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Weir Farm National Historic Site
Weir Studio
Record of Findings: History of the Interior Appearance

Judith M. Jacob, Senior Conservator
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Cover: J. Alden Weir in his studio, c.1905 [Weir Farm NHS, WEFA HP 151]

I. Introduction

The primary resource of Weir Farm National Historic Site (Weir Farm NHS) is the studio in which Julian Alden Weir painted. In preparation for the opening of his studio to the public, the interior fabric was examined to better understand its appearance during Weir's tenure. This report documents that appearance, as well as the appearance following his tenure, up until 2005, when the life tenancy at the property ended and the National Park Service (NPS) assumed full stewardship of the Weir Complex of buildings.

The study of Weir's studio was made over the course of ten years, from 2006 to 2012. During this time, the building was slowly emptied of its furnishings enabling the close examination of all exposed structural elements and surfaces. Observations and discoveries were documented with digital images and written notes, the latter used for the generation of this report. The study revealed materials and configurations of features more complex than originally thought, and in several cases, different than previously held notions of historic appearances.

Weir constructed his studio in 1885. He painted there, mostly during the spring, summer, and fall, up until a year before his death in 1919. The General Management Plan calls for the studio to be "furnished to interpret his use of the structure."[1] With the findings of this study, it was recommended that the interpretative period focus on Weir's use from 1900-1918, after modifications were made to the windows, walls, and ceiling—creating a color-neutral environment in which to paint—and before he began using the space for storage. For the most part, and excluding the aging effect of time, this appearance exists today.

II. Research and Documentation

The General Management Plan, draft Historic Structure Report (HSR),[2] and Historic Furnishings Report (HFR)[3] were prepared in the 1990s; the HFR was revised in 2003.[4] During the 1990s (and up until 2005), the studio was being used for storage and access to all surfaces was not possible, resulting in numerous inaccuracies in the reports. Despite these inaccuracies, the research presented was enormously useful for the preparation of this report, especially the transcribed excerpts from Weir's letters and other primary documents.

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[1]National Park Service, North Atlantic Region, Division of Planning, "Weir Farm National Historic Site: General Management Plan/ Environmental Impact Statement," September 1995, p. 25.

[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] David H. Wallace, "Historic Furnishings Report; Weir House, Weir Studio, and Young Studio; Weir Farm National Historic Site; Wilton, Connecticut," Division of Historic Furnishings, Harpers Ferry Center, National Park Service, draft report,1995.

[4] David H. Wallace, "Historic Furnishings Report; Weir Farm: Historical Information on the House and Studios and a Furnishing Plan for the Julian A. Weir and Mahonri M. Young Studios; Weir Farm National Historic Site; Wilton, Connecticut," Department of Historic Furnishings, Harpers Ferry Center, National Park Service, 2003.

Plans of the studio were prepared in 1995.[5] These are found in the draft HSR.

Historic photographs, mostly from the collection of Weir Farm NHS, greatly aided in the understanding of the appearance of the studio during Weir's later years. Photographs of Weir's studio, and one of Weir's drawings, are presented, as an ensemble, at the end of this report.

Over the course of the study, digital images were made to document specific features and conditions. In 2012, a set of images was made by Christopher Payne (Christopher Payne Photography, New York, NY) to document the interior of the studio following its cleaning and preservation work, and before installation of furnishings. Payne's images are presented at the end of this report.

Samples of finishes (paints and varnishes) were extracted from walls and woodwork for information on finishes history; a list of these samples is presented in Appendix A. In 2009, Susan Buck (conservator in private practice, Williamsburg, VA) further examined finish samples and her report, "Cross-section Paint Microscopy Report," is presented in Appendix B.

All project notes and digital images are filed in the Northeast Region's New York City office. A copy of this report and Payne's images have been transmitted to Weir Farm NHS and to the Denver Service Center's Technical Information Center's electronic database (eTIC). Paint samples extracted from the studio and the remains of a cabinet that were formerly in the studio have been accessioned into the Weir Farm NHS collection (Accession No. WEFA-00192).[6] A florescent light and remains of a rack that were removed have been discarded. Fragments of a heat shield that were removed are stored in the studio's closet. The pieces of ephemera that were tacked to the walls and woodwork have been removed and placed with the Sperry Andrews collection; this collection has yet to be cataloged.

III. Description of the Interior

The interior of the studio measures 480 square feet in area, and has a 14-foot high ceiling.[7] Entry is through a set of double doors on the east side. Light comes in through a set of five windows in the north wall and two in the east wall. A door to a closet is located in the west wall.[8]

Interior features of the studio will be described first, followed by a description of their finishes.

Walls and eaves (on the east and west sides) are covered with a single coat of coarse plaster. Plaster was trowel applied. Some areas were brushed and other areas floated, and marks from these tools

[5] 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 studio was created by the NPS, Northeast Region, Building Cultural Resources Center, Building Conservation Branch, and is dated 1995. 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.
[6] Paint samples extracted for the preparation of the draft HSR are in the Northeast Region's office in Lowell, MA.
[7] Henceforth, dimensions of elements will only be given if they are necessary to the description of those elements.
[8] The interiors of the woodshed, studio closet, and water tower were given cursory examinations and are otherwise not included in this study.

are visible. The junctions of walls and eaves are articulated by grounds (3-inch wide boards) running the length of the space.

The ceiling is constructed with tongue-and-groove bead boards (9¼ inches wide on face, bead-center-bead) running in a north-south direction. A trap door, made of the same boards as the ceiling, is situated at the south end and provides access to the attic. Small plaster stars are nailed to the ceiling, in between the boards, in a seemingly random arrangement.

The floor is constructed of tongue-and-groove boards, set in an east-west direction.

The two entry doors opening into the studio differ in size and component materials. The north door (36 inches wide) is fabricated from 5¼-inch-wide boards with additional pieces attached to the top and bottom; it is fixed to the casing with two decorative brass butt hinges. The door has a set of dark-brown porcelain knobs, a contemporary dead-bolt lock, and a Dutchman marking the location of the former lock. The south door (51 inches wide) is fabricated from tongue-and-groove bead boards (9¼ inches wide on face, bead-center-bead), and it is fixed to the casing with three T-hinges. Both doors are reinforced with cross braces on the exterior. An unpainted stop is nailed to the interior side of the north door along its south edge. There are numerous nails, tacks, and nail and tack holes on the interior sides of both doors.

Almost all of the light in the studio comes through the north windows. A large double-hung four-over-four window occupies the center with two single-pane windows to either side. The two sash of the center window are not a matching pair, they do not have the same profiles or muntins, and mortises in the rails of the top sash mark the former locations of four additional muntins. The two single-pane windows, non-opening, have sash lifts on their bottom rails.

Below the single-pane windows are two multi-pane windows (thirty panes each) with sash that originally slid up into pockets within the wall. Small brass stops on the sash, fixed to the bottom corners, were used to secure the window in an open position; casings have three notches on each side allowing for three open positions. The window pockets are faced with 18-inch-high vertical boards which are now only partially extant as the top portions were cut away when the single-pane windows were installed. Three of the boards of the east-window pockets are bead boards (5 inches on face). A shelf surmounts the west multi-pane window and is supported by wooden brackets nailed to the casings. Ghosts[9] of brackets are visible on the casing of the east multi-pane window.

Two multi-pane windows (thirty panes each) are set, side by side, in the east wall. The panes are partially covered with the remains of a varnish (eight of the panes have been either reset or replaced and are not varnished). These windows also slid up into pockets, 14 inches high, within the wall; two brackets for a shelf, mounted onto the casings, flank the windows on either side. The south sash has a brass stop and the north window has the ghost of a stop.

Four window openings—two pairs, side-by-side—are set in the west wall. Window openings are covered with tongue-and-groove bead boards set horizontally. Boards of the north window

[9] For this report, a "ghost" refers to the footprint—defined by a lack of paint or excess of paint—left by the removal of an object in a location that is of the same dimension and size of the footprint of that object. A "ghost" may also refer to differential soiling on a wall that marks the former location of an object situated on or against that wall.

openings are 3½ inches wide on face (bead-triple-center bead) and those of the south window openings are 3½ inches wide on face (bead-triple-center-bead and bead-center-bead). Pockets in the wall, faced with boards—16 inches high on the north end and 15½ inches high on the south end—are situated above the window openings. Ghosts of brackets are visible on the casings on either end of the south window openings. Two shelves are situated over the north window openings: one directly over the window openings and the other directly over the pocket-facing boards, mounted on similar brackets, and of slightly longer length than the lower shelf.

Brackets above the top shelf on the west wall, and above the shelf on the north wall, have an extra piece of wood—a spacer—positioned above them; those above the brackets on the north wall were cut from a tongue-and-groove board.

One small window opening is situated at the top of the south wall, between the studio and attic. The sash is now in an open position and only visible from within the attic. Slots in the exterior side of the casing indicate the former locations of louvers. The bottom rail of the casing has a bead along its bottom edge.

Baseboards mark the perimeter of the studio.

The closet door cuts into the south window openings in the west wall. The studio side of the door is faced with two boards (the south board has a bead along the north edge) with ghosts of two strap hinges on the south side and the ghost of a latch on the north side. The door is fitted with two butt hinges on the north side and a lock box and dark-brown porcelain knobs on the south side.

A wood beam spans the center of the studio, east to west, and is set into the walls just below the eave line. Braces secure its position at either end. All three elements are rough sawn and the east end of the top south edge of the beam is chamfered. Two wires hang down from the beam and are associated with a former fluorescent-light fixture.

One rough-sawn board is nailed to the north wall at the west end, extending from the floor up to the height of the shelf. A 2-inch wide piece of wood molding, rounded on the bottom arris, is nailed to the west wall, positioned between the casing of the south window and the south wall, just below the bottom of the pocket-facing boards.

At the onset of this study, a wooden rack was attached to the east wall at the south end of the space. Now, only one piece remains: a 5-inch-wide rough-sawn board that is nailed to the wall, between the tops of the window-pocket facing boards and the eave line, and extending from the south wall to the center beam's east bracket.

The cast-iron stove is positioned on the west side of the studio, near the center of the space, and is seated on two heat shields that protected the floor from sparks. The top shield is a piece of sheet steel, roughly cut to a square shape. The shield beneath is also a steel sheet, square with rounded corners, embossed with a floral pattern and a sounding "rope" edge. A rectangular strip, cut from an embossed shield, is situated in between the two. Another steel sheet, bent to a right angle, is fixed to the bottom of the wall behind the stove and positioned in front is another rectangular strip of the embossed shield. A stove pipe connects the stove to a brick chimney. The chimney is seated

on a wooden shelf, supported by a diagonal brace; the three exposed faces of the chimney are plastered. Pieces of an embossed shield are nailed to the east-west beam, the brace, and one of the chimney-framing members.

Numerous nails, tacks, pushpins, and nail (tack and pushpin) holes are found on (and in) walls and woodwork.

Walls and eaves are covered with a thin gray paint. Consecutive layers of paint were applied to the east, south, and west walls in a haphazard fashion with many splotches and drips. Specifically, these multiple layers are found from the floor up to the height of the tops of the window-pocket facing boards on the south wall, on the south end of the east wall (ending at the door), and on the south end of the west wall (ending just behind the stove). There are several ghosts of large pieces of furniture or paintings on the walls, with some ghosts overlapping each other. In the center of the north wall, beneath the windows, are numerous multi-colored paint spatters. Penciled notes, including a "JW," are found in the northeast corner.

The ceiling was originally painted blue green and adorned with gold-painted plaster stars, nailed into place. The entire ceiling is now covered with gray paint, similar to that on the walls. At the onset of this project, the gray paint was flaking extensively and much had fallen off. In areas where the gray paint had been lost, the blue green paint was revealed and showed two shades: lighter and darker, with the latter shade the result of soiling.

There is evidence of at least two painting campaigns on the floor, both with dark gray paint of slightly different hue and sheen. In several locations, the second campaign stops short of the wall and marks the positions of former pieces of furniture. Large scuffed-off areas are present, primarily in the center of the floor, and where paint is intact, it is covered with multi-colored paint spatters and little pieces of tape.

The interior faces of the east doors are painted green and their casings (and hinges) are painted the same.

Almost all elements associated with the windows and shelves are painted with a water-soluble matte black paint. The exceptions are as follows: the bottom sash of the center north window is painted white and the casings for the two single-pane north windows are unfinished. The undersides of shelves are unfinished, as are sides of the brackets that abut the walls. The casings for the south window, and the casings and bead boards of the southern-two west windows, are painted gray.

Baseboards are painted with a water-soluble matte black paint. The baseboards to either side of the east door are painted green.

The white paint that covers the center beam, its associated braces, and the window-pocket facing boards is friable and much has been lost. Thirty nails are positioned along the center of the north face of the beam and some are surrounded by a dark mark, as if something that was attached to the nail contained a substance that bled into the paint. The pocket-facing boards of the southern west windows are painted the same gray of the casings and walls.

The studio side of the closet door, and its casing, is painted the same gray as that of the walls. Areas of damage on the door reveal former dark green, light green, and ochre finishes. The closet side of the door is paneled and bears the degraded remains of a *faux bois* finish.

An extensive amount of dark resinous material has dripped over the bead boards of the southern-most west window and appears to have come from within the wall cavity.

There are numerous drips down the chimney and adjacent wall. Drips may be due to small roof leaks, condensation, and some may be creosote or another material associated with the chimney.

The cast iron stove has extensive remains of a former black coating. The stove pipe is comprised of five sections of differing dates (finishes and condition differ). The embossed heat shield and associated fragments have the remains of a silver-colored finish.

Remains of cloth-covered wires and a light socket from the original electrical system are found on top of the east-west beam at the east end. A rigid electrical metallic conduit penetrates the east eave, above the door, and is fastened to the wall at the edge of the north door surround; it terminates at a two-gang switch box with a steel cover plate. Two dark-brown plastic wall plates, each with two three-prong outlets, are set into the baseboard on the north wall at the east and west ends. A brass disk marks the location of an electrical outlet in the floor, behind the stove adjacent to the west wall; the disk was not removed to confirm the presence of the outlet.

IV. History of the Interior Appearance

In 1885, Weir had a studio constructed on his Branchville property (Figure 1). Sometime between 1899 and 1901, an addition housing a water tank was constructed adjacent to the south wall and a shed (called the "woodshed") was constructed adjacent to the west wall (Figures 5-8). The closet to the studio is housed within the woodshed.

The interior of Weir's studio retains its original plan and massing, portions of its original fenestration, and portions of its original finishes scheme. Over the years, Weir modified his studio to better control the amount and direction of light, and to create a color-neutral environment in which to paint. These modifications exist today.

The most important feature of an artist's studio, especially for a painter using a canvas or panel placed on an easel, is light. North light is desired for its cool and consistent color temperature. The easel is placed somewhere in the middle of the space where the artist can comfortably take a step back to view his work. If the artist is painting a model or a still life, that model or still life is positioned at the south end of the studio. Understanding the necessity of north light and the location of the easel in the center of the space is critical to understanding Weir's use of his studio and his decisions regarding fenestration and finishes. (Note: the oak tree directly to the north of the studio did not exist during Weir's tenure.)

Descriptions of the finishes of Weir's New York City home and studios provide insight to his choices of finishes for his Branchville studio. From 1880-1886, Weir kept a studio in the Benedict

Building on Washington Square. In 1886, he moved his studio to his home on East 12th Street and later, in 1902, moved it again to the Studio Building on West 10th Street.[10]

> My [Benedict Building] studio I have been having decorated this time in a very simple way stearing [*sic*] clear of as much bric a brac as possible, . . . keeping my walls quite simple. I have had my ceiling painted blue with stars unnumerable besprinkled about, then one can study astronomy & the great bear walks about, who knows about the little dipper & the big hour green cheese & crackers. . . .[11]

> . . . Weir had a studio in the Benedict Building, which was inhabited by a group such as Bunce, Eaton, Low, Saint-Gaudens, and Warner. This was about 1882. As Weir and I have looked around the bare studios of his later years—warm gray walls, a chair for the model on the movable platform, one easel, a perfectly plain folding screen, and nothing else, we have laughed a the luxurious studio of the young man just back from Paris, fitted up by Cottier—velvets, tapestries, brocades, a Gothic cabinet, Louis Quatorze chairs, a couch, rugs, armor, a full length copy of a Velasquez by Weir himself over the mantel, and a great yellow Venetian glass bowl filled with goldfish and hung by brass chains from a rough ceiling of darkest blue studded with stars of varying magnitudes and one impossible comet, all exceedingly decorative.
>
> Weir had colored his windows to imitate stained glass, and altogether it was a studio out of a French novel, but I need not say that, though elegant, luxurious, even sensuous, it was in perfect taste. . . .[12]

> The ceilings in the [New York City] dining room and in the studio were plaster, colored a light blue and studded with gold stars. . . . From the dining room you walked through wide sliding doors into the studio. . . .[13]

Four photographs (undated) of Weir's New York studios show fairly dark settings, although the photographs may be misleading in this regard. Two of the photographs show rooms filled with furniture and collections of objects (Figures 19-20). The other two photographs, both with Weir, show interiors only very slightly less filled with furniture and objects (Figures 21-22). Weir appears to be in his mid-to-late 40s; it may be that he had yet to discover the "bare studios of his later years" or, these two images actually do depict less clutter and "clutter" and "bare" are relative terms that need to be considered as such.

Clearly, Weir paid great attention to the appearance of his surroundings, both in his home and in his studios. It is also clear that as he aged, he moved from highly decorative schemes to ones of greater simplicity.

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[10] Dorothy Weir Young and Lawrence W. Chisolm, ed., *The Life and Letters of J. Alden Weir*, New Haven: Yale University Press, 1960. [Wallace, HFR, 2003, pp. 365-367.]

[11] J. Alden Weir [JAW] to John Ferguson Weir, October 1, 1880, John Ferguson Weir Papers, Weir Farm NHS, WEFA 197, Box 1, Folder 5.

[12] C.E.S. Wood [CESW], "A Letter," in *Julian Alden Weir; An Appreciation of His Life and Work*, The Phillips Publications, Number One. New York: E.P Dutton & Company, 1922, p. 103.

[13] Caroline Weir Ely, *11 East 12th Street*, privately issued, 1969, Weir Farm NHS, WEFA 6578.

The history of the interior appearance of Weir's Branchville studio is divided into three periods. The first period, 1885-1899, marks the appearance when the building was completed in 1885, and includes minor alterations made in the following fourteen years. The second period, 1900-1918, marks the appearance following Weir's substantial alterations to fenestration and finishes, ending when the space is filled with excess furniture from his New York City home. The third period, 1919-2005, marks the years between Weir's death and the death of Sperry Andrews, the last resident of the property; during this period, the building was used primarily for storage with some studio use by Mahonri Young (Weir's son-in law) and Andrews.

A. 1885-1899 Appearance

In 1885, Weir wrote to his sister-in-law, Ella Baker, with good news: "My studio is now finished."[14] The description of the 1885-1900 appearance focuses on the appearance in 1885 or 1886, when Weir had completed the building and had moved in. It is not known for how long the initial appearance remained intact or when his first modifications began. Three photographs show the exterior during this period (Figures 1-3).

For his Branchville studio, Weir constructed a building that was simple in both plan and execution. A number of elements appear to have been salvaged from dismantled structures or gathered from stock piles of lumber or building elements remaining from other construction projects.

With their rough sawn surfaces, weathered-gray wood, and friable white paint, the east-west beam across the center of the studio, its associated braces, and most of the window-pocket facing boards suggest materials that had been formerly located in another structure. The purpose of the nails and origin of the associated marks along the center beam are not known. The plate above the east door (exposed when siding was replaced a number of years ago) has a mortise in the center that does not correspond to either of the two doors.[15] Perhaps a different door was envisioned during framing, or the plate was salvaged from a dismantled structure.

The two exterior doors of the studio do not match. The north door most likely came from another structure and was lengthened (top and bottom) to fit its new location; its original hinges remained in place. Originally, both exterior and interior faces were painted or stained dark red. When the door was installed in the studio, the interior face was painted black. The corresponding south door is constructed with the same tongue-and-groove bead boards as those of the ceiling, suggesting that the door was constructed specifically for this location at this date. Like the north door, the interior face was painted black.

[14] JAW to Ella Baker, Branchville, July 7, 1885, Archives of American Art [AAA] microfilm Reel 125, Frame 363. Note, in the following year, Anna Weir wrote to her sister "Julian's studio is finished, and is as comfortable as possible." [Anna Weir to Ella Baker, Branchville, August 6, 1886, AAA Reel 125, Frame 379.] While the different dates were most likely not mistakes of the authors, It is possible that the shell of the studio was completed in 1885 and the interior completed in 1886, and also possible that Anna's note of "finished" referred both to the building itself and the interior finishes and furnishings. It is also possible that that Anna was simply noting that the building was finished, and the fact that it had been finished the year before was not of significance to this letter.

[15] Carden, et al., HSR, p. 248; and Tom Ballos, "Completion Report, Weir Farm Barn Preservation, Weir Studio Exterior Restoration," National Park Service, Northeast Cultural Resources Center, Building Conservation Branch, 1998.

The interior of the studio was illuminated with natural daylight with the large center window in the north wall providing the principle light. Additional light was furnished by eight multi-pane windows located in the north, east, and west walls. The small window at the top of the south wall was covered on the exterior by fixed louvers. All windows could be opened for ventilation.

With differing muntins, the top and bottom sash of the center north window were clearly not obtained as a pair. The top sash originally contained eight panes and at some point, the panes and four muntins were removed and replaced with four larger panes, and the unit turned on its side for installation. The bottom sash may or may not have been specifically fabricated to pair with its upper partner. The two different sizes of the multi-pane windows (30-pane and 36-pane), and a first paint layer of white on some of the sash, indicate their salvage status.

Photographs dating from 1885-c.1905, depict the east windows with a distinct glare (Figures 1-4). The glass of these windows is now partially covered with deteriorated varnish, and this varnish may be the cause of the glare. Varnish may have been applied to darken the light coming into the room or— if colored—to provide a decorative aspect to the interior; it is also possible that a matting agent was added to the varnish to provide a "frosted" appearance. (In 1900, a cabinet was built against the wall that completely covered the windows; varnish would not have post-dated the cabinet.)

Measurements of the west window casings indicate two thirty-pane sash at the north end and two thirty-six-pane sash at the south end. The extent to which light could penetrate these windows is not known. Exterior shutters, hinged at the top, were fixed above the windows. (Shutters are still in place and closed over the window openings.) Because the west windows are set high on the exterior wall, opening and securing the shutters from the outside would have only been possible with a ladder. Opening and securing the shutters from the inside would have required the operator to push them forward and fasten them to the siding while leaning out of the window. Unfortunately, no evidence of fastening devices exist to suggest in what manner and to what degree the shutters could be propped open. The several nails in the siding on the exterior, above the windows, are in locations that do not relate to the shutters.

The southwest corner of the studio is depicted in an etching from 1890 (Figure 11). In this image, Weir shows a small child sitting in the corner, facing the window, and painting. While difficult to determine exactly, there appears to be a curtain on the south side of the window and maybe one on the north side too. Placing curtains over the windows would have been a far easier means of regulating light than maneuvering exterior shutters. While there are a number of nails and nail holes in the top window casings of the west windows, none definitively mark former locations of curtain rods or tiebacks.

The attic window in the south wall provided ventilation to both the studio and the attic above and with its exterior louvers (no longer extant), would have provided only the barest amount of illuminetion to the interior. Originally, the sash was operated from the floor by means of a rope and pulley.

Wooden shelves, supported on brackets, were positioned above each of the multi-pane windows.

The walls and eaves of the studio were given a rough plaster finish. Brush marks are, however, curious and there may be two possible reasons for their presence: either the scratch coat was laid in preparation for a second coat (that never came) and the wet surface brushed to provide a texture for keying this second coat or, the rough surface of a scratch coat was desired and brush marks provided additional texture.

Walls and eaves were painted with a water-soluble paint, dark brown in color (iron oxide pigments), matte, and textured or bulked with a fine aggregate. The paint reacts positively for proteins, indicating a glue binder.[16] Distemper paints are made with whiting (ground chalk), glue, and pigments; they are inexpensive and fast drying. Weir's paint is a pigmented glue-base material, similar to a distemper but without the whiting.

Extracted paint samples show a layer of plant-resin varnish covering the brown paint. Varnish may have been applied to enrich the brown color, or may have been applied later, in 1900, in preparation of the next painting campaign. In the few small areas where brown paint is visible—the meeting of the west wall and eave—varnish is not present. However, while this lack of varnish may indicate an original unvarnished surface, determining this is not possible. Abraded areas on the walls, especially on the east eave at the north end, have no trace of brown paint. It is possible that the brown paint was applied quickly and not completely and again, determining this is not possible. What can be said is that in 1885, or in the following year or two, Weir painted his studio walls with a dark brown paint and may or may not have applied a varnish as well.

The ceiling was the primary decorative architectural feature in the studio. It was painted blue green and covered with gold-painted plaster stars. Stars have a hole in the center, through which a nail was used for fastening. Almost all of the stars are broken and many of the fastening nails are bent to hold the broken star, suggesting that broken stars were salvaged from another location and brought to Branchville. Nails and star-shaped areas not covered with later paint indicate that there were originally more stars than at present. The pigments of the blue green paint are comprised of calcium carbonate, synthetic ultramarine, yellow ochre, burnt sienna, carbon black, and possibly some raw umber and lead white. The binding medium showed a positive reaction for proteins and carbohydrates and a weak reaction for oils, suggesting an emulsion that contained glue, starch, and oil.[17] In samples extracted from the ceiling, a pigmented varnish was found directly on the wood. The varnish could have been factory applied, or applied prior to painting as a sealer. It is not known if varnish covered the entire ceiling.

Today, the visible areas of blue green paint on the ceiling are mottled, with some areas darker in color than others. A close examination of the surface, an *in situ* cleaning test, and a microscopic examination of samples, suggests that the areas of lighter blue green match (or closely match) the original paint color and the areas of darker blue green are soiled.

[16] Information on paint composition was provided by Buck.

[17] In her study of finishes, Buck examined both samples taken from the ceiling and from the top edge of the eave adjacent to the ceiling. She found some variations in the pigments, possibly due to the location of the eave sample: an area that may or may not have received a full coat of wall paint and a varied amount of painted-over ceiling paint. Likewise, the protein component may have been that of the wall paint. The blue green paint may have been an emulsion, it may also have been an oil; it is not soluble in water.

Most of the woodwork in the studio (excluding the center beam, brackets, and window-pocket facing boards) was painted black with a water-soluble paint. The bottom sash of the center north window was painted white, or more likely, arrived on the building site already painted white. The floor was finished with a dark brown stain.

The studio, with its brown walls, black woodwork, and fewer north windows, would have been a fairly dark place. The ceiling, on the other hand, would have been lighter and brighter, and the gold stars would have had a pronounced visual presence.

Of all the nails, tacks, and nail and tack holes in the walls and woodwork, some, undoubtedly, date to the first period of Weir's tenure.

While the cast iron stove is not original, its location—in the center of the space beneath the chimney—is original. The stove (or the presence of a stove and chimney) indicates Weir's use of his studio beyond the warmest months of summer. Various stove parts from Sears Roebuck & Co., now in the Weir Farm NHS collection (WEFA 2197 and WEFA 2198), may have been components of the original stove.[18]

B. 1900-1918 Appearance

The 1900-1918 appearance of the studio is marked specifically by Weir's alterations to light and color. Alterations were made in 1899 and 1901, and possibly in 1900 as well; major alterations were made to the house in 1900-1901. For ease of discussion, the period of 1899-1901 will be designated as "1900." At this time, light in the studio was adjusted and modified (two large north windows were installed and the four west windows were removed) and the walls and ceiling were painted. In addition, a woodshed was constructed adjacent to the exterior west wall and a water tower was constructed adjacent to the exterior south wall (Figures 5-8). A closet was constructed at the south end of the woodshed with a door cut into the studio wall.

In a letter dated August 1, 1899, Weir's good friend, C.E.S. (Charles Erskine Scott) Wood, notes the installation of the two north windows: "I shall probably be east sometime during next winter, and then shall hope to see the results of the new studio windows."[19] Whether Wood is responding to a description of new windows or a plan for new windows is not known. However, the letter provides the date—give or take a year—for this one particular alteration and also provides a clue to Weir's enthusiasm for new windows.

New windows were installed to either side of the center window. The facing boards of the multi-pane window pockets were cut to fit the new windows, greatly decreasing the extent to which the multi-pane windows could open. Both new windows have sash lifts on their bottom rail, indicating a former—or intended—function as working sash. Plaster damage created during the installation of the west window was not repaired.

[18] Carden interviewed Sperry Andrews in 1994, and it was his belief that the stove parts (then in storage in the Young Studio) may have come from the original stove in the Weir Studio [Carden, et. al., HSR, p. 252.]
[19] CESW to JAW, Portland, Oregon, August 1, 1899; AAA Reel 125, Frame 779.

With two additional north windows, whatever light was provided by the west windows was no longer necessary. Weir constructed a woodshed and closet adjacent to the exterior west wall, removed the four windows, and covered the openings with bead boards of the same dimension as those found in the house.[20] Shutters were closed and the shutters of the southern two windows were cut to fit the closet door and the wall between the closet and woodshed.

The four west windows that were removed from the studio appear to have been fit into two other structures on the site: the water tower and the Bindery (now attached to Young's studio and called the Etching Room).

In 1900 or 1901, the water tower was constructed to hold a tank that fed the new plumbing system in the house (kitchen, bathroom, laundry).[21] In 1994, while the roof of the tower was being repaired, a sheathing board, thought to be original, was found with the date of "May 1, 1901" written on it.[22] Two thirty-pane windows (stripped and painted in 1994) are set into the south wall of the water tower and are probably those removed from the west wall of the studio (Figure 8).[23] The louvers of the south window are no longer in place and may have been removed at this time.

Two thirty-six pane windows, probably the former south windows in the west wall of the studio, are now in the walls of the etching room of Young's studio. This room was formerly the Bindery, a small building assumed to have been located on the site; no information on its construction or original location has been found. The interior of the etching room is faced with the same bead boards (3½ inches on face, bead-triple-center-bead) as those used in the house and in the west windows in Weir's studio. The use of these bead boards and the presence of the multi-pane windows suggest a construction date of 1900 or sometime shortly thereafter (Figures 9-10). The sash of the windows are painted black and match those of the north and east multi-pane windows in Weir's studio.

The closet door of Weir's studio was clearly salvaged from another location. Hardware ghosts, trimmed top and bottom rails, and the degraded *faux bois* finish that does not correspond with any of the studio's finishes attest to its salvage status.

Over the years, Weir continued to modify incoming light with a variety of drapes that covered, or partially covered, windows. Two photographs show curtains and other fabrics hung over the north windows (Figures 5-6). Coverings are also present in a c.1934 photograph and it is not known if these were of Weir's or Young's design (Figure 7). There are many protruding nails in the casings of the north windows, a number of which have fibers attached to them.

A cabinet was constructed against the east wall, covering the two windows (Figures 12-14). The cabinet, presumably, served to both store items and block incoming light. The fact that it covered

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[20] In the house, bead boards face the walls and eaves of the attic, face the closet walls in the butlers' pantry, and were used to create partition walls in the basement.

[21] Plans: "Alterations in House of Mr. J. Alden Weir, Branchville, Connecticut" (n.d).; and specifications: "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).

[22] Carden, et. al., HSR, p. 254.

[23] In 1998, existing paint on both windows in the water tower was removed in preparation for repainting (white) [Ballos, "Completion Report."]. Paint samples extracted for this study had no remains of original paint.

windows that had already been covered with varnish, and that other modifications were made to the illumination of the studio, indicates that its light-blocking feature was intentional. The cabinet was constructed of bead boards, measuring 3½ inches wide on face. Boards that remain from the cabinet (now in the Weir Farm NHS collection)[24] and photographs show no painstaking endeavors to make a well-fitting structure: the northwest corner was poorly aligned and vertical boards were toe-nailed to the floor with no supporting seat.

At some point, the shelf above the east window on the north wall was removed. After the windows on the west wall were removed, the south shelf and brackets were repositioned above the pocket-facing boards of the northern-two windows; ghosts of the brackets for this shelf, on the window casings, have been painted over.

In addition to altering the light coming into his studio, Weir made changes to wall and ceiling finishes. While the actual date of these changes is not known, they were made following the installation of the two north windows, the covering of the west windows, the relocation of the south shelf on the west wall, and the installation of the closet door.

Weir painted the plaster walls and eaves with a gray distemper paint. He then painted the lower half of the walls of the southern portion of the studio with another coat of gray paint, applied in a splotchy manner and with many drips (Figures 12-13, 15). He painted the ceiling—stars and all—with the same gray paint.[25] The paint contains whiting, an extensive amount of carbon black pigment, lesser amounts of yellow ochre and synthetic ultramarine pigments, much lesser amounts of burnt umber, raw umber, burnt sienna, zinc white, and possibly indigo, and a glue (protein) binder. Pigment concentrations vary between paint layers.

Because distemper paint is water soluble, new distemper paint will dissolve the glue of an existing distemper paint and both layers will fail. The layer of varnish on the walls, covering the 1885 paint, would have acted to seal this paint and allow a second water-soluble paint to be applied on top; the application of varnish would have been far easier and less messy than washing off the old paint.

Following the first layer of gray paint, Weir struck a line across the south wall of his studio between the tops of the east and west windows. The entire wall below this line was painted again; gray paint was applied by flopping a paint-filled brush against the wall and quickly dragging and swirling it around. Excess paint was allowed to drip. This application method created a visually mottled surface and Weir was able to get a second layer down without disrupting the first. Weir then struck another line on the south wall, this time between the tops of the window-pocket facing boards, and repeated the operation. Paint was applied, in the same manner, to the east and west walls, to the height of the window-pocket facing boards and back to the chimney on the west wall, and back to the door on the east wall. There is no second application behind the cabinet, indicating that it was installed between the two applications of paint. The southern west

[24] At the beginning of this project, the rack on the east wall was disassembled; boards that had been part of the former cabinet (identified by their profile, painted surfaces, and hardware ghosts) were salvaged.

[25] In her study of finishes, Buck found the gray paint of the ceiling to be of different composition than that of the walls. With a second examination, and larger samples, the two paints were found to be the same in appearance and general pigment composition.

windows (bead boards and casings) and the closet door and frame were also painted. When looking at the walls, the second application of paint appears to be slightly purple and darker than that of the upper wall and north wall. This color is due to the build-up of the thin layers of paint and differences in pigment concentrations in the paint formulations.

Weir selected the color gray—a neutral color—for his studio walls. He also selected a mottled appearance. With his easel in the center of the space, facing south, he would have only needed a "backdrop" on the lower portion of the south wall and half-way back on the east and west walls. Wood described the studios of Weir's later years as having "warm gray walls."[26] The presence of yellow ochre in the paint provided the warmth that Wood described.

At the end of the nineteenth century, numerous recipes for distemper paint (often called "kalsomine") were published in books and periodicals. Ready-made distemper paints were also available. Weir probably made his own paint, replacing much of the whiting (called for in recipes) with black pigment. Judging by the friability of the paint today, Weir's estimate of an adequate amount of glue was terribly low. It is not known whether Weir himself painted the walls and ceiling, if the work was hired out, of if there was a collaborative effort.

The two new north window sash were painted black, or arrived on site already painted. Their casings were left unpainted.

The cabinet in the southeast corner of the studio was painted with a thin gray oil paint. The paint contains finely ground pigments, indicating a purchased product. The cabinet was painted in place, evidenced by the small dried pools of paint on the floor.

After the cabinet was installed, the floor was covered with a layer of dark gray paint. Areas of the floor—around pieces of furniture—were later repainted (second-coat lap marks are visible in both the northwest and southwest corners). It is not known when the second layer of paint was applied. (A full investigation of the locations of the second painting campaign, scuff marks, and paint spatters may provide information on former locations of furniture and Weir's use of the studio.)

Covering the north wall, below the center window, are numerous little spatters, drips, and brush marks of colored paints. The north end of the floor is also covered with these same spatters, indicating that a table or bench was positioned here, set out from the wall. The table or bench was used by Weir for mixing paints and cleaning brushes. Numerous paint spatters of different colors are found all over the floor, but in far less concentration than at the north end.

Green paint spatters are found over much of the floor and there are short thin lines of green paint (barely visible) on the walls. The two shades of green match the two shades of green on the shutters for the house (stored in the barn). It is likely that shutters were repainted in the studio: some shutters were placed on the floor and others were propped up against the wall. Shutters may have

[26] CESW, "A Letter," p. 103.

been painted during Weir's tenure (possibly in 1911 or in 1912 following work on the house)[27] or later, possibly in 1933.[28]

Perhaps during Weir's tenure, and perhaps later, the inside faces of the two studio doors, their casings, and the baseboards to either side were painted green; the baseboard to the north of the door was painted half-way to the north wall and the baseboard to the south of the door was painted to the edge of the cabinet. The paint contains finely ground green pigments and an oil binder, indicating a purchased product. The present water marks on the doors suggest that painting may have been in response to earlier episodes of water infiltration and associated drips. The green paint on the extant boards of the cabinet suggests that the cabinet was painted green at this same time.

A considerable amount of a glossy black material covers the bead boards of the southern-most west window. The material contains trace amounts of pigments and oil, and is similar in appearance to waterproof coatings for roofs. Its presence provides a possible construction chronology: the windows were removed and covered with bead boards, the walls and bead boards were painted gray, and during the construction of the woodshed roof, the material flowed down through the wall cavity and out onto the casing and boards filling the window opening. It is also possible that drips date to a later repair.

Photographs of the studio show different objects attached to the walls (Figures 12-14). Today, there are an extensive number of nails, tacks, and nail and tack holes in both the plaster and woodwork. Weir may have had some objects on the walls for years while other objects were put up and taken down on a frequent basis.

Electricity was most likely installed in 1900, or shortly thereafter. The cloth-covered wires on top of the center beam, and possibly the outlet beneath the brass floor plate, remain from this time.

It is not known when the original stove was replaced with the current stove.

With the possible exception of the green doors and cabinet, Weir made no further changes to his studio after the work of 1900.

In November, 1912, Weir wrote a letter to Wood noting "that terrible studio of mine."[29] While Weir wrote the letter from Branchville—with summer and early fall temperatures gone—it is not known if he was actually referring this studio or to his New York studio. If he was describing his Branchville studio, this may be the only indication of unhappiness that survives in written form.

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[27] "That man Tingley must be very stupid as he mixed the color I wanted for the blinds & Montons [*sic*] 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, WEFA 192, Box 1, Folder 10.]

[28] "The [exterior] blinds were painted last winter." [Dorothy Weir Young (DWY), Branchville Account Book, July 31, 1934.]

[29] "I am working hard and have several good canvasses and one I sold 'Hot off the bat' out of that terrible studio of mine [Branchville?], that I prohibit anyone going in, but was caught with the door open." Note: it is not known if the brackets with "Branchville?" were made by DWY or by Wallace. [JAW to CESW, Branchville, November 15, 1912; AAA Reel 125/1284.]

C. 1919-2005 Appearance

In the fall of 1918, with declining health, Weir closed his apartment in New York and moved the contents to Branchville with excess furniture and sundries stored in the studio.[30] Weir died in New York on December 8, 1919.

Following Weir's death, the studio remained a storage facility and sometimes-work space. When Young moved to Branchville in 1931, he used his father-in-law's studio until the construction of his own in 1933. In 1989, Wallace interviewed Charles Burlingham, Jr. (son of Cora Weir Burlingham and Charles Burlingham) and asked about the use of the studio following Weir's death. Wallace noted: "Charlie Burlingham never went into Weir studio [1930s-40s]. Dorothy went in sometimes—she kept things in there. It was always kept the way JAW left it—his brushes in cans, etc. It was a sacred place to the family."[31]

During his tenure, Andrews used the studio primarily for the storage of his paintings. Three photographs document this period. The first photograph, facing the south wall and made in 1958, shows furniture, paintings, and miscellaneous dinnerware and ceramic mugs (Figure 16). The second photograph, facing the northwest corner, shows a desk, cupboard, and heavily laden shelves. The multi-pane window has water-stains and paint loss on the sash, indicating that water infiltration had been a problem for many years (Figure 17). The third photograph, facing the west wall and probably made in the 1970s or 1980s, shows a space packed with furniture, paintings, art supplies, and frames. There is a hanging fluorescent lamp that had been removed prior to the onset of this project (Figure 18).

At some point, the cabinet against the east wall was removed. In its place, a wooden rack, partially made out of boards from the dismantled cabinet, was installed. (The rack was removed in 2011.)

While it is not known when the current stove was brought to the studio, it is present in a photograph that dates to the 1970s or 1980s (Fig. 18).

The rigid electrical metallic conduit and switch box were probably installed in the 1940s or 1950s, along with new wiring. The two wall plates on the north baseboard may also date to this time. The electrical system was upgraded again in 1993.[32]

Sperry Andrews tacked pictures and notes to the walls and doors of the studio. Many notes—giving directions or instructions for things—were tacked up near the end of his life as mnemonic devices. By now, all of these items have been removed with the exception of one small newspaper clipping on the window casing of one of the southern windows on the west wall; this clipping is visible in the 1980s photograph. Without a full investigation of nails, tacks, and nail and tack holes, it is sufficient to note that many of these date to Andrews and mark his use of the studio. Pushpins with plastic heads clearly belonged to Andrews and these have been removed from the walls.

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[30] JAW to CESW, Branchville, Oct. 12, 1918, AAA reel 126, frame 279; and JAW to CESW, Hotel Belmont, NY, May 9, 1919, AAA Reel 126, Frames 309-310.

[31] Charles Burlingham, Jr., taped interview, Cambridge, MA, March 17, 1989, Weir Farm NHS. [Wallace, HFR, 1995, pp. 332.]

[32] Conversation with Kevin Monthie, Facility Manager, Weir Farm NHS, October 30, 2013.

V. Conclusions of Findings

The investigation of the studio that lead to the production of this report was carried out, side-by-side, with the work to restore, reconstruct, and preserve elements of the interior necessary to presenting the space to the public. Standard methods of investigation were employed: examination of historic photographs and documents, examination of Weir's drawings and paintings, and close inspection of all surfaces, including extracted paint samples. In a number of cases, it was during a cleaning operation (primarily on the floor) that information on materials and appearance was revealed.

To restore the studio to the hypothetical appearance of 1900-1918, while preserving the effects of time, the following interventions were made:

1. Gray paint on the ceiling, walls, and woodwork was stabilized by introducing a new binding medium to prevent further loss from flaking and powdering.
2. The rack on the east wall was removed, boards original to the c.1900 cabinet were saved, and the former cabinet was reconstructed, based on historic photographs, nail holes in the floor, paint on the floor and walls, and the extant boards.
3. Excessive soiling was removed from the floor by cleaning. Spider webs and debris from insects and rodents was removed from the space by vacuuming and dusting (spider webs and insect debris continue to accumulate). Glass of the north windows was cleaned.
4. Excessive drip marks (from water) on the inside faces of the exterior doors were reduced by cleaning.
5. A uniform black waxed finish on the stove and stove pipes was reconstructed with new wax. The heat guards were cleaned and given a protective coating of wax.
6. Sperry Andrews' ephemera (notes, clippings, postcards, etc.) that was tacked to the walls was removed, as well as plastic-headed pushpins.
7. The fluorescent light installed by Andrews was removed.
8. The floor, in locations where visitors will stand, is covered with a protective mat.

The studio has now been filled with furnishings, most dating to Weir's tenure. Photographic replications of his paintings are propped on an easel and against pieces of furniture. When visitors enter the space, they are greeted with the materials and collections of an artist, in a space designed by him, which still exists close to a century after his departure.

VI. Historic Images

Figure 1: Weir Studio, between 1885-c.1899. Note possible covering on inside of windows. [Detail, Weir Farm NHS, WEFA 9447.]

Figure 2: Weir Studio, c.1891. Note that one window has been raised. [Detail, Weir Farm NHS, WEFA HP 14.]

Figure 3: Weir Studio, c.1895. Note possible covering on inside of windows. [Detail, Weir Farm NHS, WEFA HP 896.]

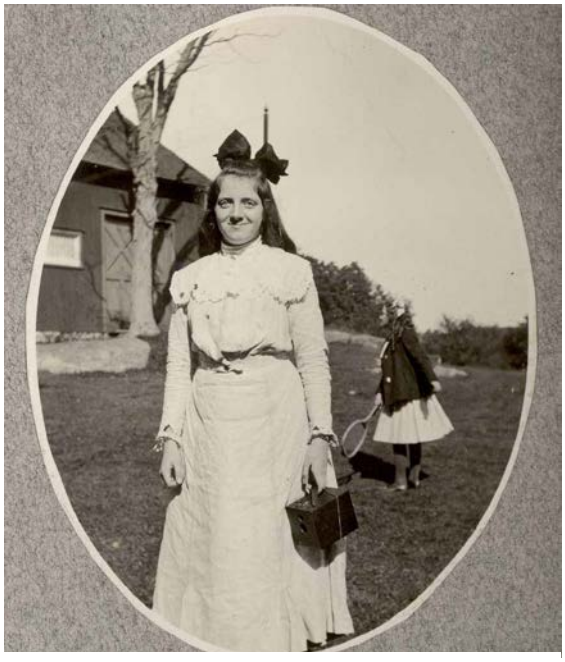


Figure 4: Weir Studio, c.1905. Note possible covering on inside of window. [Weir Farm NHS, WEFA 9451.]

Figure 5: Weir Studio, n.d., after c.1899. Note coverings on inside of windows. [Detail, Weir Farm NHS, WEFA 9451]

Figure 6: Weir Studio, c.1910. Note coverings on inside of windows and bottom sash of center window is raised. [Detail, Charles Burlingham, Jr. Collection.]

Figure 7: Weir Studio, c.1934. Note covering on inside of upper east window. [Detail, Weir Farm NHS, WEFA HP 150.]

Figure 8: South side of water tower, c.1950. Note multi-pane windows. [Detail, Iselin Photo Collection.]

Figure 9: Former Bindery now an addition to the Young Studio, after 1933. Note multi-pane window. [Weir Farm NHS, WEFA 9450.]

Figure 10: Young Studio, c.1950. Note multi-pane window in addition. [Detail, Iselin Photo Collection.]

Figure 11: J. Alden Weir, *The Little Artist II*, drypoint, 1890. Figure facing southwest corner of studio. Note window and curtains. [Brigham Young University Museum of Art, purchase/gift of Mahonri M. Young Estate, Inv. No. 824000988A.]

Figure 12: Weir Studio, facing south wall, c.1905. Note different colors on wall. [Brigham Young University, MSS P 78 WeirJA F2 16.]

Figure 13: Weir Studio, southeast corner, c.1905. Note cabinet placed against east wall and different colors on wall. [Weir Farm NHS, WEFA 9451.]

Figure 14: Weir Studio, facing southwest corner, c.1905. [Weir Farm NHS, WEFA 9451.]

Figure 15: Weir Studio, facing south wall, c.1905. [Weir Farm NHS, WEFA HP 151.]

Figure 16: Weir Studio, facing south wall, 1958 [Weir Farm NHS, WEFA, HP 327.]

Figure 17: Weir Studio, northwest corner, after 1958. [Weir Farm NHS, WEFA HP 951.]

Figure 18: Weir Studio, facing west, c. 1970s-80s. [Weir Farm NHS, WEFA HP 1171.]

Figure 19: One of Weir's New York City Studios, n.d. [Brigham Young University, BYU MSS P 78 120.]

Figure 20: One of Weir's New York City studios, n.d. [Brigham Young University, BYU MSS P 78 119.]

Figure 21: One of Weir's New York City studios, n.d. [Brigham Young University, BYU MSS P 78 weir.]

Figure 22: Weir in one of his New York City studios, n.d. [Brigham Young University, BYU, MSS P 78WeirJA F1 4a.]

VII. Contemporary Images

Figures 23 and 24: Weir Studio, Christopher Payne, photographer, 2011.

Figure 25 and 26: Weir Studio, Christopher Payne, photographer, 2011.

Figure 27: Composite view of floor, color not corrected for uniformity. Christopher Payne, photographer.

Appendix A

List of Extracted Paint Samples

A total of sixty-nine paint samples were extracted from the interior of the Weir Studio for this study. Samples were examined microscopically (both a stereo and a compound microscope with fiber-optic light sources) and those with the most clearly defined stratigraphies (successions of finish layers) were mounted in resin cubes for better examination. The examination was made to aid in documenting finish histories and determining past architectural changes not chronicled in written records. Nine of the samples were sent to Susan Buck for additional examination and analysis.

Paint samples were taken over the course of six years, from 2006 to 2011, concurrently with the study of the interior.

Finish samples were extracted from plaster and wood with a small hobby knife. Samples included both the finish layer(s) and a portion of the substrate and were taken from locations as inconspicuous as possible. Multiple samples of certain elements were taken for comparative or verification purposes. Sixty of the samples are housed in pieces of folded acid-free paper which are placed in labeled coin envelopes. Samples are numbered, sequentially from 001-060. A list of samples (excluding those sent to Buck) and their locations is presented below.

Note: numbers of doors and windows are those of the 1995 drawings (HSR) which differ from drawings made in 2010 for the fabrication of storm windows.

Sample #	Sample location
001	N wall, above W105 pocket-facing boards
002	N wall, W end, 5' up from floor
003	N wall, above W107 pocket-facing boards
004	N wall, plaster drops on top edge of W107 pocket-facing boards
005	E wall, N end, just above base
006	E wall, between D1 and W101
007	E wall, between D1 and W101 above base
008	E wall, just below N end of W101
009	S wall, W end, center gray stripe
010	S wall, W end, 3" above center gray stripe
011	W wall, S end, lower wall
012	W wall, S end, just above N-S board, S of W108
013	W wall, S end, top of wall
014	W wall, top of eave next to ceiling
015	W wall, top of eave, next to ceiling, by E-W beam
016	W wall, below N end of W108
017	W wall, S end, above W108 pocket-facing boards

018	W wall, just to N of chimney
019	W wall, below S end of W110
020	N face of chimney
021	Ceiling
022	Ceiling, SE corner
023	Ceiling, W edge
024	D1, N door, exterior, top cross brace
025	D1, N door, exterior, S end, original stile
026	D1, N door, exterior, S end, bottom of stile
027	D1, S door, exterior
028	D1, N door, interior, near bottom
029	D1, N door, interior, casing, above base
030	D1, S door, interior, near bottom
031	D1, S door, interior, casing, above base
032	W wall, S end, ground (between wall and eave)
033	E-W beam, S face
034	E-W beam, N face, brown/gray area by nail
035	E brace, below E-W beam, E side, S face
036	E brace, below E-W beam, E side, bottom face
037	D103, door stop
038	W102, pocket-facing boards
039	W105, bottom rail
040	W105, pocket-facing boards, W end
041	W106, top sash
042	W106, bottom sash
043	W107, pocket-facing boards
044	W108, bead boards, black resinous coating
045	W108, pocket-facing boards
046	W108, casing
047	W110, pocket-facing boards
048	W110, casing
049	W203, sash
050	W303, casing, bottom R corner
051	W303, casing, bottom
052	Baseboard, N wall, E end
053	Floor, N end, near W wall
054	Floor, near stove
055	Floor, near D1
056	Floor, S of stove, dark-yellow-green paint spatter
057	Floor, S of stove, dark-blue-green paint spatter
058	Shutter in storage, dark-yellow-green paint surface
059	Shutter in storage, dark-blue-green paint surface
060	Rack on E wall, middle diagonal brace

Cross-section Paint Microscopy Report

J. Alden Weir Studio
Weir Farm National Historic Site
Wilton, Connecticut

For: Judith M. Jacob, Architectural Conservator
United States Department of the Interior
National Park Service
Northeast Regional Office
New York Field Office
26 Wall Street
New York, New York, 10005

Conservator: Susan L. Buck, Ph.D.
303 Griffin Avenue
Williamsburg, VA 23185

Date: Revised Report November 29, 2009

Southwest Corner of Weir's Studio[1]

Purpose:

The goal of this project is to use cross-section microscopy and pigment analysis techniques to identify the original paints and the subsequent coatings on selected areas of the interior of the J. Alden Weir's studio, a building constructed in 1885, with a water tower added c. 1899. It is hoped that this analysis will provide more information about how these paints may have changed in color over time, provide additional information on pigments and binding materials, and perhaps suggest if these paints could have been from dry pigments and commonly available binders in Weir's studio.

[1] Image provided by Judy Jacob.

Procedures:

For the first phase of analysis samples from six areas of the interior of the studio were sent by Judy Jacob in labeled baggies for analysis, along with photographs showing the locations of the samples and descriptions of the sample locations. Before casting, the samples were examined at 45X magnification under a binocular microscope and portions of the best samples 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. A second set of samples from three areas of the painted ceiling were taken by Judy Jacob in September 2009 to help clarify the reasons for the variations in the color of the ceiling paint.

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 printing and do not accurately represent the actual colors.

Paint Analysis Results:

The samples were first reviewed under a binocular microscope at 45X to identify the best samples for cross-section analysis. This initial screening suggested that many of the paint layers were chalky and embrittled, and had flaked away from the substrates during sampling.

The current appearance of the studio, based on photographs and observations provided by Judy Jacob, shows how Weir's last repainting efforts have aged and degraded. He apparently painted over the original blue ceiling and applied painted stars with a grayish paint, and repainted the brownish walls with mottled lighter gray paints. Areas of the ceiling where the later gray paint has flaked away reveal a much brighter blue paint, as do the recent cleaning tests completed by Jacob. At the time of testing it was not clear why the newly cleaned blue paint was so much brighter, as it was such a different color from the patchy areas of blue paint that had been exposed earlier where the gray overpaint flaked away. The plaster eaves on either side of the board ceiling were painted in a different manner and do not exhibit the same type of flaking.

Image of the ceiling in an area of a cleaning test[2]

Overall image of the ceiling with the applied stars

[2] Image provided by Judy Jacob.

The sample locations descriptions are listed below. The discussion of the paint evidence with begin with the wall paints and one area of the plaster eaves (samples 5, 6 and 2), followed by the wood ceiling paints (samples 7 and 9). Then the paint evidence on the door will be presented (sample 1), and this section of the report will end with an explanation of the findings from the sample taken from the black paint drips (sample 3).

Phase I Sample Locations:
1. D1, door, north side.
2. Top of the west plaster eave, edge of ceiling and eave, above E-W beam, with overlap of green ceiling paint.
3. Black paint drips, W108 boards.
4. Flakes of gray paint from ceiling, above E-W beam.
5. West wall, just to south of W110.
6. East wall, just below north end of W101.

Phase II Wood Ceiling Samples:
7. Ceiling sample from brighter area.
8. Ceiling sample from darker area.
9. Ceiling sample from darker area.

West wall. The cross-section sample from the west wall (sample 5) contains three generations of coatings. The first layer on top of the coarse white coat of plaster is a coarse, brown, slightly translucent paint similar to the first brown paint found in sample 2 from the plaster eaves. There are remnants of a resinous varnish or sealant on top of this first brown paint. The second generation is a somewhat translucent gray paint with distinct unevenly ground and mixed large, bright yellow and finely ground blue pigment particles. This paint could have originally been more greenish, but the presence of a considerable amount of chunky charcoal black pigments suggests it was always a somewhat dark color.

There are remnants of the third generation paint in this cross-section which is a thin blue-gray paint that is considerably more opaque than the gray paint below.

Polarized light microscopy analysis for pigment identification suggests that the first brown layer is composed primarily of calcium carbonate and brown iron oxide pigments (likely burnt umber and raw umber). The second generation gray-green layer is composed of synthetic ultramarine, yellow ochre, brownish iron oxide pigments (likely burnt sienna and raw umber), calcium carbonate, and charcoal black. The thin uppermost gray layer was difficult to confidently separate from the layer below, but pigment analysis suggest this layer is composed of isolated indigo pigments (isotropic, $n>1.66$), raw umber and zinc white. The presence of zinc white in this layer was confirmed with the fluorochrome stain TSQ which serves as a marker for zinc (Zn^{2+}).

Binding media analysis with fluorochrome stains indicates that there are protein components in all three paint layers, and there are carbohydrate components in the coarse brown and gray-green paints. There are also spotty positive reactions for the presence of

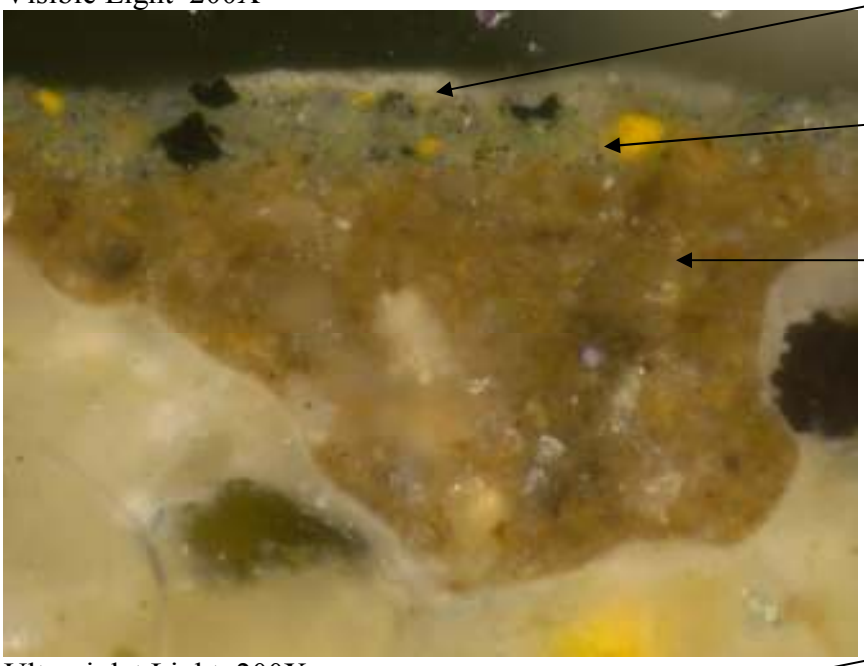
oils in the plaster substrate and the first brown paint layer. Perhaps the uppermost paint is a traditional distemper or calcimine layer, while generations 1 and 2 are washes with carbohydrate and protein components. Generation 1 could also be an emulsion paint with oil, carbohydrate and protein components. Examples of several patent recipes from the late nineteenth century suggest that emulsion paints could be very complicated combinations of materials (see the patent recipes included at the end of this report).

Sample 5

Generation	Layer	TTC for carbohydrates	Alexafluor 488 for proteins	RHOB for oils	TSQ for Zn
3.	Thin blue-gray	-	+	-	+
2.	Gray-green	+	Strong +	-	-
1.	Resinous varnish	-	-	-	-
1.	Coarse brown	+	Strong +	Spotty +	-
	Coarse plaster			Spotty +	

Sample 5. West wall, just to south of W110.

Visible Light 200X

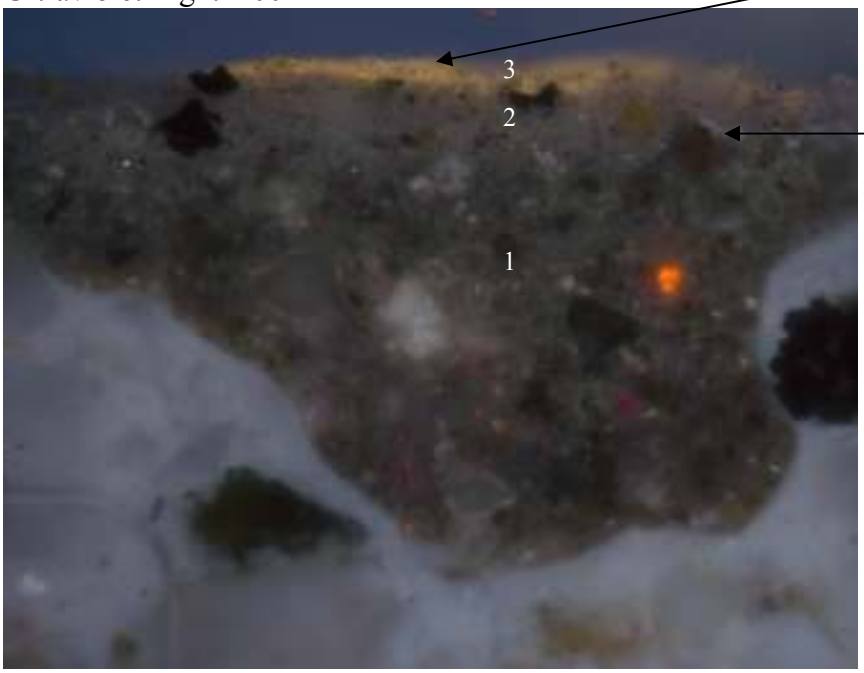


3. Thin blue-gray paint

2. Grayish paint

1. Sandy brownish paint or plaster on top of coarse plaster base coat

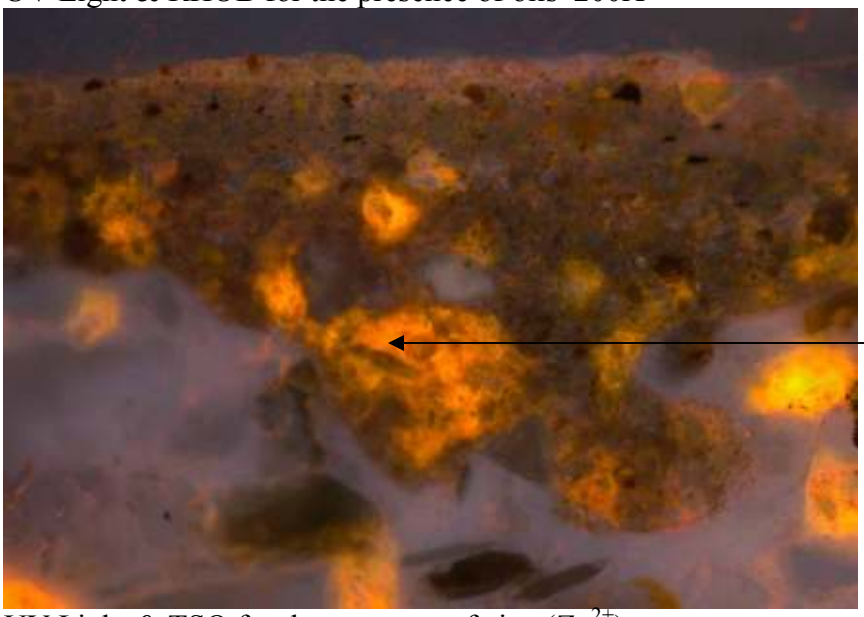
Ultraviolet Light 200X



3. Thin blue-gray paint

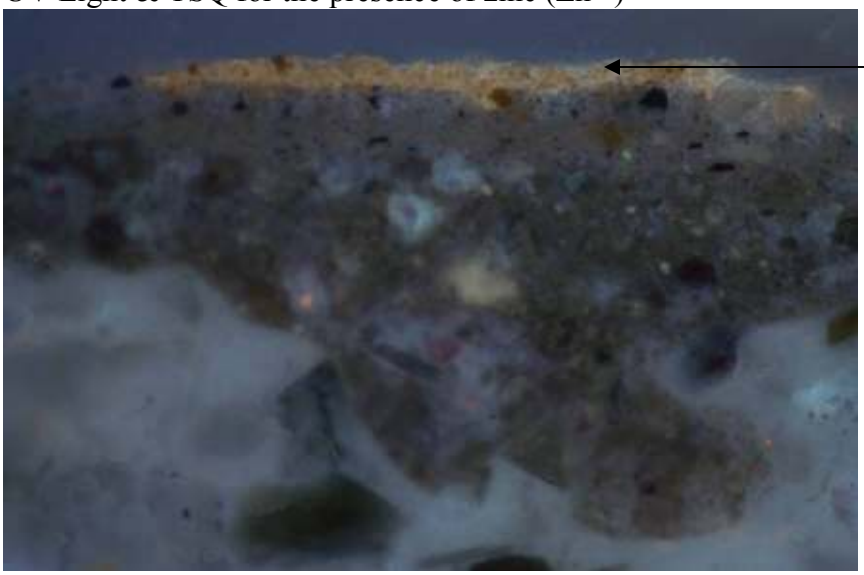
Remnants of the varnish or sealant layer on top of brown layer

Sample 5. West wall, just to south of W110.
UV Light & RHOB for the presence of oils 200X



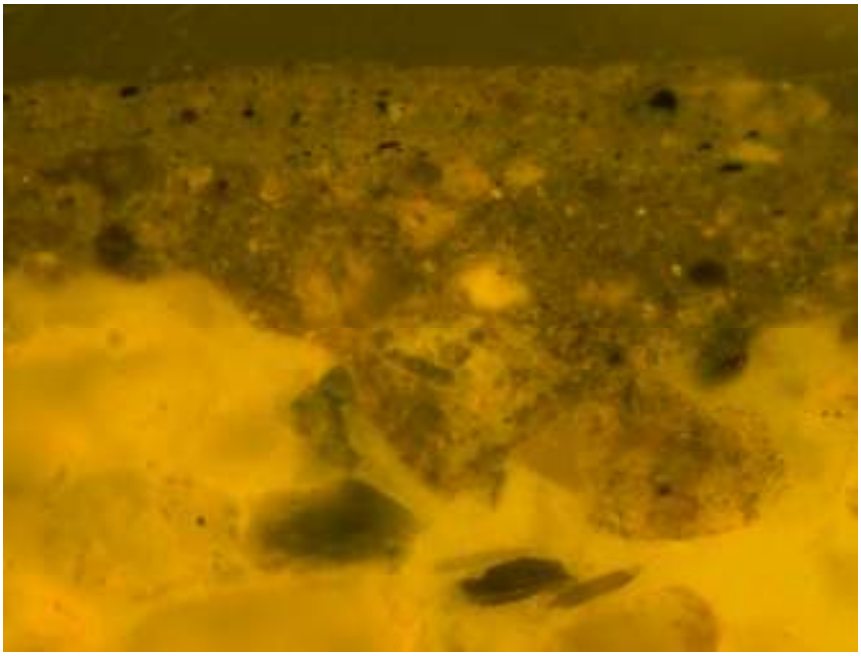
Positive reaction color is orange, false positive is pink (a deposit of the stain)

UV Light & TSQ for the presence of zinc (Zn^{2+})

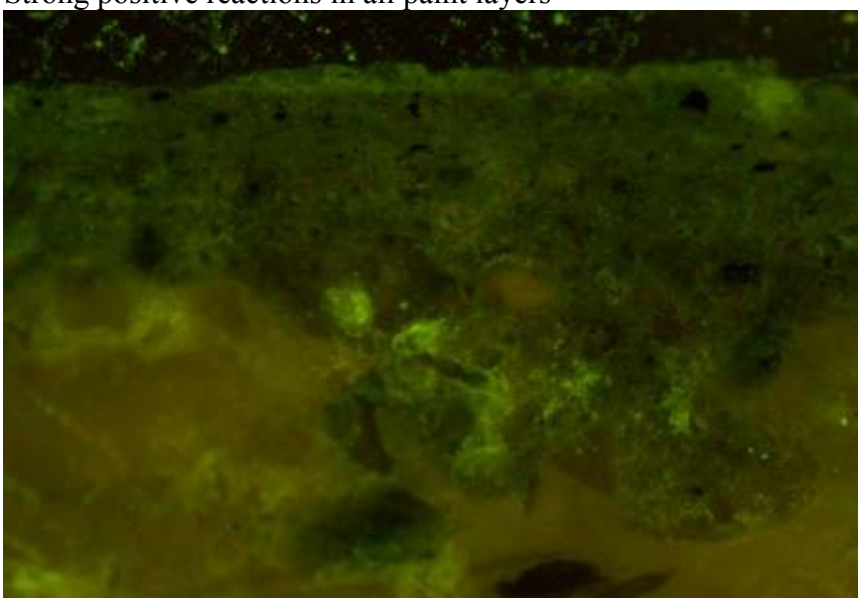


Weak positive reaction for zinc in (sparkly blue color) in the uppermost layer

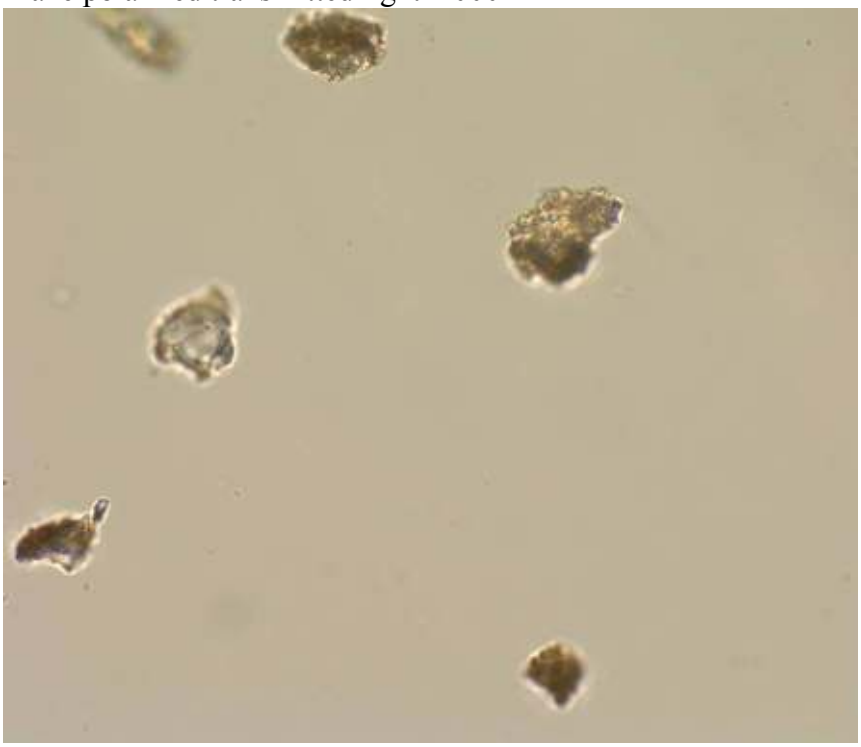
Sample 5. West wall, just to south of W110.
B-2a filter 200X



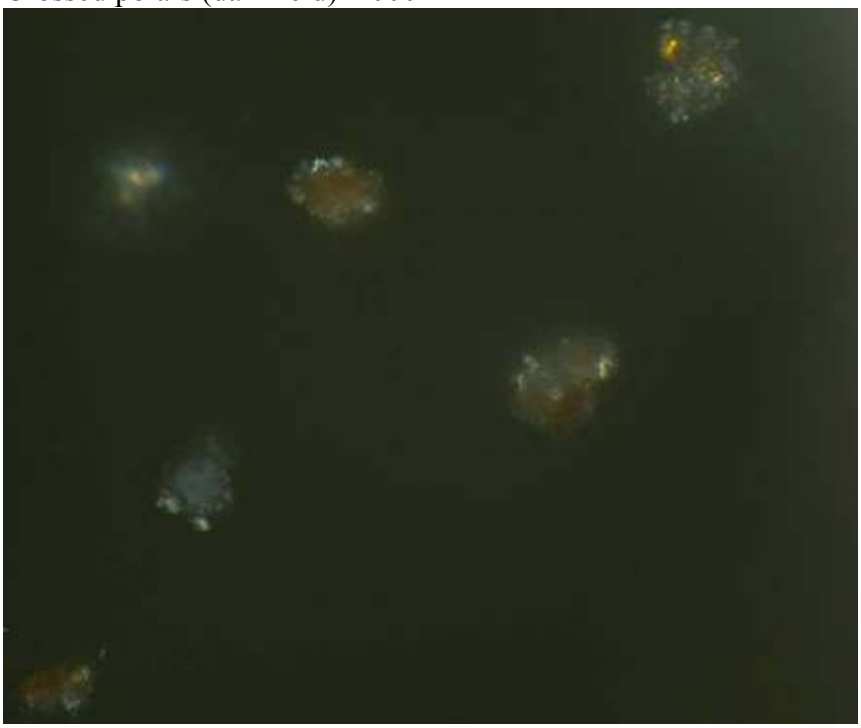
B-2a filter & Alexafluor 488 for the presence of proteins 200X
Strong positive reactions in all paint layers



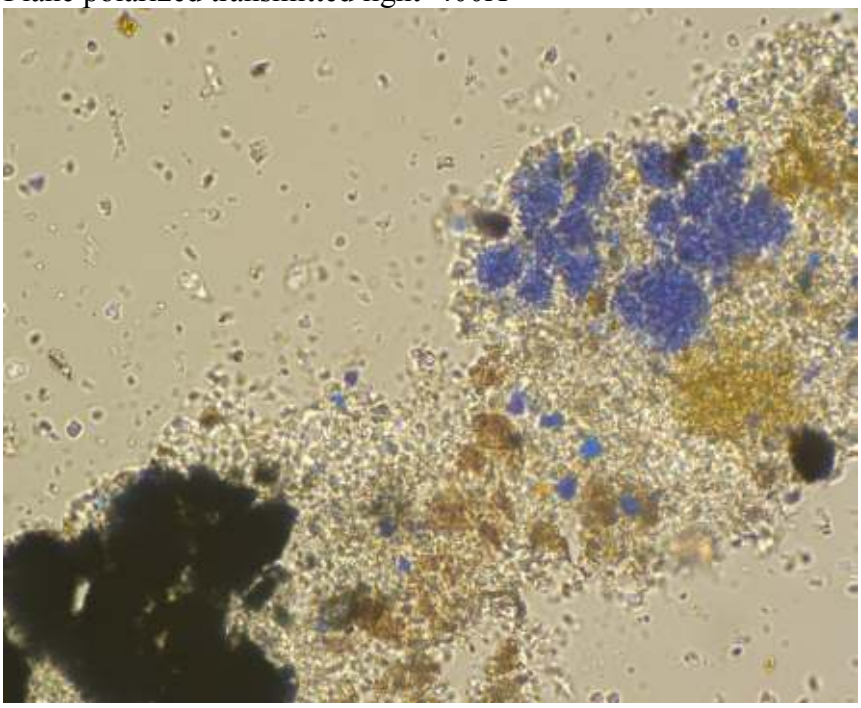
Sample 5. West wall, just to south of W110. Pigments in the first brown layer.
White pigments – Calcium carbonate
Brown pigments – iron oxide brown pigments, possibly burnt umber and raw umber
Plane polarized transmitted light 1000X



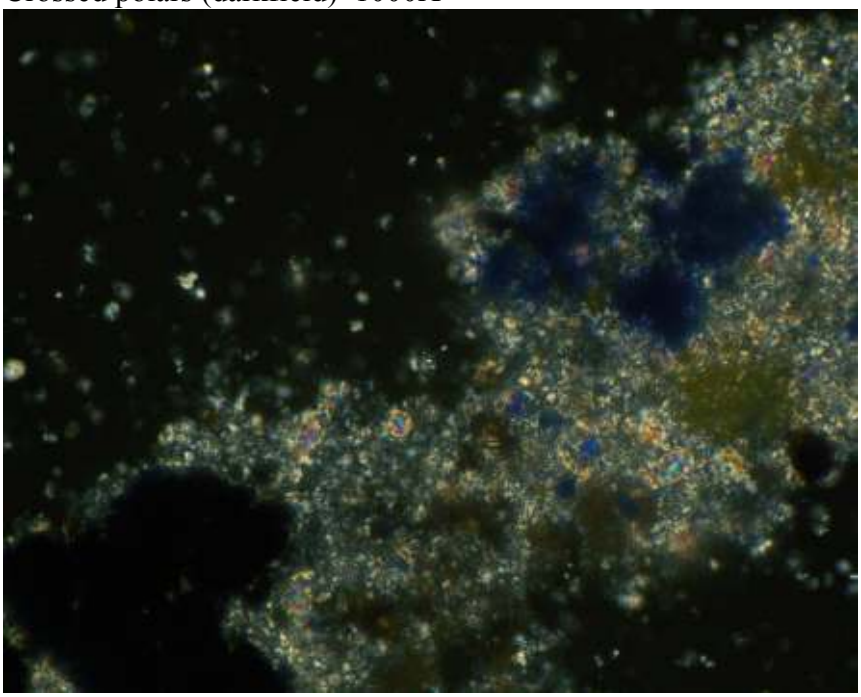
Crossed polars (darkfield) 1000X



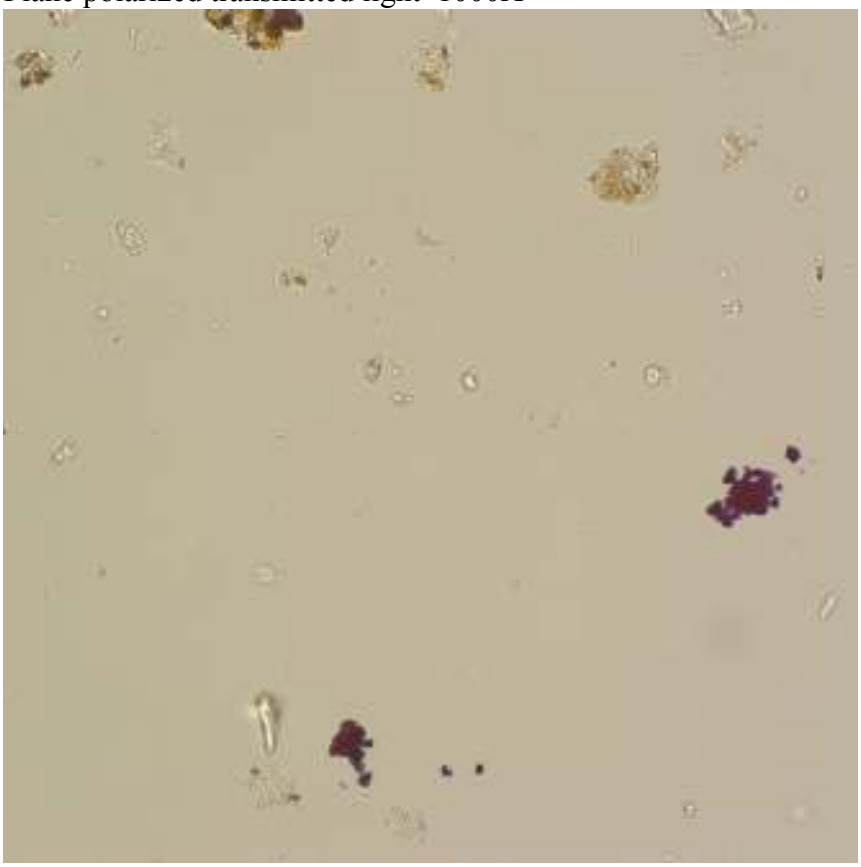
Sample 5. West wall, just to south of W110. Pigments in the second gray-green layer.
Blue pigments – synthetic ultramarine
Yellow pigments – yellow ochre
Brown and orange pigments – burnt sienna and burnt umber
Black pigments – charcoal black
White pigments – calcium carbonate
Plane polarized transmitted light 400X



Crossed polars (darkfield) 1000X



Sample 5. West wall, just to south of W110. Pigments in the third thin blue-gray layer.
Dark blue pigments – Possibly indigo
Scattered brownish pigments – iron oxide, possibly raw umber
White pigments – Zinc white and calcium carbonate
Plane polarized transmitted light 1000X



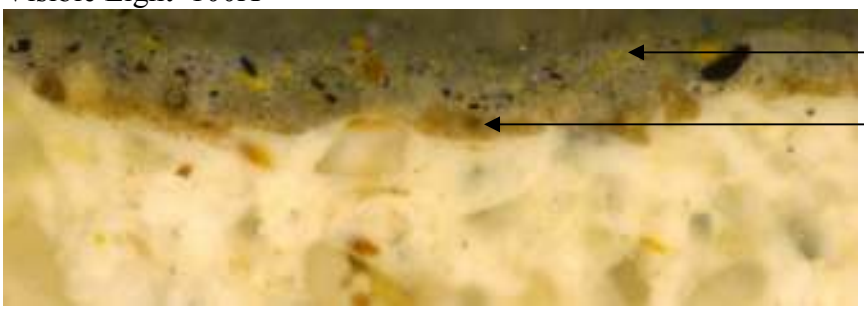
Crossed polars (darkfield) 1000X

East wall. The paint history in this sample from the east wall is the same as sample 5, but it is missing the third generation of thin gray-blue paint. The results of fluorochrome binding media analysis shows there are strong positive reactions for carbohydrates (starches, sugars) and proteins in both layers. There was no reaction for the presence of oils, but there was an uneven deposit of the DCF stain on the porous substrate.

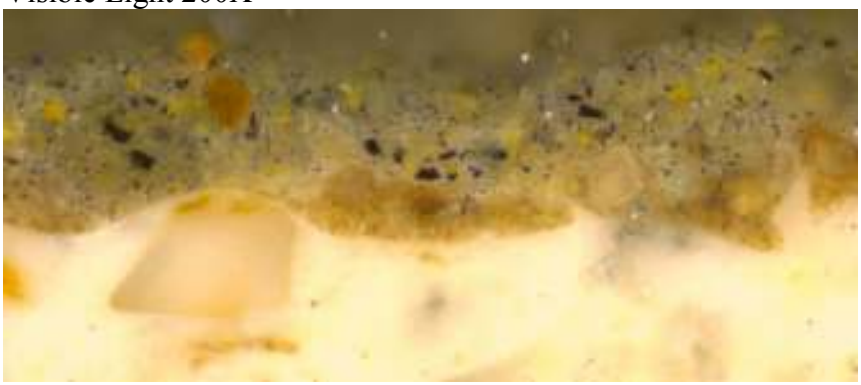
Sample 6

Generation	Layer	TTC for carbohydrates	Alexafluor 488 for proteins	DCF for oils
2.	Gray-green	+	Strong +	-
1.	Varnish	-	-	-
1.	Coarse brown	+	Strong +	-
	Coarse plaster			Spotty +

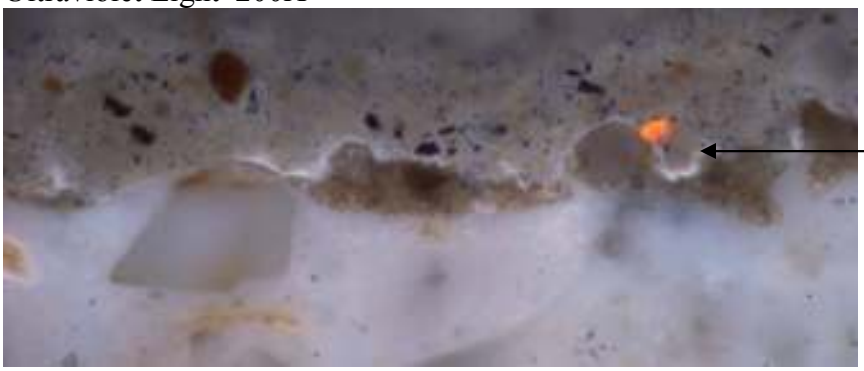
Sample 6. East wall, just below north end of W101.
Visible Light 100X



Visible Light 200X

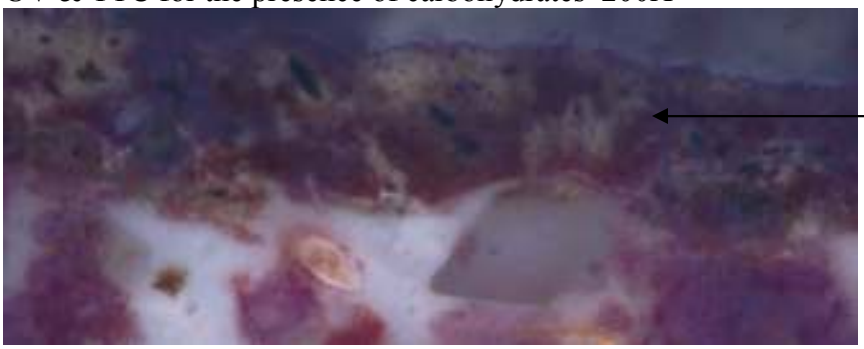


Sample 6. East wall, just below north end of W101.
Ultraviolet Light 200X



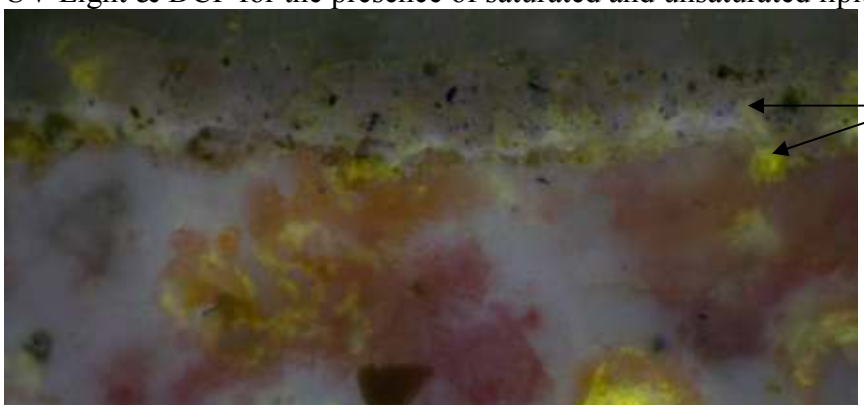
Thin plant resin varnish or sealant on top of brown layer, like samples 2 and 5

UV & TTC for the presence of carbohydrates 200X



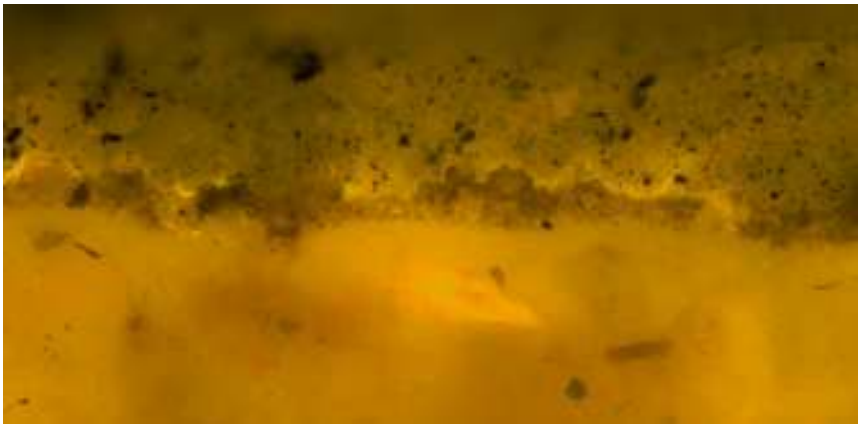
Strong positive reaction for carbohydrates in the paints and plaster

UV Light & DCF for the presence of saturated and unsaturated lipids 200X

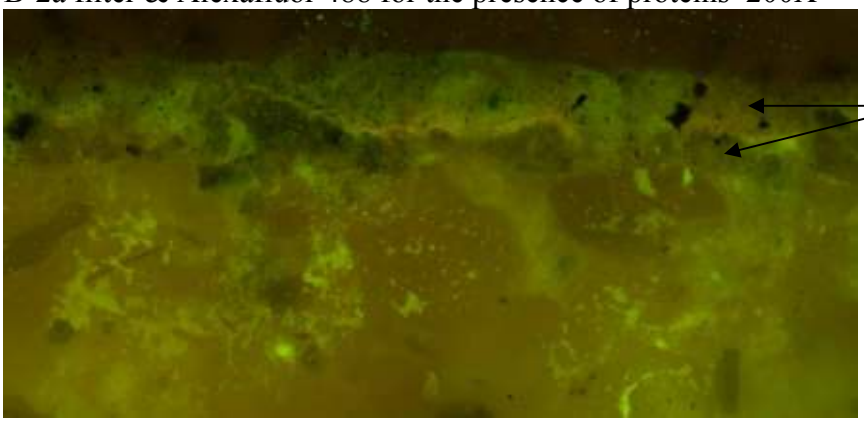


Spotty deposits of staining material seem to have produced false positive reactions

B-2a filter 200X



B-2a filter & Alexafluor 488 for the presence of proteins 200X



Positive reactions for proteins in the coating layers

Plaster Eaves. The first layer in cross-section sample 2 from the plaster eave is a coarse brown paint/plaster layer that was also found in samples 5 and 6, from the west and east walls. There is a thin, resinous layer on top of the brown plaster which may be remnants of a plant resin varnish (based on its characteristic bright white autofluorescence). It is not possible to determine whether this varnish was a finish coating for the first brown layer, or a sealant applied to the porous, coarse brown layer just before the blue-green paint was applied. The second generation is the eroded, uneven blue-green paint layer that can be seen below the gray paint on the ceiling; this is the paint from the adjacent wood ceiling that was lapped over onto the plaster of the eave.

Binding media analysis with biological fluorochrome stains shows that there are strong positive reactions for the presence of carbohydrates (starches, sugars, or the sugar component of milk and casein) in both paint layers. There is a strong positive reaction for proteins in the blue-green layer and a weak positive reaction for proteins in the brown wall paint layer. There is also a spotty positive reaction for the presence of unsaturated lipids on the surface of the blue-green layer, but this appears to be more like a deposit on the surface rather than a component of the binding media. These binder reactions suggest the possibility that these are emulsion paints, or possibly limewash or calcimine layers that have additional organic amendments. A whitewash, or "colourwash" recipe published in 1878 in *Workshop Receipts, for the Use of Manufacturers, Mechanics and Scientific Amateurs* shows that a variety of organic additives, such as hide glue, potato starch, rice flour and milk, were added to change the working properties of traditional washes for plaster and brick.

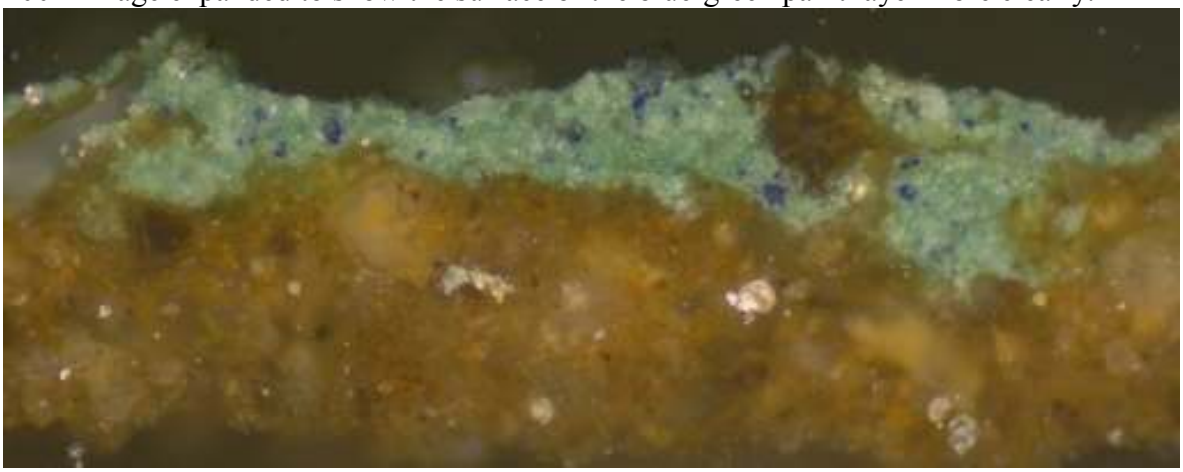
Sample 2

Generation	Layer	TTC for carbohydrates	Alexafluor 488 for proteins	DCF for oils
2.	Blue-green	+	Strong +	Spotty+
1.	Varnish	-	-	-
1.	Coarse brown No substrate	+	Weak+	-

Pigment identification of the blue-green paint layer using polarized light revealed that the blue pigments are synthetic, or artificial, ultramarine (isotropic, n<1.66), white lead (birefringent, n>1.66), calcium carbonate (translucent white, birefringent, n<1,66), with scattered yellow ochre particles (isotropic, n>1.66) and possibly a few raw umber particles (isotropic, n>1,66). There are no distinct green pigments in the dispersed sample, despite the overall greenish-blue tone of the layer. The presence of synthetic ultramarine in combination with yellow ochre would certainly create a greener blue color.

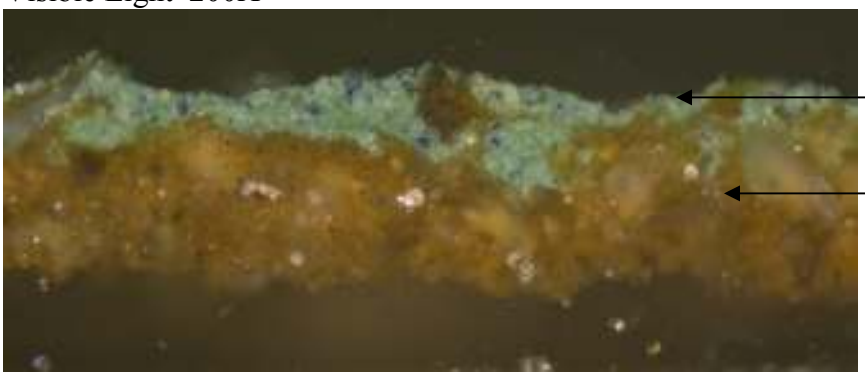
Sample 2. Top of the west plaster eave, edge of ceiling and eave, above E-W beam, with overlap of green ceiling paint.

200X image expanded to show the surface of the blue-green paint layer more clearly.

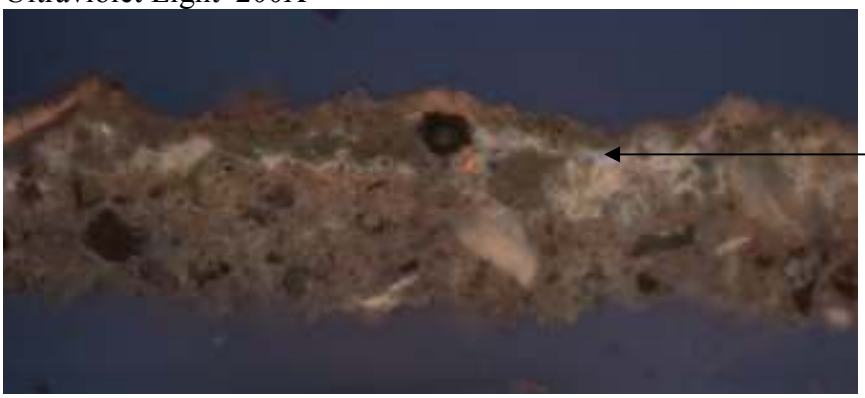


Sample 2. Top of the west plaster eave, edge of ceiling and eave, above E-W beam, with overlap of green ceiling paint.

Visible Light 200X



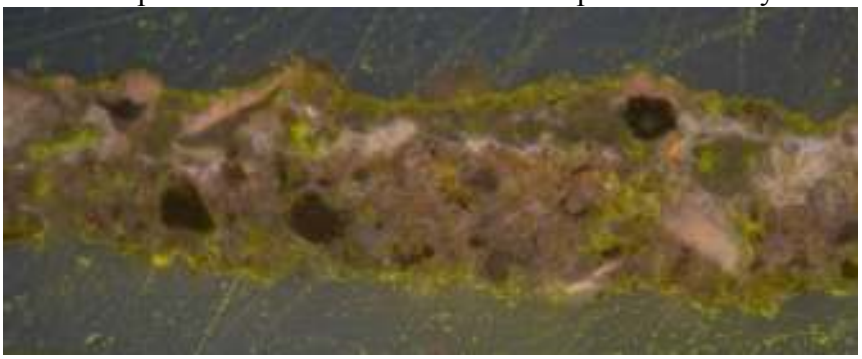
Ultraviolet Light 200X



UV & TTC for the presence of carbohydrates 200X

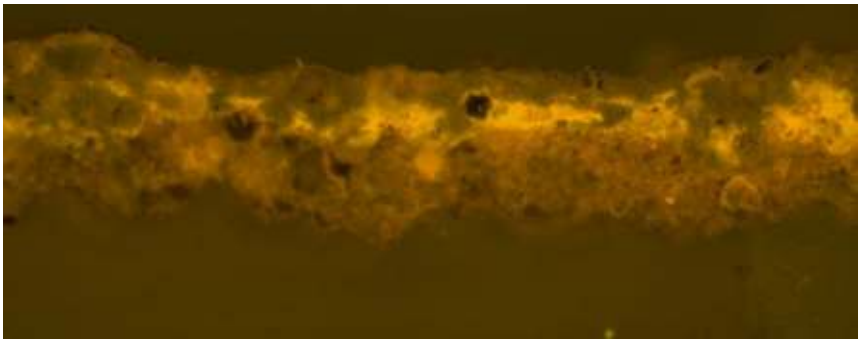
UV & DCF for the presence of saturated and unsaturated lipids 200X

There is a positive reaction for unsaturated lipids in both layers

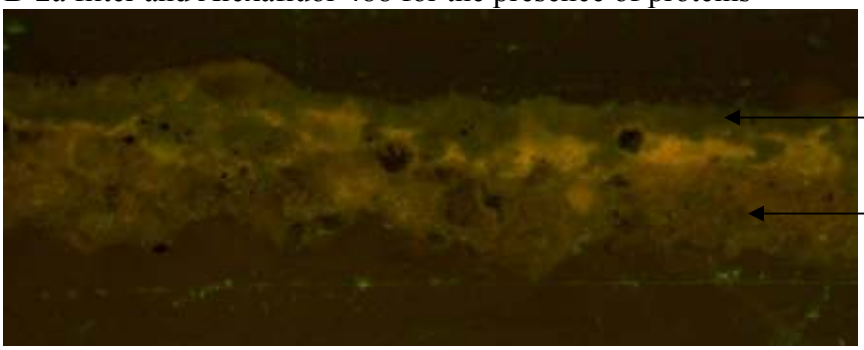


Sample 2. Top of the west wall, edge of ceiling and eave, above E-W beam, with overlap of green ceiling paint.

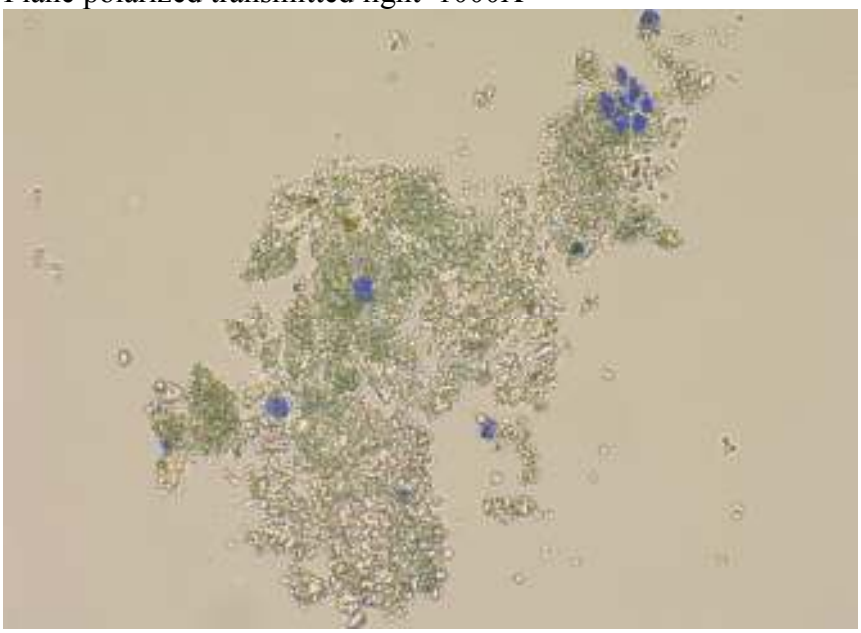
B-2a filter 200X



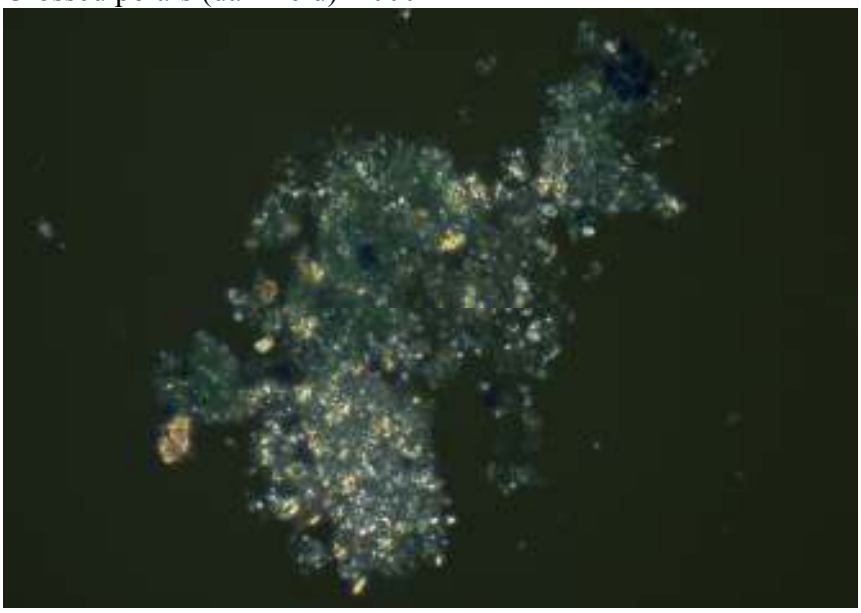
B-2a filter and Alexafluor 488 for the presence of proteins



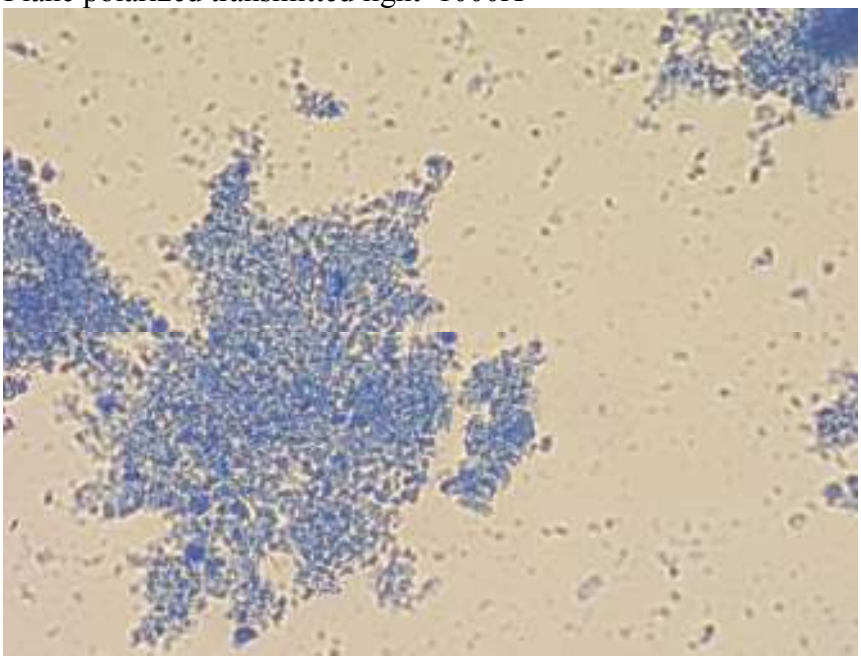
Sample 2. Top of the west plaster eave, edge of ceiling and eave, above E-W beam, with overlap of green ceiling paint. Pigments in blue-green ceiling paint layer.
Blue pigments – synthetic ultramarine
Yellow pigments – yellow ochre, possibly a few raw umber particles
White pigments – white lead and calcium carbonate
Plane polarized transmitted light 1000X



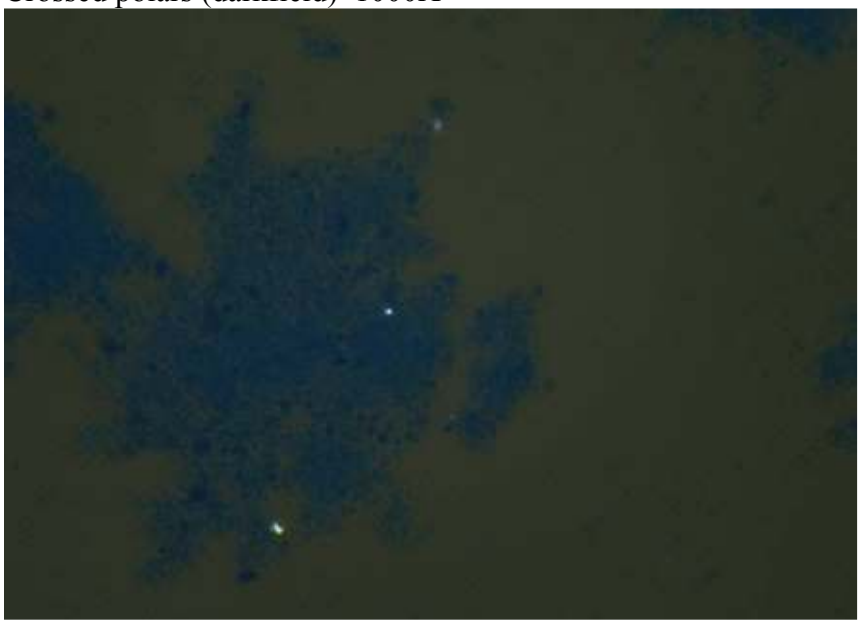
Crossed polars (darkfield) 1000X



Standard Reference Pigments – Synthetic (artificial) ultramarine
Plane polarized transmitted light 1000X



Crossed polars (darkfield) 1000X



Wood Ceiling. The original color of the wood ceiling is puzzling as the color is considerably brighter and lighter in the areas of the cleaning tests and the areas where the later gray paints have most recently flaked away. In the areas where the gray ceiling paints flaked away many years ago the exposed blue-green paint is considerably darker. In cross-section this blue-green layer also has a noticeably bluer and greener aspect. Sample 4 was taken from an area of the wood ceiling that now appears chalky gray, but perhaps was intended to be more slightly more greenish gray, based on the suspended blue and yellow pigments in the cross-section. This layer was not found in the other five samples.

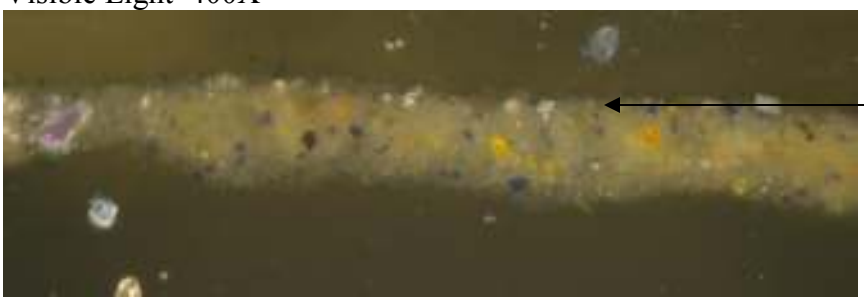
Pigment identification with polarized light microscopy shows that this layer contains many of the pigments found in the blue-green layer of sample 2, but in different proportions. The primary pigment is calcium carbonate, with synthetic ultramarine, yellow ochre, burnt sienna (orange particles, slightly birefringent, n>1.66), and chunky charcoal black pigments. Microchemical testing with 1M HCl showed that there is an effervescence when the paint dissolves in this dilute acid, confirming the presence of calcium carbonate and suggesting this could be a modified limewash.

Binding media analysis with fluorochrome stains produced a positive reaction for proteins with Alexafluor 488 and a very strong positive reaction for the presence of carbohydrates with TTC. There was no reaction for the presence of oils in the gray layer in sample 4. So, this gray layer could be a whitewash or limewash with organic additives. In samples 7 and 9 but there were positive reactions for proteins, carbohydrates and oils, so the blue-green layer could be an emulsion paint. This is consistent with the findings in sample 2.

The second set of ceiling samples (samples 7 and 9) helps to confirm that the color variations in the ceiling are primarily due to grime and soot which was deposited on the surface and somehow penetrated and diffused into the paint layer. In sample 7, from a brighter area, the color of the blue-green is consistent throughout. By comparison, in sample 9 from a darker area, there are a few tannish and blackish accretions on the surface, and in the reflected ultraviolet light photomicrograph it is possible to see that there is a diffusion of fine soot or staining from the surface of the paint down into the upper portion of the layer.

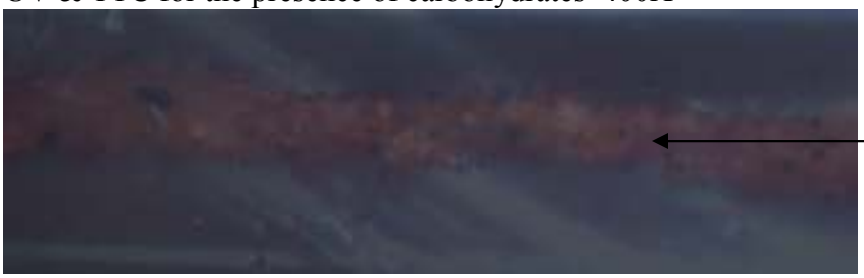
One additional finding from this second set of wooden ceiling cross-sections is that there is a thin pigmented varnish on the surface of the wood substrate. This could have been the original translucent finish coat on the wood, or it could have been intended to seal the wood prior to painting.

Sample 4. Flakes of gray paint from ceiling, above E-W beam.
Visible Light 400X



Ultraviolet Light 400X

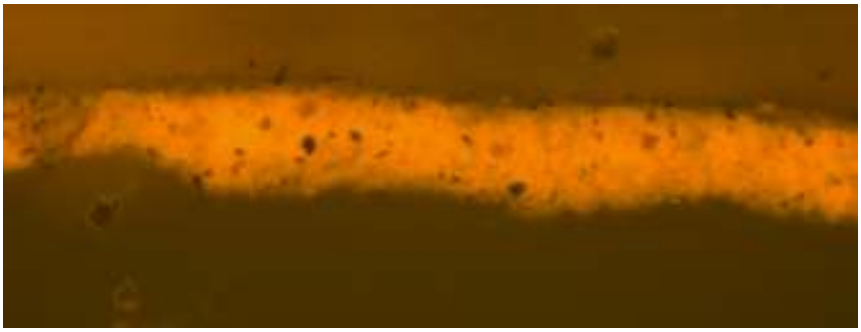
UV & TTC for the presence of carbohydrates 400X



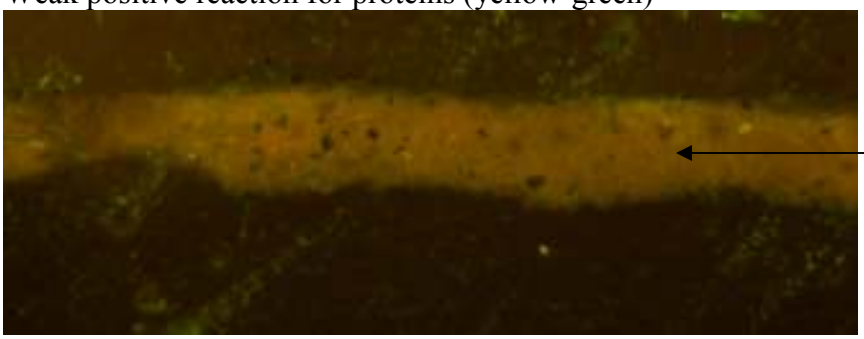
Sample 4. Flakes of gray paint from ceiling, above E-W beam.
UV & Rhodamine B for the presence of oils 400X

No reaction, it is simply a deposit of the stain on the surface

B-2a filter 400X

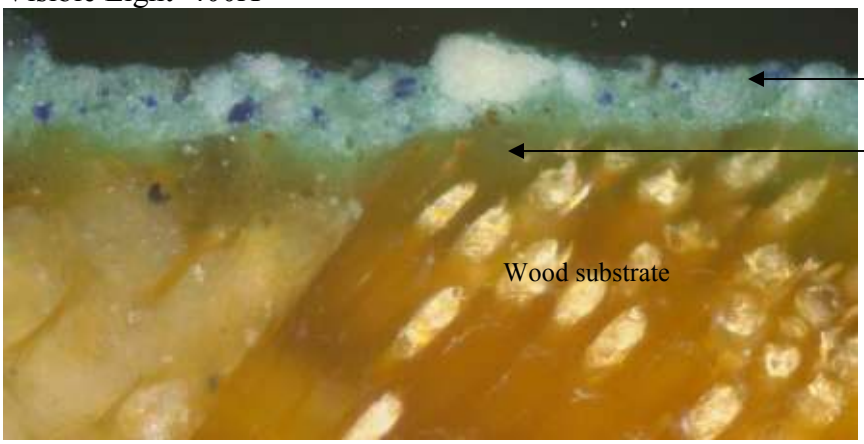


B-2a filter & Alexafluor 488 for the presence of proteins
Weak positive reaction for proteins (yellow-green)

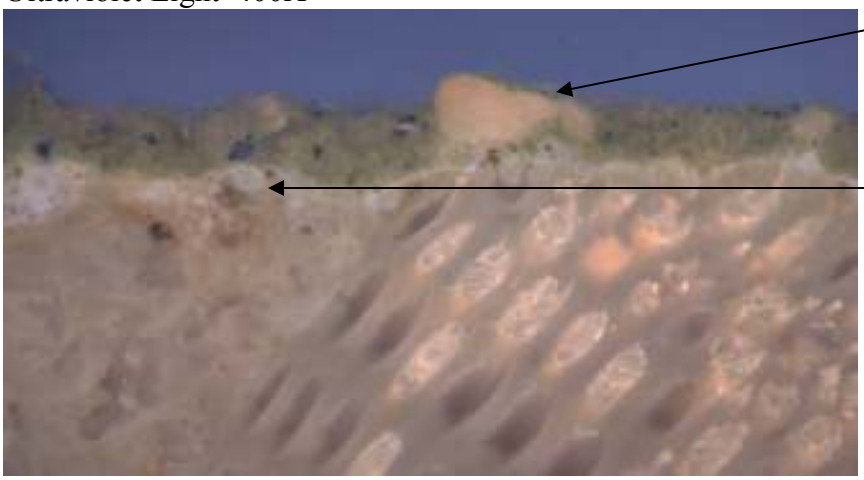


Color change throughout the layer suggests the protein component is distributed throughout the layer

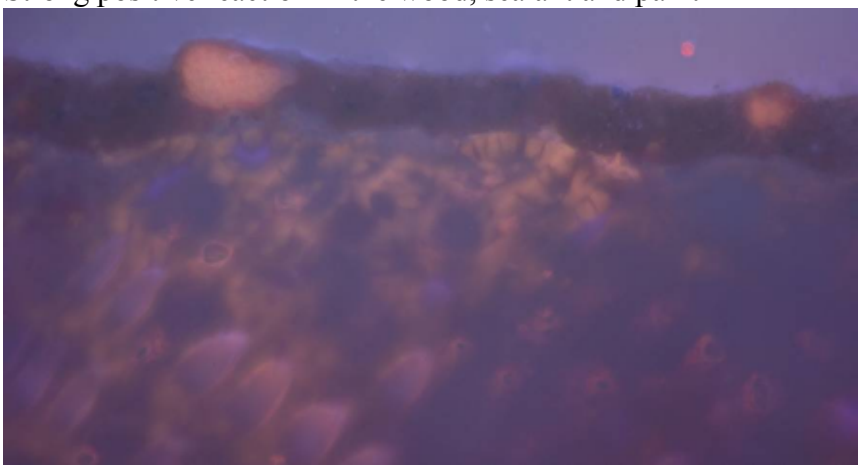
Sample 7. Ceiling sample from brighter area.
Visible Light 400X



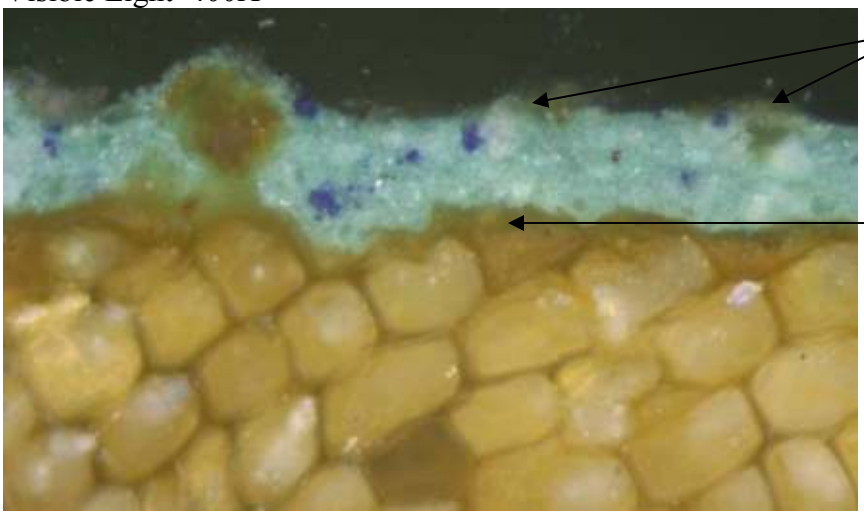
Ultraviolet Light 400X



UV Light & TTC for the presence of carbohydrates 400X
Strong positive reaction in the wood, sealant and paint



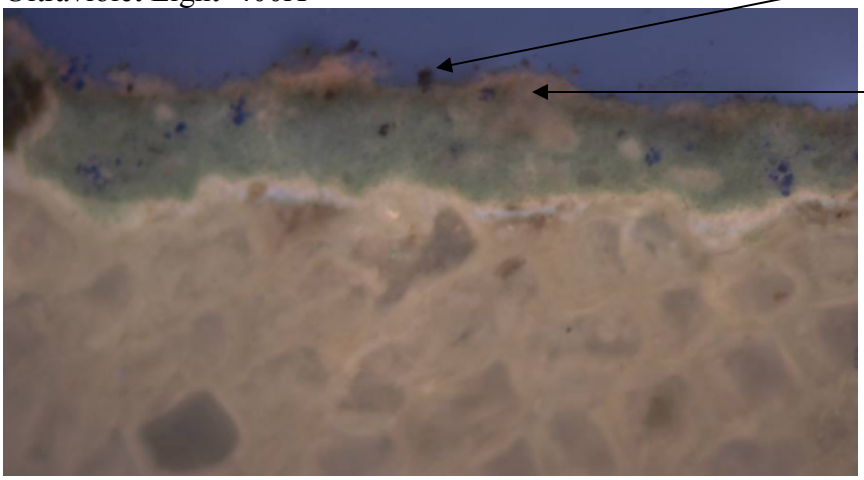
Sample 9. Ceiling sample from darker area.
Visible Light 400X



Subtle tannish accretions on the blue-green paint surface

Thin layer of pigmented varnish or sealant

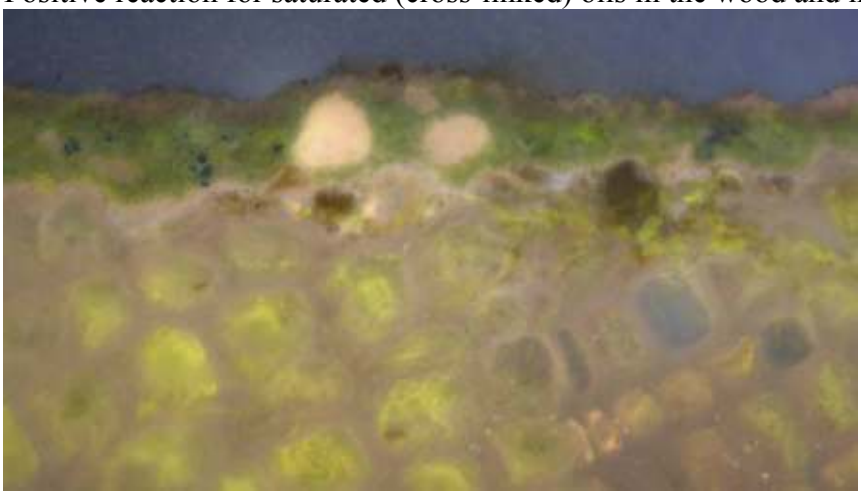
Ultraviolet Light 400X



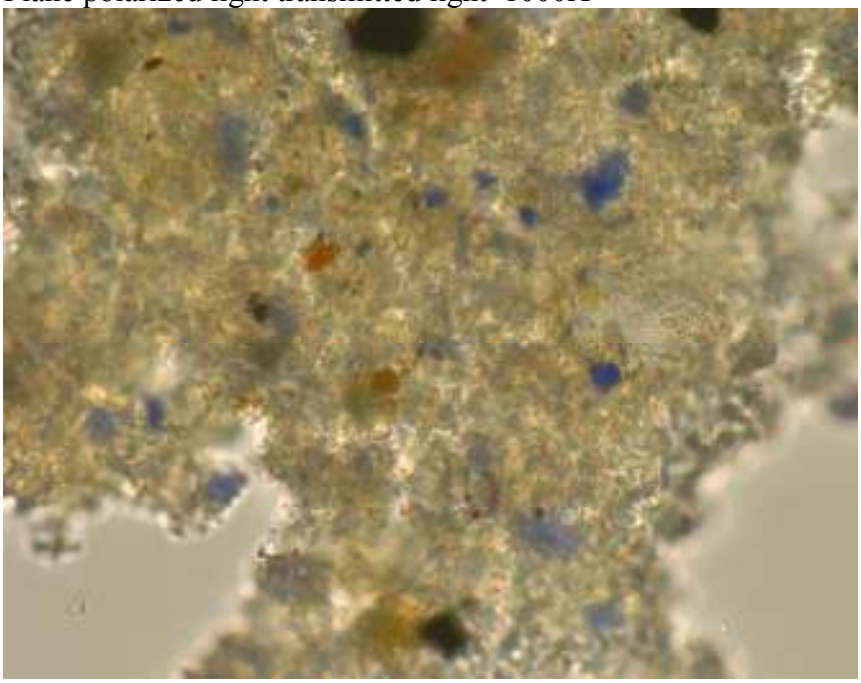
Sooty particulates on the surface

Discoloration of the surface is most readily discernible in reflected ultraviolet light

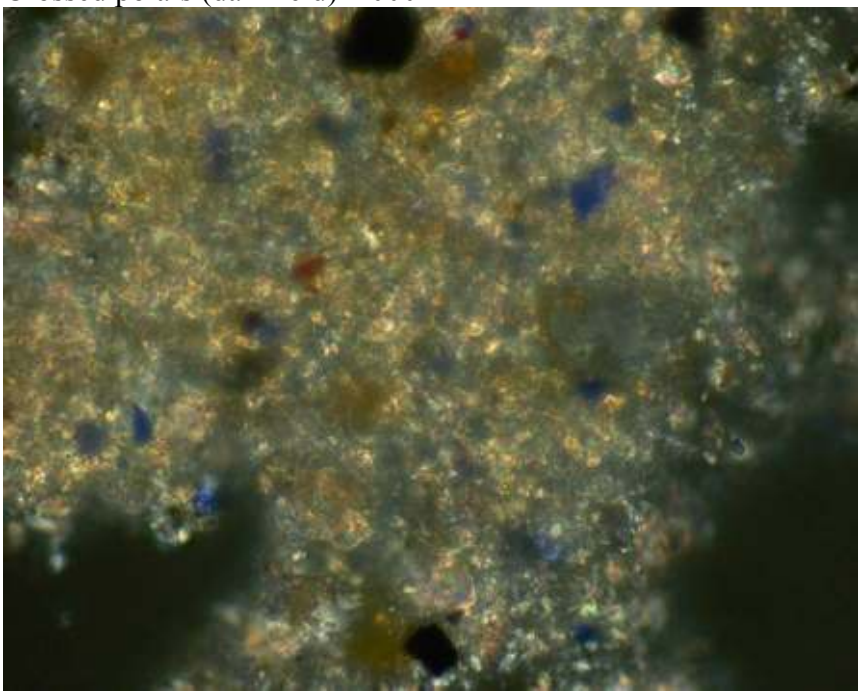
UV Light & DCF for the presence of oils 400X
Positive reaction for saturated (cross-linked) oils in the wood and in the paint



Sample 4. Flakes of gray paint from ceiling, above E-W beam.
Blue pigments – synthetic ultramarine
Yellow pigments – yellow ochre, raw umber
Orange pigments – burnt sienna
White pigments – calcium carbonate
Black pigments – charcoal black
Plane polarized light transmitted light 1000X



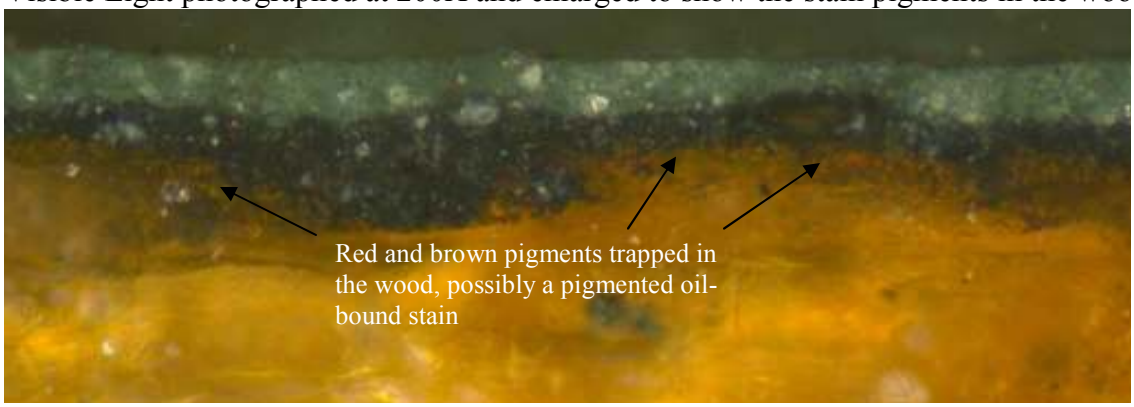
Crossed polars (darkfield) 1000X



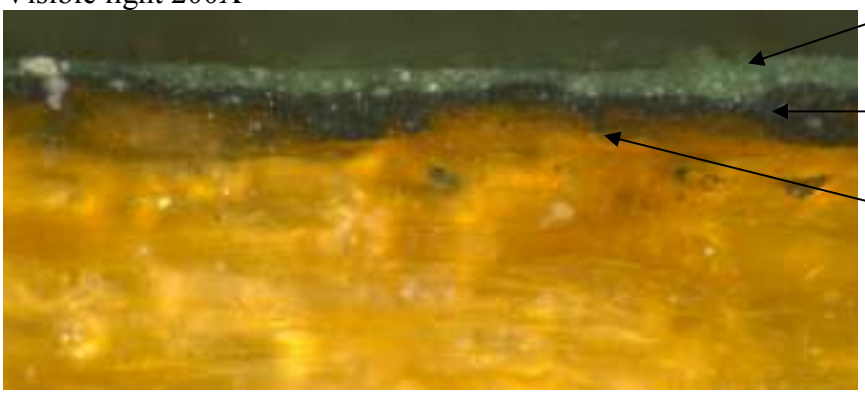
Door. One key question about the green paint on the door was whether it is the original color and if so, if it has changed over time. The cross-section shows that the green paint is the third generation on the door. The first generation is a deep red-brown stain (the pigments are trapped in the wood fibers), the second generation is black, and the third generation is a finely ground deep green which does not resemble the green paints found on the ceiling. The surface of this uppermost green door paint does not appear particularly blanched, but it does seem slightly darkened and dirty. It is finely ground and still slightly glossy.

Binding media analysis with biological fluorochrome stains suggests that all the layers in this paint sequence are oil-bound. There is also oil trapped deep in the wood fibers (see the staining reaction with the fluorochrome Rhodamine B) which suggests the first pigmented stain layer was applied as a low viscosity, oil-based layer. There are no varnish coatings present in this cross-section sample, but the oil binding component has contributed to the slight glossiness remaining in the uppermost green paint layer.

Sample 1. D1, door, north side.
Visible Light photographed at 200X and enlarged to show the stain pigments in the wood

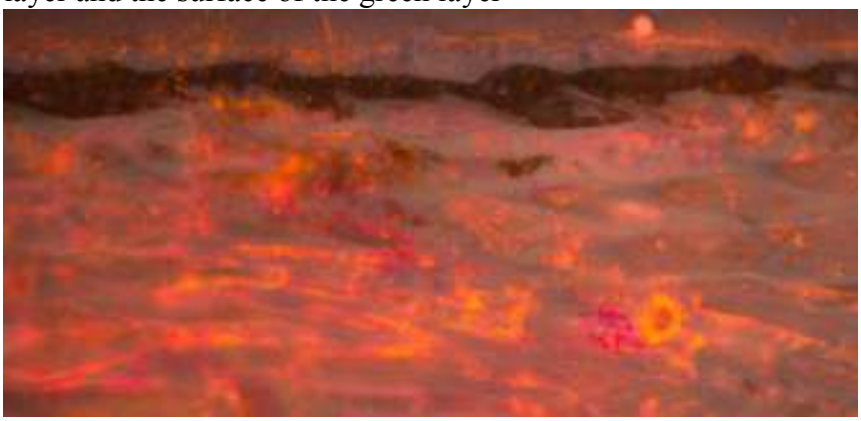


Sample 1. D1, door, north side.
Visible light 200X



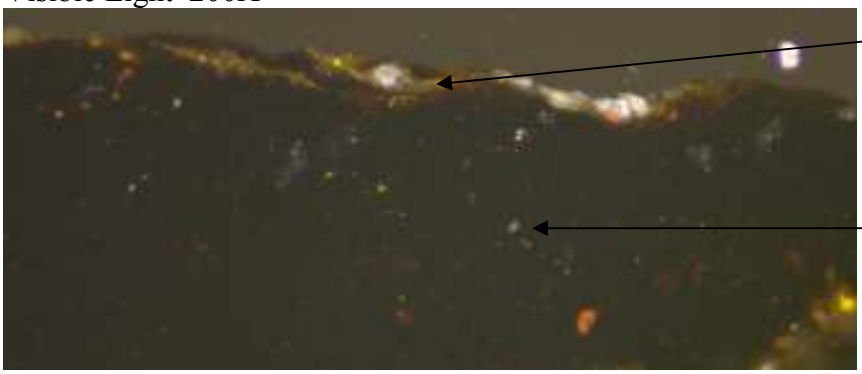
Ultraviolet Light 200X

UV & RHOB for the presence of oils 200X
Strong positive reaction in the wood, positive reaction in the pigmented stain, the black layer and the surface of the green layer



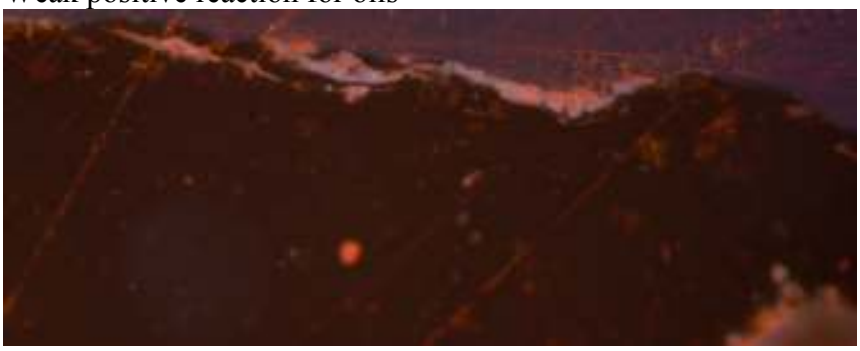
Black drips on southernmost west window. This is an interesting material as it appears dark brown and glossy in uncast form, but there are suspended red and yellow pigments discernible in the brownish material when viewed in the cross-section. There are also remnants of a yellowish paint-gray paint on the surface that could be an accidental overlap of gray paint from the wall which are now discolored. This somewhat amorphous brown material is slightly translucent (unlike an oil-bound paint) and it most resembles natural pine tar with some pigments to add opacity, durability, and to contribute to drying. This type of material was a byproduct of turpentine production and was a typical waterproofing material in the 18th and 19th centuries, primarily before the Civil War. The precise nature of this coating would have to be determined with other analytical methods such as FTIR and/or GC-MS, but it does seem to have an oil component, based on the weak positive reaction with the fluorochrome Rhodamine B.

Sample 3. Black paint drips, W108 boards.
Visible Light 200X



Ultraviolet Light 200X

UV & RHOB for the presence of oils 200X
Weak positive reaction for oils



Conclusion:

Cross-section microscopy and pigment analysis of this group of cross-sections suggests that all of the wall and ceiling paints represent coatings could have been made and applied by J. Alden Weir from dry pigments and readily available organic binding components. The blue-green and grayish paints are complex mixtures of pigments and organic binding components that may have been mixed by Weir to produce specific colors and working properties. This is particularly intriguing when considering the gray wall paint, as it would be quite simple to produce a gray paint from a simple combination of pigments such as lampblack and calcium carbonate, but the gray-green wall paint is actually composed of at least five different pigments. The paints on the door are more typical oil-based coatings, and the brownish-black material on the window seems to have been from an accidental spill of a natural resinous material like pine tar. The pine tar was more likely used for waterproofing architectural elements like gutters and fences, not as an art material.

The presence of synthetic ultramarine ($Na_{6-10}Al_6Si_6O_{24}S_{2-4}$) in the blue-green and gray paints is not surprising. It is a blue pigment that was in widespread use for fine art and architectural paints by the end of the nineteenth century. Artificial, or synthetic, ultramarine is quite stable, although it can be decolorized by exposure to acids.[3] The finding of indigo in the uppermost thin layer in sample 5 was rather surprising, but indigo was sometimes the blue pigment of choice for limewashes because the more commonly used blue pigment Prussian blue turns brown under alkaline conditions. The other pigments found in the wall and ceiling paints are typical stable, inexpensive pigments used in a wide range of artist's and architectural paints.

The strong positive reactions for the presence of carbohydrates and proteins in most of the wall paint layers are consistent with late nineteenth century painting practices for limewashes and whitewashes. Organic materials such as casein, milk, flour, molasses, and glue were used to make traditional limewashes and whitewashes more durable and make them adhere better to a variety of surfaces.

The first phase of analysis did not suggest an obvious reason for why there is such a distinct color change and brightening of the blue-green paint where the gray ceiling paint has recently flaked away, and in the area of the cleaning test. However, in the second set of samples the comparison of the cross-section photomicrographs for sample 7, from a bright ceiling area, and sample 9, from a darkened ceiling area, suggests that the darkening is due to airborne materials (soot, grime, nicotine) that were absorbed into the porous surface of the paint. This darkening and discoloration is most obvious in the reflected ultraviolet light photomicrograph for sample 9.

[3] See Rutherford Gettens and George L. Stout, *Paintings Materials: A Short Encyclopedia*, New York: Dover, 1966. 164.

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 0.02% in water, pH 9, 0.05M borate and 5% DMF to identify the presence of proteins. Positive reaction color 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 yellow and unsaturated lipids is pink.
>
> Rhodamine B (RHOB) 0.06% in ethanol to identify the presence of oils. Positive reaction color is bright orange.

The best cross-section photographs for each area were mounted and labeled and are included with 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.

Pigment Preparation:

Individual pigments were scraped from five individual paint layers from three different samples with a scalpel under 45X magnification. These pigments were crushed and dispersed on clean microscope slides, and then were permanently mounted under a cover slips with Cargille MeltMount with a refractive index of 1.66 (n=1.66). The dispersed pigment samples were examined under plane polarized transmitted light, and under crossed polars, at 400X magnification and 1000X magnifications (with a 100X oil immersion objective). The refractive indices and optical properties of the unknown pigments in the five different layers were identified and compared to standard reference pigment samples.

Example of a Late Nineteenth Century Paint Recipe for Plaster Which Contains Protein and Carbohydrate Components:

From: Ernest Spon. *Workshop Receipts, for the Use of Manufacturers, Mechanics and Scientific Amateurs*. New York: E & F. N. Spon, 446, Broome Street. 1878, 117-118.

> **To Whitewash, or Colourwash.** – If a room is to be whitewashed or coloured, the walls and ceilings are to be washed with clean water, frequently changed, the rough patches scraped smooth, swept with a broom, and all cracks and loose places carefully stopped. When this is done, before proceeding further, all the

rubbish should be cleared from the room and the floors swept. In some instances, as after illness, it will be the best to make the whitewash of lime, for lime is a good purifier. But as lime-wash is apt to turn black, whitewash is generally made by putting whiting to soak in water overnight, and afterwards mixing very smooth, as thick as cream, with about a teacupful of size to two galls. of wash, white will prevent its rubbing off when dry: or potato starch may be used, which leaves the white uninjured. Another mode is to mix into a stiff paste, with cold water, 6 balls of whiting; to this add 2 lbs. of very hot, but not boiling, size, and a small quantify of blue black ground fine, and let the whole get cold. Whitewash thus prepared may be altered to any required colour: yellow ochre mixed with a small quantity of blue black makes a stone-colour; without the black, a buff or straw colour; and warmer tints may be produced by using indigo or the blue black above mentioned, or Venetian or orange red, vermillion will give different shades of pink, and a green may be obtained with a mixture of indigo and yellow ochre. Some care will be required in the mixing, but if too much of the colouring matter is not added at first, it will not be difficult to get a colour according to taste. By a little management the wash may be laid on without splashing, the method being, not to take too much at a time into the brush, or to jerk it at the end of the stroke. As a rule, ceilings or walls should be whitewashed at least once a year, and oftener whenever necessary. For common work a mixture of ½ bushel of lime, 1 lb. of common salt, ½ lb. of sulphate of zinc, and a gallon of sweet milk can be used. For brickwork exposed to damp, take ½ a peck of well-burnt lime, fresh from the kiln, slake with water, then add a sufficient quantity of water to reduce it to a paste, pass through a fine sieve; add a gallon of clean white salt that has been dissolved in boiling water, and a thin smooth paste, also hot, made from 1 lb. of fine rice flour; also ¼ lb. of best glue, made in a water bath. Mix these ingredients all together, stir them well, then add ¼ lb. of best Spanish whiting dissolved in 5 qts. of boiling water. Stir again, and cover over to retain the heat and keep out the dirt. Let it stand a week, then boil again and apply hot. The above proportions will suffice to cover 40 square yards.

Emulsion Paints – U.S. Patent Recipes
Research Conducted by Richard C. Wolbers

Ca. 1850 Emulsion Paint

Water	200
Linseed oil	80
Caustic soda	20
Potato starch	6

Ca. 1860-70 Emulsion Paint

Water	200
Linseed oil	130
White spirit	30
Caustic soda	20
Copal	20
Potato starch	10
Casein	6
Manganese abietate	0.1

End of the 19th Century Emulsion Paint

Lithopone	380
Water	65.5
Linseed oil	30
Shellac	30
Ammonium bisulfate	4.5

Beginning of the 20th Century Emulsion Paint

Water	32
Varnish	16
Hide glue	10
Naptha	4
TEA linoleate	0.6
Phenol	0.1

1930s Emulsion Paint

Dehydrated castor oil	33.41
Lithopone	39.81
Casein	3.31
Phenol	0.06
Ammonium hydroxide	23.41

General Wall Paint Definitions:

Distemper – A somewhat chalky paint composed of dry pigments in dilute hide glue.

Casein – A paint binder made of the solids from skimmed milk (curds precipitated out with vinegar, acetic acid, or hydrochloric acid).

Calcimine (Kalsomine) – A nineteenth century term for a commercially prepared distemper paint with a hide glue binder (offered in dry powder form). Also a generic term in the twentieth century used to refer to commercially prepared distempers and to paints with just casein, or casein and dilute hide glue, binders.

Emulsion paint – A paint made with oil and water components and emulsifiers to produce a stable emulsion.

Limewash – Slaked lime and water, sometimes with other pigments as colorants, and organic components such as flour, salt, sugar, hide glue, milk, casein, rice starch and oil, added to make the limewash more durable.

Whitewash – A generic term sometimes used to apply to limewash. A dilute wash of hide glue and whiting, or lime and water. May be pigmented.