["Hasbrouck Brown *Historical Colors line*] Gloss level: Semi-Gloss
- 6. West Elevation: Five Panel Door: [refer to illustration, below]

Rails and Stiles: Dark Brown: Benjamin Moore HC-71 ["Hasbrouck Brown Historical Colors line] Gloss level: Semi-Gloss Panels: Light yellow: Benjamin Moore CW-395 ["Governor' Gold" Colonial Williamsburg line] Gloss level: Semi-Gloss

- West Elevation: Store front enframement: All surfaces, except panels: Dark Brown: Benjamin Moore HC-71 ["Hasbrouck Brown *Historical Colors line*] Gloss level: Semi-Gloss
- 8. Store front enframement: Panels below shop windows: Light yellow: Benjamin Moore CW-395 ["Governor' Gold" *Colonial Williamsburg line*] Gloss level: Semi-Gloss
- **9.** Porch Board and Batten Ceiling: Moderate blue: Benjamin Moore CW-605 ["Palace Blue" *Colonial Williamsburg line*] Gloss level: Semi-gloss
- **10. Lintels of Porch:** Dark Brown: Benjamin Moore HC-71 ["Hasbrouck Brown *Historical Colors line*] Gloss level: Semi-Gloss [refer to illustration below]
- **11. Turned columns: :** Dark Brown: Benjamin Moore HC-71 ["Hasbrouck Brown *Historical Colors line*] Gloss level: Semi-Gloss [**refer to illustration below**]
- **12. Outriggers and Nailers:** Light yellow: Benjamin Moore CW-395 ["Governor' Gold" *Colonial Williamsburg line*] Gloss level: Semi-Gloss
- 13. South and East Elevations: Bead board Doors and Door frames: Dark Brown: Benjamin Moore HC-71 ["Hasbrouck Brown *Historical Colors line*] Gloss level: Semi-Gloss
- 14. 1928 East Elevation: Re-used 19th century door Light yellow: Benjamin Moore CW-395 ["Governor' Gold" Colonial Williamsburg line] Gloss level: Semi-Gloss [refer to illustration below]
- **15. Re-used 19th century door frame:** Dark Brown: Benjamin Moore HC-71 ["Hasbrouck Brown *Historical Colors line*] Gloss level: Semi-Gloss

West Elevation: Five panel Door Restoration finishes



Porch Ceiling and Lintels:



Turned Columns and Outriggers





1928 East Elevation Re-used Door, frame, etc.

Additional elements of the Store building:

Store front entrance:

Above the door to the store there are vertical bead board wall sections: all of these locations are to be painted in the same color as the bead board ceiling: Moderate blue: Benjamin Moore 2057-50 ["Turquoise Powder"] Gloss level: Semi-gloss

Porch Fascia board:

Dark Brown: Benjamin Moore HC-71 ["Hasbrouck Brown *Historical Colors line*] Gloss level: Semi-Gloss

End of Finish Schedule

Color standards: CIE Lab coordinates, Hunter Lab

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

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

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

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



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



In addition, the Munsell Color Conversion Number is also provided. The Munsell Color System is a universally accepted system of color notation.

F.W. Fraley Store Exterior

Light yellow: Benjamin Moore CW-395 ["Governor' Gold" *Colonial Williamsburg line*] Gloss level: Semi-Gloss



F.W. Fraley Store Exterior

Dark Brown: Benjamin Moore HC-71 ["Hasbrouck Brown Historical Colors line] Gloss level: Semi-Gloss



F.W. Fraley Store Exterior

Moderate blue: Benjamin Moore 2057-50 ["Turquoise Powder"] Gloss level: Semi-gloss



F.W. Fraley Store Exterior

White: Benjamin Moore OC-61 ["White Diamond" Off-White Colors line] Gloss level: Semi-Gloss



CIE Lab, Hunter Lab Coordinates, Munsell Color Conversion Numbers

Light yellow: Benjamin Moore CW-395 ["Governor' Gold" Colonial Williamsburg line]

CIE Lab coordinates Designated observer 2 degrees Illuminant C

L* = 87.11 a* = -0.98 b* = 33.29

Hunter Lab: L* = 87.11 C*= 33.31 h degrees = 91.69 Munsell Conversion Number: 3.14Y8.59/4.59

Dark Brown: Benjamin Moore HC-71 ["Hasbrouck Brown Historical Colors line]

CIE Lab coordinates Designated observer 2 degrees Illuminant C

L* = 37.63 a* = 7.47 b* = 8.43

Hunter Lab: L* = 37.63 C*= 11.26 h degrees = 48.47 Munsell Conversion Number: 2.80YR3.66/1.91

Moderate blue: Benjamin Moore 2057-50 ["Turquoise Powder"]

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CIE Lab coordinates
Designated observer 2 degrees
Illuminant C
L^* = 73.53 a^* = -12.53 b^* = -14.33
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Hunter Lab: L* = 73.53 C*= 19.03 h degrees = 228.84 Munsell Conversion Number: 6.41B7.20/4.56

White: Benjamin Moore OC-61 ["White Diamond" Off-White Colors line]

CIE Lab coordinates Designated observer 2 degrees Illuminant C L* = 93.37 $a^* = 1.15$ $b^* = 2.06$

Hunter Lab: L* = 93.37 C*= 2.36 h degrees = 119.07 Munsell Conversion Number: 5.03GY9.23/0.25