A Material Evaluation of the Gropius House: Planning to Preserve a Modern Masterpiece

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The American home of the renowned Bauhaus founder, tucked into the rural community of Lincoln, Massachusetts, is the subject of interior and exterior materials analysis.

Introduction

Despite Walter Gropius's international reputation as an architect and teacher, when he and his wife, Ise, arrived in the United States in 1937 they were virtually destitute. In 1934 they left their furnishings, artwork, and personal belongings in the care of Ise's sister and escaped the increasingly hostile Nazi regime for the safety of an architectural partnership in London, England. In 1937 Gropius responded to an invitation to become a professor of architecture at the Graduate School of Design, Harvard University.

Soon thereafter, Henry Shepley, a prominent Boston architect, convinced Mrs. Helen Storrow, an elderly philanthropist, to provide the land in rural Lincoln, Massachusetts, and funding for Walter to design and build a house for himself and Ise. Gropius sited the house at the top of a rise, with a long drive leading up through an old orchard. Ground was broken in March 1938. Gropius was intimately involved in all aspects of the design, including the selection of materials.

Marcel Breuer, an architect and former colleague at the Master of the Carpentry Workshop of the Bauhaus, arrived in the U.S. soon after the Gropiuses, also to join the Harvard faculty. Mrs. Storrow provided an adjacent lot on the same terms, and the two architects worked as partners to plan and build their houses. Their modern, flat-roofed houses became tangible advertisements for their work but clashed with the Colonial Revival-style house of their neighbor James Loud. The Loud family complained about being surrounded by "chicken coops."[1]

In fact, Gropius's design combined many traditional materials (pine clapboards, brick, fieldstone, and redwood sheathing) with industrial materials (glass blocks, welded steel, acoustic plaster, and chromed metal). It was a laboratory for Gropius's ideas, as well as an effective teaching tool for Harvard students who saw the house under construction.

The conceptual design and forms of the Gropius House have remained fresh and vibrant over the past fifty years. However, many original construction details and materials have not fared so well. Repair invoices and correspondence reveal ongoing roof drainage problems and extensive interior repairs as a result of water damage.

In 1974 Ise Gropius gave the property to the Society for the Preservation of New England Antiquities (SPNEA) but retained a life tenancy. She wrote in 1978 that "Since my house has since become a museum and will go into the possession of the Society for the Preservation of New England Antiquities I am obliged to keep everything as it was built in 1937."[2] Nevertheless, her papers indicate that she made substantial repairs using non-original materials and methods and purchased new and different furniture covers, floor coverings, carpets, and textiles, resulting in subtle changes.

After Ise's death in 1983, the Gropius House was opened as a museum (in 1984) and is now filled with the family's artworks and furnishings. It is interpreted as it was during 1967-69, the last two years of Walter's life.

The presentation of the house is problematic. Exterior paint has peeled extensively, and inside repairs and selective replacement of material and repainting undoubtedly changed the original appearance. This paper examines the physical evidence to assess how

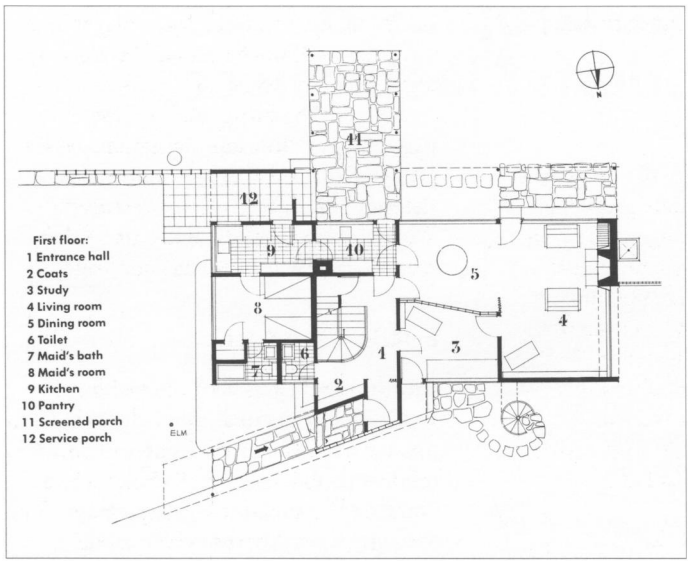

Fig. 1. First-floor plan of the Walter Gropius House in Lincoln, Massachusetts. Courtesy of the Society for the Preservation of New England Antiquities.

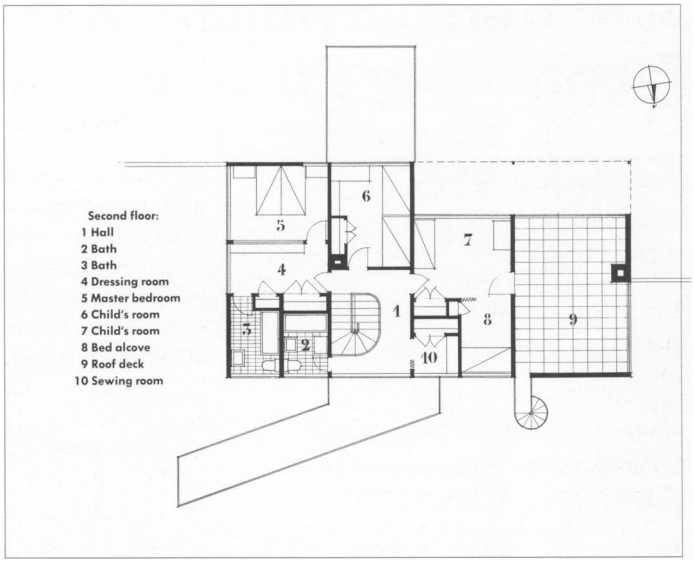

Fig. 2. Second-floor plan of the Walter Gropius House in Lincoln, Massachusetts. Courtesy of the Society for the Preservation of New England Antiquities.

the house has changed, identifies the surviving original materials, and makes suggestions for future research and long-term preservation.

Efficient Design

By 1931, when Walter Gropius wrote "The Small House of Today" for *Architectural Forum*, he had clearly thought hard about the most important aspects of a livable house:

> The dwelling house should no longer resemble something like a fortress, like a monument with walls of medieval thickness and an expensive front intended for showy representation. Instead it is to be of light construction, full of bright daylight and sunshine, alterable, time-saving, economical and useful in the last degree to its occupants whose life functions it is intended to serve.[3]

He emphasized "opened walls" to let in sunlight, the use of clearly defined and simple forms, and the need for all building parts to exist in harmony and proportion. He applauded the availability of new materials and construction methods, which made it possible to shift the load to a steel or concrete skeleton, allowing larger expanses of glass. Gropius also suggested that a flat-roof design was manifestly advantageous over a traditional sloping-roof form. Most of these design elements can be found in his Lincoln house.

The 1931 article also describes the layout of an ideal small house:

> The ground plan ... is a geometrical projection of its spatial idea — the organizing plan for moving within the house. The elevation, facade, is the result of that plan and not the starting point.... Hence, no artificial symmetry, but a free functional arrangement of the succession of rooms, short, time-saving passages of communication, moving space for children, clear separation between the living, the sleeping, and the housekeeping parts of the house, and finally, proper utilization of the ground and especially the sunny aspect. The bedrooms need morning-sun (facing east), the living rooms should have southern or western light, and the north side is left to storerooms, kitchens, staircases and bathrooms.[4]

This suggested arrangement almost precisely describes the Gropius House in Lincoln (Figs. 1, 2). There are no space-wasting passages. The living room has large windows to the west and the south, the dining room faces south, the master bedroom faces south and east. Heavy floor-to-ceiling curtains can be closed to separate certain rooms. The 1931 article also emphasized the advantages of balconies and flat roofs for growing plants and garden vistas. At the Lincoln house, porches and roof terraces and views of the gardens, orchard, and beyond are important.

Unfortunately Gropius did not write in detail about colors, textures, or materials for decoration, nor do published black-and-white photographs of his related Dessau director's house indicate colors and textures of interior surfaces.

The Lincoln house was adapted to the New England climate, as Gropius explained:

> When I built my first house in the U.S.A. — which was my own — I made it a point to absorb into my own conception those features of the New England architectural tradition that I found still alive and adequate. The fusion of the regional spirit with a contemporary approach to design produced a house that I would never have built in Europe with its different climatic, technical and psychological background.[5]

However, unlike traditional New England houses, Gropius painted the brick chimney, oriented white-painted clapboards vertically in the entrance hall, and sheathed the exterior with non-indigenous redwood sheathing, applied vertically and painted white.

The most immediately recognizable difference between this house and most local houses was the flat roof, which sloped slightly towards a central drain and directed water down into a dry well near the driveway. Although flat-roof designs had already been incorporated into a number of significant houses in Europe and the United States, it was still a new and curious phenomena for residents of Lincoln. [6]

Original Specifications

The original specifications written by Gropius and Breuer are in the SPNEA archives. The sections most pertinent to this paper relate to paint and materials purchases. Dutch Boy white lead in oil is specified. It was to be mixed on site in proportions of 4 gallons of raw oil to 100 lbs. of white lead for the primer and 2½ gallons of raw oil to the same quantity of white lead for the finish coat. The redwood sheathing was to be backprimed with one coat of aluminum primer, as was all exterior trim and woodwork and the unexposed parts of all metal work. Metals were to be shop-primed with red lead. The interior wall paint was to have a primer followed by two coats of a semi-gloss finish.

These specifications are not particularly unusual. To the contrary, white lead in oil was well-known as a durable exterior paint. And it is good practice to backprime before installing sheathing to help counteract warping and deformation due to differentials in moisture penetration. Most of the materials specified for painting and decorating were advertised in contemporary architectural magazines like *Architectural Forum* and *Architectural Record*.

However, it appears that many of the interior materials were changed between the time the specifications were written and the time the construction took place. The surfaces of the living room, dining room, and study were specified as painted, smooth-finish plaster, but were actually finished with white, textured, acoustic plaster from the California Stucco Company.[7] This plaster is extremely coarse and nubbly, primarily due to its wood-fiber and vermiculite additives, which presumably contributed to its sound-deadening qualities. Wallpaper was originally specified for the living room, dining room, study, maid's room, and all bedrooms, but only two bedrooms were wallpapered. A cotton fabric covering, not wallpaper, was originally applied to the master bedroom, dressing room, and entry hall. The specifications called for Formica tops for a sideboard and a dressing table, but analysis suggests another laminate. Wood floors were specified for the entrance hall, but cork was installed.

House Maintenance Issues

Gropius attended to the broadest and most minute maintenance problems. A 1945 list reveals a range of concerns from "Readjust heating outlet near living room couch" and "Readjust window cranks" to "Redecorate the whole interior including cellar."[8]

The exterior was repainted in 1960 and 1971. A roof leak was repaired, and some interior rooms were repainted in 1967. In 1974 water damage required scraping and repainting the foyer. The sequence of repairs and repainting reconstructed from invoices can help to interpret, and sometimes date, the paint sequences.[8]

SPNEA's 1985 specifications for the restoration were primarily directed at repairing areas of water damage, roof repairs, and stabilization by such measures as installation of UV-blocking film on windows. The specifications also included interior and exterior repainting and restoring the finishes in the master suite and two bedrooms. The SPNEA Conservation Center produced a study of original paint, but apparently it was not followed, since several key advisors questioned its accuracy.

In 1988 the bleached and pock-marked cork flooring manufactured by Dodge Cork was replaced after tests determined it could not be restored.[9] Work on the roof, the exterior, and the metal window casings has continued.

Exterior Paint Analysis

Research indicates that the Gropiuses were very concerned about the color and quality of the exterior paint and chronic mildew problems. By 1995 the white paint on the sheathing was peeling off in long strips, and corrosion of metal windows was pushing off the gray paint.

A variety of analytical methods including visible and ultraviolet light cross-section microscopy, fluorescent staining techniques, and FT-IR microspectroscopy were used to characterize the binding media in the various layers of exterior paint. Under ultraviolet light at 125X and 250X magnifications, specific fluorescent stains applied to cross-section paint samples can indicate whether there are protein, carbohydrate, and oil components in the binding

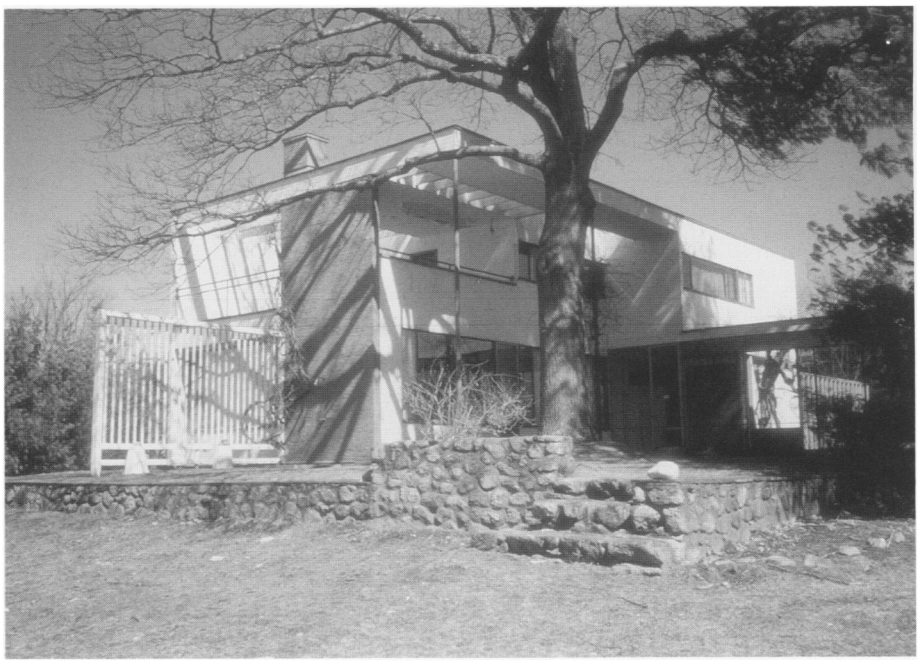

Fig. 3. The south and west facades of the Gropius House, with second-floor porch and pink sheathing. Photograph by Christopher A. Packard.

Fig. 4. The dressing room and master bedroom are separated by a large window wall. The other walls are covered with painted canvas. Photograph by J. David Bohl. Courtesy of the Society for the Preservation of New England Antiquities.

media of the layers. The analysis indicated that all sheathing paints were oilbound (consistent with the recorded purchases of lead white in oil) except for one intermediate layer where cleavage between the layers was occurring. This layer was isolated, pressed between a diamond cell, and analyzed to identify its organic components, using an FT-IR microscope. This technique generates a spectra of the organic components, which can then be compared to a set of known spectra.

The FT-IR analysis revealed an anomolous, unstable polyvinylalcohol (PVOH) -based paint layer that was incompatible with the adjacent white lead and oil layers. Paint cleavage was taking place at this layer.[10] In addition, there was a film of the fungicide Retardol (pentachlorophenol) above this layer, to combat mold, but it had penetrated the redwood and created hygroscopic conditions that exacerbated the paint-cleavage problem. The synthetic PVOH layer and Retardol may date to the 1971 paint job in which "1601" finish white was applied to the house. Although the fungicide appears only in one invoice from 1960, it may well have been used on a more regular basis to combat mildew.

The final stage of this analysis determined appropriate color matches for the 1960s paint on the sheathing, the trim, and the second-floor porch wall with the help of a tristimulus color measurement instrument (a Minolta Chromameter CR-241). This instrument combines a 30X microscope with a color measurement computer, allowing the use of samples as small as 0.3mm across. It revealed that the exterior colors had changed subtly under SPNEA ownership.

The north side was painted in 1996 after the analysis was completed, and work will continue during 1997. The intent is to paint the sheathing and window frames with the colors identified through the paint study as relating to the 1960s, Walter Gropius's last years. The white paint was then a slightly warmer, more creamy white, and pink porch-wall paint was a slightly warmer, more intense pink than the current color. The trim is being painted a darker gray than the most recent color.[11] The chimney was painted the same sequence of grays as the trim, but interestingly, the primer on the brick was a thick silver-colored metallic paint layer, perhaps for waterproofing purposes. This primer has trapped moisture in the brick and caused large areas of peeling paint.

The first generation of pink paint on the porch sheathing is one of the few clearly datable layers (Fig. 3). It was applied in 1949 to reduce the bright reflection from the south-facing wall. Gropius explained the decision:

> The wooden seperation [sic] wall towards the street became on sunny days such a dazzling background that we chose to change the white color into what we used to call Bauhaus pink. It was a certain pink which the Bauhaus painters had agreed on to be the best color when they exhibited their art works in the Bauhaus exhibition rooms. Lyonel Feininger who happened to visit us in Lincoln as that time (October 1949) supervised the whole painting process because the house painters did not know what we meant with a washed out carmosine. We said: Pappi Leo, see to it that he actually puts on the Bauhaus pink.[12]

A 1960 invoice for paint materials suggests this color was still being custom mixed on site using white lead and carmine exterior paint to achieve the proper Bauhaus pink.

Interior Materials

Paint and surface materials were sampled to determine where original materials survived and how the appearance of wall surfaces may have changed from aging and degradation, from changes made by Walter Gropius, Ise Gropius, or SPNEA.

A total of forty samples, approximately 300 to 400 microns in size, were taken from protected, representative areas, then cast in cubes and examined in cross section at magnifications of 50X, 125X, and 250X under reflected visible and ultraviolet light.[13] Fluorescent stains were used to characterize various binding media components.

Living room. Six samples were taken from the walls, ceiling, built-in cabinet, and wood trim. Analysis suggests two to three generations of white paint on the trim. One door contains three white paint layers, and the second generation

(which has a slightly creamy tone) has mold spores, due perhaps to past high moisture conditions in this corner or perhaps to unstable paint. This small group of samples suggests that various elements were painted at different times. The first layer was a slightly warmer white than the current layer.

There appears to be only one, thin, white paint layer on the acoustic plaster in the living room and dining room; it is not possible to determine whether this is the original paint. Because of its thin application and the depressions and additives in the plaster, the walls have a mottled, grayish appearance.

Dining room. This space has the same textured acoustic plaster ceiling and white-painted woodwork as the living room, emphasizing the visual continuity between the two rooms. Samples taken from the door frames on the east side of the room are intriguing because the inner surfaces where the plaster meets the door surround were first painted white and repainted twice at at an early date with a silver-colored metallic paint, which makes the edges of the door frame appear to recede. This may be an example of Gropius's experimentation with paints to achieve a specific effect.

Study. The north wall is virtually all glass. The glass blocks of the south wall diffuse light from the dining room. Because there are so many windows and doors, there is actually very little wall surface; it has the same acoustic textured plaster with a thin, white paint layer and a gray film of dirt on the plaster. There are only one to two layers of white paint on the door jamb and bookshelf. Apparently the original surfaces are mostly intact.

First- and second-floor entrance halls. Ten samples were taken from the hall because of the variety of wallcoverings. The first-floor west and south walls have white-painted vertical clapboards, and clapboards are used on the south, east, and west walls on the second floor.

A painted canvas wallcovering was applied to the rounded wall below and along the staircase up to the second floor. The fabric texture is not easily discernible below the accumulated paint layers. All the wall surfaces have been painted white. There are two to three generations of white paint on the wood and textile wallcovering, although a number of the clapboards on the first floor appear to have been scraped thoroughly before repainting. The first generation white is a slightly warmer white than the cool white paint currently on the clapboards. The door frames and trim are now painted with a creamy white color, noticeably different in hue from the clapboards and the fabric-covered walls.

Analysis indicates that significant portions of the first-floor painted wall surfaces were stripped and repainted. The current paint history may date to the 1974 repair and repainting of the "rain damaged foyer" or possibly to work done in preparation for the 1988 fiftieth anniversary party for the property. Fortunately, the full paint history appears to be more intact on the clapboards and trim on the second floor.

The ceiling plaster is covered with only a thin wash of white paint and a distinct layer of accumulated dirt. The oak-veneered wall of the coat closet appears to have been originally coated with a synthetic resin varnish, perhaps nitrocellulose, and then recoated at some point with a second layer of a synthetic resin varnish containing flatteners for a matte appearance. Remnants of several translucent, amorphous layers, with brown pigments on the surface of this oak-veneer, suggest that several layers of tinted paste wax were applied to saturate and protect the wood, perhaps in 1988. There are no written records to indicate how this surface was treated in the past.

The variety of whites and the history of repairs in the first-floor entrance hall suggest there is now a whole range of white paints from different periods in this space. A more extensive sampling of all elements is required to understand fully the sequence of paint layers and to identify the correct paint layer for color matching to the 1967-69 interpretation period. This is a priority, as the current mix of whites ruins the visual coherence of this two-story entry and stairhall.

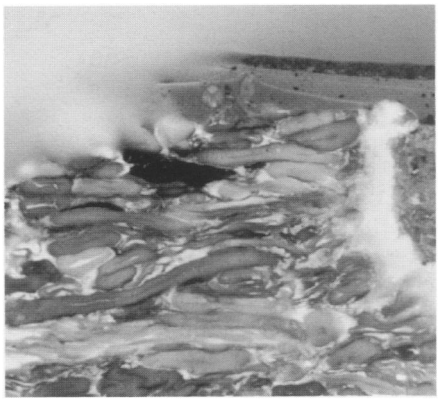

Fig. 5. A cross section of the black laminate on the dressing table shows a fibrous substrate and four black coatings. An autofluorescent resin component is visible in the substrate (photographed at 125X under ultraviolet light). Photograph by Susan L. Buck.

First-floor bath. One sample indicates only two generations of white paint on top of the finish plaster; they are not white lead-based and are most likely recently applied. By comparison, the master bathroom appears to have eight generations of paint.

Master-bedroom suite. The dressing room is medium gray, with a band of light gray along the top of the walls. The bedroom is painted light gray throughout, with medium gray paint on the woodwork. Vertical wood battens on the west wall are painted like the walls and create a distinctive pattern, especially in the raking light from the south window. Archival photos show artwork and artifacts hanging from the battens.

Inspection of the walls indicated that, with the exception of the glass dividing wall, many of the surfaces are covered with the same type of cotton canvas used in the entrance hall (Fig. 4). Paint analysis showed that the wallcovering was first painted deep red-brown, with a coarsely textured red-brown paint applied in three layers. The three layers vary slightly in color, perhaps because Gropius was trying several different shades until finally settling on the third red-brown. This red-brown paint has penetrated deeply into the fibers of the textile, suggesting this wallcovering was never left unpainted. In the second paint

generation both spaces were repainted with a thin, somewhat more finely ground, red-brown paint, and then the rooms were repainted light gray in the third and fourth paint generations.

Invoices do not reveal when these two rooms were repainted, and photographs from 1938 and 1948 do not differentiate colors. However, a 1945 photograph shows that the dressing-room ceiling was the same dark tone as the walls.[14] The sample taken from the dressing-room ceiling indicates that it was also painted the same red-brown color as the walls.

Walter Gropius was apparently an extremely light sleeper. His daughter recalled that the walls and ceilings in the master bedroom suite were deep red-brown in an attempt to keep the bedroom as dark as possible.[15] The north window wall curtain was also kept tightly closed at night to shut out the morning light from the east window in the dressing room. After his daughter moved out of the house in the 1940s, Walter Gropius moved to the more protected bed nook in her room at the northwest corner of the house. It was apparently during this period that Ise Gropius chose to repaint the bedroom suite in lighter gray tones.

These two rooms contain the most complicated paint history and the widest variety of wall surfaces. This paint analysis also indicates that although this suite of rooms is radically different in terms of color and surface texture from its original appearance, the current gray colors are in keeping with the interpretive period of the house.

Black dressing table. Two items that appear not to be made of a stock catalog material are the dressing table and the black top of the sideboard. Originally specified as Formica, they were identified by Ise Gropius as Cafolite, apparently to replicate the shiny black Cafolite countertops in the Oyster Bar in New York, where the Gropiuses had their first meal in America.[16]

Although there was a burgeoning of new plastic products in the 1930s, Cafolite does not appear in the literature. However, several early 1940s sources mention Caffelite, a coffee-bean molding compound made by the Caffelite Corporation.[17]

The worn edges of the dressing table reveal a coarse, fibrous substrate. The cross-section samples showed four opaque black layers applied to a fibrous substrate with a resinous binder (Fig. 5). Its laminated structure is similar to that of Formica, in which layers of resin-impregnated kraft paper are cured under heat and pressure.[18] Despite wear, it is still remarkably glossy and quite striking in appearance.

The substrate of the dressing table was analyzed at the Winterthur Museum Analytical Lab using FT-IR microspectroscopy. Because of the number of organic materials (oils, resins, plant fibers, and proteinaceous components), the resulting spectra were complex and not easily decipherable, although fluorescent staining indicated a strong oil component in both the substrate and the black coatings. Analysis of an actual sample of Caffelite could confirm the nature of the material. A comparison with contemporary Formica may also be revealing.

Master bathroom. Two samples of wall paint contain approximately eight generations of paint, beginning with an off-white paint layer. The paint becomes progressively more beige and does not relate to the colors in the dressing room or bedroom.

Conclusion

SPNEA is acutely aware of the importance of the Gropius House and the vulnerability of its materials. Today the house is open to visitors only during the summer. Tour groups are generally limited to 12 to maintain security and to limit wear and tear. Visitors must wear cloth booties to protect the flooring. The heavy shades are opened only during tours, and during the winter the thermostat is lowered to control the relative humidity. These measures have helped to preserve the life of all artifacts and finishes in the house. This is especially important for the sideboard and dressing table, as the ultraviolet component of light is especially damaging to plastics and will cause yellowing and embrittlement.[19]

Some surfaces will never again appear as originally executed. The coarse fabric texture on the walls in the stairhall and master bedroom suite is now lost due to repainting, and wallpaper in two bedrooms was completely stripped. However, it will be possible to recapture the patterns and sharp-edged effects of the vertical clapboards in the stairhall once additional paint analysis and color-matching identifying the appropriate 1960s white are complete. Simply cleaning the dirt off the acoustic plaster surfaces will help to emphasize their texture and brighten their appearance.

The current policy of stabilization, not replacement, limits further loss of original materials. One exception is the redwood sheathing. Because of the pentachorophenol and the incompatible synthetic PVOH-based paint layer, the exterior paint will continue to cleave off. To achieve an intact paint surface, the current exterior paint must be removed by chemical stripping. SPNEA's approach for its other houses is to simply scrape off loose paint, sand the edges, and then repaint, but in this situation the use of chemicals is unavoidable. Fortunately, the sheathing on the south side, which is protected by the porch roof, remains intact and well adhered. This paint history will be left in place and will be available for future research.

This research indicates that several important areas of the house now look markedly different. The texture of the canvas wallcoverings is completely obscured, and the palette of the master bedroom suite is dramatically different. Numerous generations of white paint of varying hue and value on the interior and the exterior reflect both the shift from traditional white lead-based paint to modern titanium white-based paints and the many repair and restoration campaigns.

Although the white paint issue has been satisfactorily resolved on the exterior, this research suggests further sampling and color matching using a color measurement instrument would help to identify the appropriate white colors for the current interpretation date. This is especially important in the central hall, which connects all the main rooms and is the first space seen by

visitors. At least three generations of white paint are visible here, which diminish the play of light on the vertical clapboards and the integration of the first-floor with the second-floor hall.

Other areas for future research include a detailed examination of the master bedroom suite and an analysis of the service areas, guest bedrooms, and the glossy black synthetic material. Such analysis contributes to an understanding of the often subtle effects Walter Gropius wished to achieve in the house and of the types of materials he chose to achieve these effects. Finally, identification of these materials also contributes to an understanding of how best to care for and protect them for the long term.

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Notes

1. Peter Gittleman, "The Gropius House," Master's thesis, Boston University, 54.

2. Ise Gropius to the Levelor Company, Hoboken, New Jersey, June 16, 1978. SPNEA Gropius Archives, Box 6.

3. Walter Gropius, "The Small House of To-Day," *Architectural Forum* 54 (March 1931): 266.

4. Gropius, "The Small House of To-Day," 274.

5. Gropius, *Scope of Total Architecture,* xxi-xxii.

6. These include the 1925 Dessau Bauhaus director's and masters' houses; Le Corbusier's 1926-27 Villa Stein and 1928-29 Villa Savoye, J.P. Oud's 1924 house at the Hook of Holland, and Richard Neutra's 1927 Lovell House and Frank Lloyd Wright's 1920 Barnsdall House in Los Angeles. In 1938 the Boston architect Royal Barry Wills won a design from the American Gas Association for a small flat-roofed house.

7. Ise Gropius, *History of the Gropius House* (Boston, 1977), 14-15.

8. SPNEA Gropius Archives, Box 6.

9. Tests by SPNEA employee Andy Ladygo determined the flooring could not be restored to reflect the original appearance of the cork tile. The original flooring was saved by Peter Gittleman, SPNEA Director of Interpretation and Education, and a sample was placed in the SPNEA archives.

10. This analysis was conducted at the Winterthur Museum Analytical Lab using an FT-IR microscope Analect RFX-6 model, with the help of Winterthur Museum senior scientist JAnice Carlson and Professor Richard Wolbers, of the University of Delaware/Winterthur Graduate Program in Art Conservation.

11. Susan Buck, "Exterior Paint Analysis: Gropius House," SPNEA, 1995.

12. SPNEA Archives, Gropius House, Box 3.

13. An Olympus BH-T Series 2 epi-fluorescent polarizing light microscope was used for the analysis. A fiberoptic light source was used for reflected visible light. The binding media stains triphenyl tetrazolium chloride, fluorscein isothiocyanate, 2,7 dichlorofluorscein, and Rhodamine B were used for this analysis.

14. SPNEA Archives, Gropius House, Box 6.

15. Personal communication, Peter Gittleman, July 1997.

16. Gittleman, "Gropius House," 41.

17. This new plastic was described as being the result of research sponsored in the 1930s by the Brazilian government to discover ways to use coffee beans in making plastics. The effort apparently had limited success, as described in the 1945 book entitled *The New Plastics:* "The work has reached the pilot-plant stage, but commercial production has not been inaugurated, and the war has served to divert attention from such a product. Technical difficulties have been responsible for the lack of progress. Resins produced from coffee lack sufficient aldehydes, a deficiency that might make large-scale manufacture uneconomical. Research, however, is continuing. The Caffelite Corporation is identified with this work.

18. Anthony J.T. Walker, Kimberly A. Konrad, and Nicole L. Stull. "Decorative Plastic Laminates," in *Twentieth Century Building Materials* (Washington, D.C., 1995): 127.

19. John Morgan, *Conservation of Plastics:* 16.

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