A Study of the Materials and Environment at Russel Wright's Dragon Rock

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Abstract: Russel Wright (1904-1975), a noted American industrial designer, worked for more than thirty years to site, design, construct, decorate, and furnish his remarkable house Dragon Rock in Garrison, New York. Located in an abandoned quarry, the site Wright called Manitoga contains acres of walking trails, carefully constructed landscapes and vistas, and Wright's studio and sculptural house. The rugged terrain of the quarry and the surrounding vegetation directly influenced the design of the house which is constructed on eleven levels, and incorporates boulders, trees, and plant materials into the structure and interior. In some areas of the house the interior is almost indistinguishable from the exterior because of the positioning of large rocks, and the broad expanses of glass on the southern and eastern sides overlooking the quarry pond.

Wright selected and applied all the interior finishes, including plaster, paint and wood coatings. He purposely juxtaposed natural materials such as wood, stone, leather, copper, and fur, with newly invented materials like epoxy paints, plexiglas, styrofoam, and Formica. Wright described Dragon Rock as follows: "My own experimental and personal country home is intended as an experiment and demonstration that contemporary design can create from old and new materials a home highly individual, capable of the variety of moods that can be found in traditional homes, a home that can join the emotional, sentimental and esthetic characteristics with the practicality and comfort that we created in the 20th century."

A recent technical study of the interior finishes and materials at Dragon Rock has revealed the vulnerability of many of the natural and synthetic materials chosen for finishes. High light levels have bleached and embrittled clear wood finishes as well as the natural materials such as pine needles, leaves, ferns, and butterflies embedded into the decorative and functional surfaces. Chronic moisture problems have resulted in considerable deformation of built-in cabinetry and complete loss of original cork flooring in the ground floor kitchen. The intent of the materials analysis conducted by the SPNEA Conservation Center as part of a Historic Structures Report completed by Ann Beha Associates, Architects was not only to identify the materials used for paints and clear coatings, but to identify ways to slow the rapid degradation of materials due to the extreme environmental conditions and to stabilize the interior finishes and furnishings without compromising Wright's original intent.

Study Design

THE PAINTED AND CLEAR-FINISHED SURfaces in each interior space in both the house and the studio were examined and sampled during two days of on-site work in November 1995. A total of 55 samples were taken from the main house and 34 samples from the studio. These samples were analyzed using visible and ultraviolet light cross-section analysis to identify the paint and finish layer history, and stained with fluorescent stains to characterize the binding media in each layer. Polarized light microscopy analysis was also used to identify the pigments in specific paint layers. A small group of especially puzzling and problematic samples from the unstable stucco-like sand paint in the main hall, the green painted living room wall and the darkened living room floor coating were also taken to the Winterthur Museum Analytical Lab in Winterthur, Delaware to more conclusively identify the binding media components.

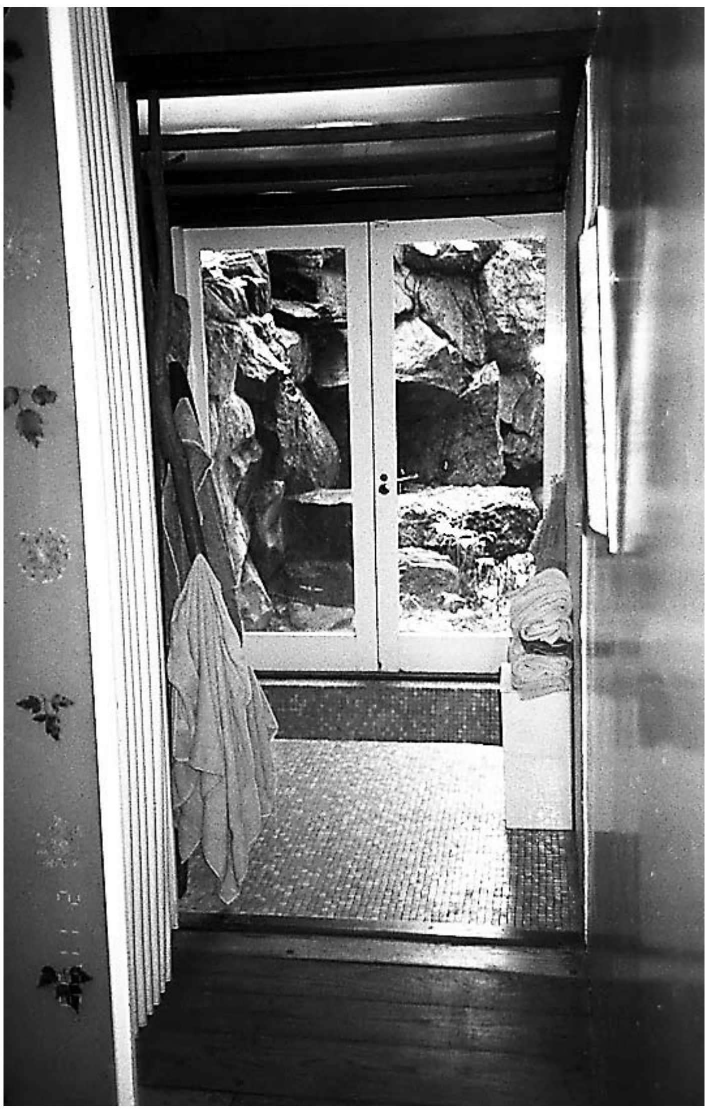


Figure 1. Sliding door panels, like this one leading into the Harem Bathroom, incorporate fragile plant materials from the site.

In general, most of the painted and metallic surfaces have survived with complete intact coating histories, while comparatively less evidence survives of the original woodwork and flooring finishes in both buildings. One interesting finding was Wright's use of a pigmented synthetic resin varnish which contains flatteners on many of the woodwork elements in the house. This type of varnish would have originally produced a matte surface and was probably intended primarily as a protective, washable coating, not a decorative, glossy finish.

This same pigmented/flatted varnish coating was found as the second generation of coatings in the main room of the studio, the first building completed on the site. Based on the presence of this woodwork finish, the different types of sand paint applications in the studio, and the green plaster ceiling in the studio, it may well be that Wright first tested out his coatings on the surfaces in the studio, and refined them for use in the house.

There are indications that Wright repainted selected areas during his lifetime. This includes the closet adjacent to the bathroom in the studio, and the north and east walls in the den. The color changes in these areas were significant. There are other changes which took place after Wright's death, including painting over the faded purple fabric in the "Purple Bedroom", the new surface coatings in "Annie's Bedroom" and in the studio bedroom, and the painted shelving in the kitchen. But a remarkable number of areas in the house and studio still retain their original surface coatings, and although some of the surfaces may have changed in appearance due to the effects of aging and/or unstable materials, Wright's original intent can be plainly deciphered from the surviving evidence.

Wright's Choice of Materials

One fortunate aspect of this study was that Russel Wright wrote and spoke at length about Dragon Rock and why he selected the incredible array of synthetic and natural materials for use throughout the house. Wright's unusual choices for interior finishes reflect an interest in achieving natural-looking, organic surfaces in deliberate contrast to reflective metallic foils and paints, and shiny plastic surfaces. In analyzing and interpreting these surfaces it is particularly important to remember that Wright made and applied most of the coatings in the house, some of which appear to be quite experimental. In a slide lecture presented in Garrison, New York in April 1961, Wright stated: "The interior woodwork, painting and plastering was done by myself, with an occasional assistant from the office." During the same lecture he also listed many of the materials used in the interior of the house and explained his intent in juxtaposing dissimilar materials:

> In doing the designing, I considered various types of materials. Here are some of the natural materials used in the house:
>
> Lumber, in various conditions, sanded and finished, weathered, rough-cut, or lumber just with the bark removed. Leather, fur, stone, birch-bark, copper.
>
> This collection shows the extremely rich-textured materials. I think they give one an impression that is too rich and too restless.
>
> Here are a few of the man-made materials used in the house:
>
> Fiberglass, Formica, Foam Rubber, Metal Foil, Styrofoam.
>
> These man-made materials are exactly the opposite of the natural ones. The natural materials are amorphus in shape and organic in texture. The machine-made ones have the repetition of their manufacturer; they are sleek, smooth. What I have done is to combine the two. This combination of the natural with the machine-made makes one type of material compliment or enhance the other.[1]

The interior finishes in Russel Wright's house and studio are both intriguing and problematic from a conservation standpoint. Wright deliberately used recently developed synthetic materials, such as epoxies, latex and acrylics, in unconventional ways. He incorporated fragile organic materials, such as pine needles, into his paints, and used sand and metallic powders to create shimmering, glittering effects. Some of these coating material combinations are inherently unstable or incompatible, so they may have changed significantly in appearance since they were first applied. An additional important consideration in interpreting Wright's finishes is that the chronic moisture problems in the house and the high light levels due to broad expanses of glass have contributed significantly to the degradation of many of the organic and synthetic materials.

The UV content of the light in the house and studio was measured with a Crawford Type 760 UV monitor manufactured by Littlemore Scientific Engineering Company, Oxford, England. The measurements ranged from 150 μw/l in the bar/bath off the living room to 400 μw/l in the "Harem Bathroom", the bathroom off the main hall of the house. This

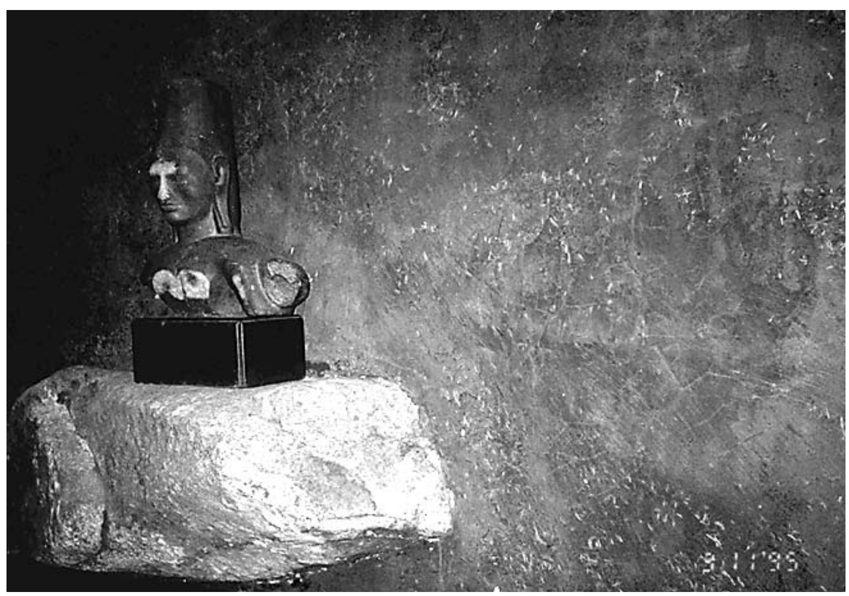


Figure 2. Russel Wright created textured green plaster walls in the living room by pressing pine needles into the pigmented plaster while it was still wet.

is well beyond the maximum recommendation for the UV content of light in museum spaces of 75 μw/l, while a maximum level of 50μw/l would be more appropriate for the fragile natural materials such as the butterflies, leaves, and ferns incorporated into the walls, screens and wallcoverings.

There is a very marked example of chronic light exposure when the sliding door in the Harem Bathroom is pulled completely closed. The butterflies sandwiched between the plastic at the leading edge of the door are embrittled, pale and faded from this outer edge to about one and half feet in. However, the butterflies sandwiched between the plastic panels at the inside section of same door are still brilliantly colored and remarkably intact. It appears that this door is most often left in a partially closed position which has caused the significant damage to the butterflies on the leading, exposed edge of the door.

Ultraviolet light exposure also has a dramatic impact on many of the synthetic materials in the house. In *Conservation of Plastics*, ultraviolet light is cited as the leading cause of degradation for modern "plastic" materials:

> Light, and especially the more energetic ultraviolet component, is damaging to all plastics. The amount of UV in daylight and emitted by many fluorescent lamps is sufficient to cause degradation in numerous polymers. It is responsible to the fading of many colorants and for inducing yellowing. In addition to purely photochemical effects, light may also initiate chemical reactions, in particular, it is responsible for initiating an auto-catalytic form of degradation known as autoxidation, to which hydrocarbons are especially vulnerable. Polyethylene, polypropylene, nylon, gutta percha and plastics which are based on natural and synthetic rubber (e.g. ABS) are susceptible to this type of degradation, which is potentially very damaging as it may propagate through the material at an alarming rate.
>
> Protection from light is the single most effective measure for extending the life of plastics. … Protection from ultraviolet can be provided by screening out all UV wavelengths from the illumination and/or by the use of protective or sacrificial coatings which preferentially absorb the UV energy and dissipate it in a harmless manner. However, all wavelengths of light are harmful to plastics to some extent so that, even with all the UV removed, light levels should be kept low.[2]

At Dragon Rock light plays an important role in creating the visual effects in the house, and the broad expanses of glass provide views to the outside which blur the distinctions between the exterior and interior spaces. It is not appropriate, nor practical, to lower the overall light levels in the house to the level achieved in museum spaces, but it is critical to investigate and implement methods to lower the UV content in the areas which contain the most fragile, vulnerable natural and synthetic materials. This could be done through the creative use of UF-3 plexiglas, UV-blocking film and UV-blocking glass. All of these materials are designed to block approximately 98% of the UV content of the light and have an estimated effective life of about 15 years.

Materials Survey

In Mary and Russel Wright's book *Guide to Easier Living* published in 1950, the Wrights recommend specific types of materials for different coating applications in an effort to prolong the life of interior surfaces and to reduce the regular housekeeping and maintenance of household interiors. For example: the book suggests the use of high gloss enamel of either alkyd resin or oil base for easy washing; lacquer coatings on metals to limit spotting and rusting; and spar varnish or marble floor varnish on table and furniture tops to withstand alcohol and water damage. Charts at the back of the book recommend a wide range of coating materials for every conceivable surface. Wright presumably followed his own recommendations in finishing the interior surfaces at Dragon Rock. The recommended materials which merit "excellent" and "good" ratings for durability, ease of cleaning and resistance to spotting and abrasion are likely most relevant to this study. The list includes:

For wood: spar varnish; liquid phenolic plastic; lacquer; alkyd resin enamel; and rubbed-in boiled linseed oil

For wallcoverings: scrubbable wallpaper; vinyl-coated fabric; canvas; thermosetting plastic sheets like Micarta and Formica; baked enamel on metal; porcelain enamel on metal; glass; polished hard marble; asphalt tile; rubber tile; linoleum

For table top materials and coverings: spar varnish; liquid phenolic plastic; rubbed-in boiled linseed oil; alkyd resin enamel paint; soapstone; slate; asbestos board; hard marble; laminated thermosetting plastic; vinyl tile and sheet; cellulose acetate tile and sheet; methyl methacrylate tile and sheet; vinyl coated fabric; factory finished compressed wood fibre; glazed ceramic tile; baked synthetic finish metal; porcelain enamel finish metal; stainless steel

For hardwood floor coverings: penetrating floor seal; gymnasium-type floor finish; modified varnish; liquid phenolic plastic; floor enamel

For masonry: brick; gloss, matte and unglazed tile; latex-bonded terrazzo; cement-bonded terrazzo; magnesite; flagstone; marble; unpainted cement

For floor coverings: cork; asphalt tile; vinyl plastic; rubber tile; linoleum; enamel surface, felt base; waxed leather

In addition, in his slide lecture Wright described the green wall surfaces in the living room as plaster, and the stucco-like textured paints in the main halls as epoxy paints. In reviewing this list of materials more than 40 years after being suggested in *Guide to Easier Living*, and in some cases, more than 30 years after some of these materials were used at Manitoga, we now know how these materials age and degrade. We also know more about the damaging effects of light, heat and relative humidity. For example: certain types of coating materials such as spar varnish and acrylics (methyl methacrylate) tend to yellow and turn slightly milky with age; linseed oil coatings can darken dramatically over time; and vinyl and linoleum can become quite darkened and embrittled. In addition, materials like epoxy resins, while chemically resistant, hard and durable, require very precise measurements of proportions when mixing the resin and catalyst. These types of epoxy coatings form a moisture-impermeable coating which may not be compatible when used over a porous substrate (such as plaster).

Review of the Analysis Results

One of the most unstable painted surfaces in the house is the stucco-like sand paint in the main hall which continues down along the stairway. The thickly textured sandy white paint is peeling away in large crusty pieces from the plaster substrate beneath it. Cross-section samples from a peeling area of the stair hall preserves the most paint evidence. The first layer on top of the plaster substrate is thin gray-green paint layer. Directly above this, in the same paint generation, is a thick, finely ground white paint layer. The top layer is the coarse sand paint. This sand paint layer was analyzed with FT-IR microspectroscopy and the presence of an epoxy binder in this white paint layer was confirmed.

Another sample taken from the wall adjacent to the stairway down to the kitchen has a similar sand paint on the surface, and the paint appears quite stable in this area. In this sample the white paint layer is directly on top of the plaster substrate (there is no initial gray-green layer in this sample). Perhaps the gray-green layer has contributed to the instability of the paint layers or, the active peeling is more directly related to moisture wicking up from the first floor through the central wall. Moisture could travel with ease through the porous plaster, but not through the more impermeable epoxy paint layer, thus forcing the paint off at its weakest area of adhesion—either between the plaster and first layer of paint, or between the paint layers.

A sample from the bamboo slats in the coat closet indicates that this surface was coated with two very thick layers of what appears to be an acrylic resin varnish. This varnish coating is intact and appears quite well adhered. The coating from the protected oak board at the back of the closet is identical to the pigmented/flatted synthetic resin coating on the woodwork in the entry, suggesting that these samples all contain the original finish applied by Wright. This same pigmented/flatted finish coat was also found (in a more degraded form) as the second generation coating on a window frame in the main room of the studio.

In the den there are a wide variety of very complicated coating histories. One intriguing piece of

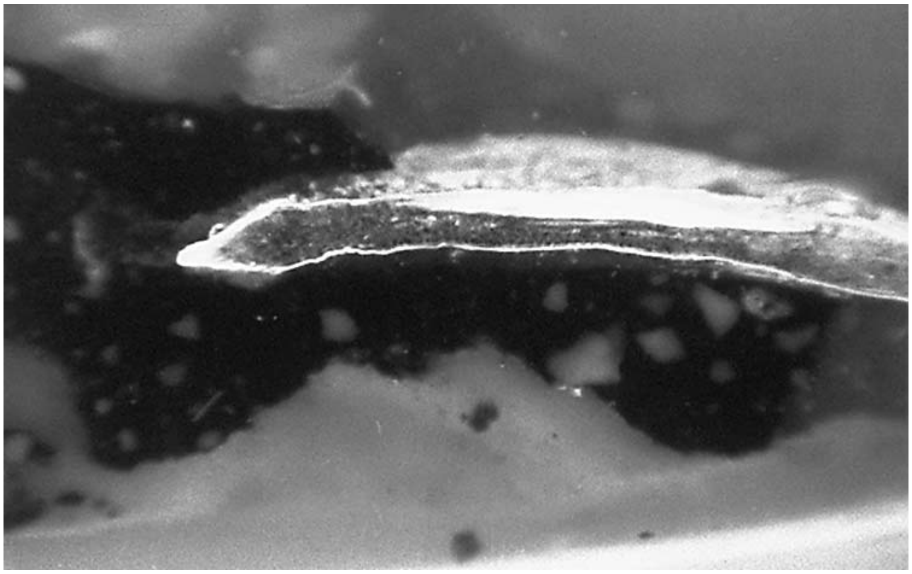


Figure 4. This cross-section shows a pine needle partially embedded in the green plaster above a more traditional white finish plaster. Above: UV light. Right: Visible light.

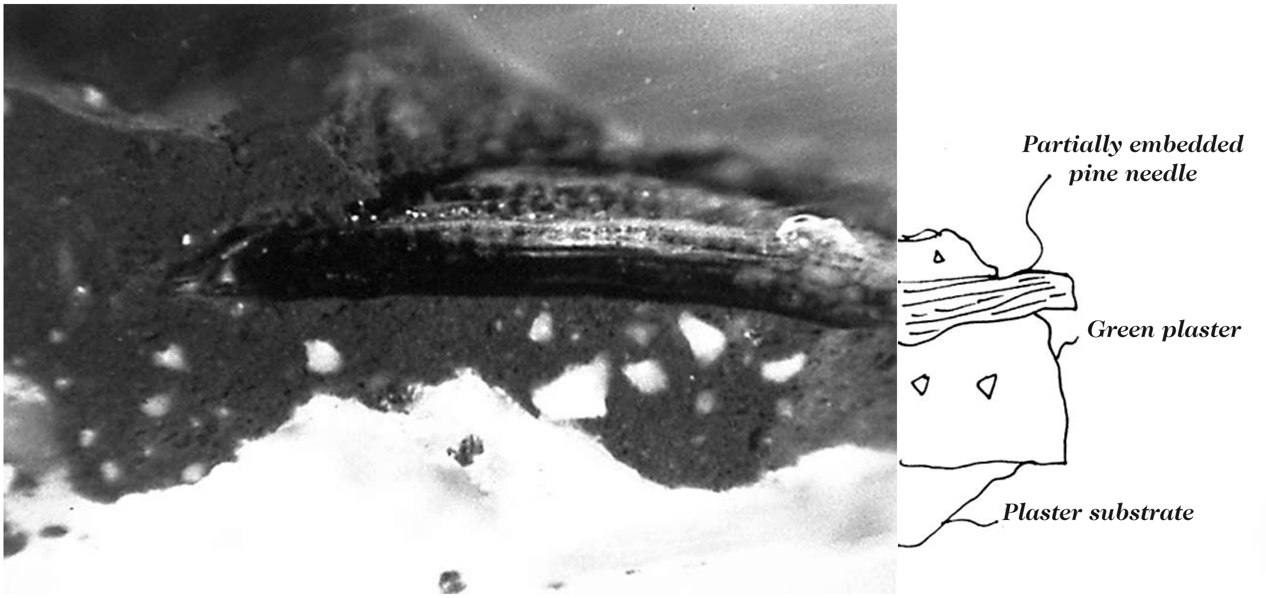
evidence was the presence of a silver-colored metallic powder paint layer on the ceiling. The paint in this ceiling sample is virtually identical to the paint found on the ceiling in the living room. It is a thin silvery metallic paint layer in a resinous binder on top of a pale gray-green oil-bound or alkyd resin paint layer. There also appears to be a very thin grayish wash on top of the silvery layer, perhaps to slightly diminish the reflective qualities of the surface. This may also be an unstable metal, vulnerable to corrosion, because the silvery effect is now almost completely lost on the ceiling.

Unlike Wright's recommendations in his *Guide to Easier Living* to apply a lacquer coating to metal surfaces to reduce the amount of cleaning and polishing required, and to limit corrosion, there is no evidence of a surviving lacquer coating on the sliding copper door panels in the den. But, there is evidence of a thin synthetic coating on the copper panel in the studio bathroom.

The small guest bath/bar was only sampled on a limited basis because the surfaces are quite sound. It is particularly interesting that the sand paint on the east wall of this room is quite different in overall effect from the stucco-like paint on the other side of the same wall. The paint in this space was applied more smoothly, and the sand particles are more reflective. Most importantly, the paint on this side of the wall is well-adhered, whereas the paints on the stairway side of the wall are actively peeling off the surface. In cross-section this paint is also different: the uppermost layer is a finely ground oil or alkyd base white paint on top of a sandladen primer. This paint was not tested for the presence of an epoxy in the binder, but it does appear to have a different layer structure than the textured paint along the stairway on the east facing wall.

The green wall paints in the living room were identified as plaster colored with stable pigments, including lampblack, yellow ochre, and iron oxide. The green plaster also contains pine needles which were pressed into the plaster before it had set. The combination of lampblack and yellow ochre produces an optical green which is generally a darker, more olive green color. These are all stable pigments, in use since antiquity. The living room samples were analyzed with FT-IR microspectroscopy and confirmed to be plaster with pigments (based on the presence of double peaks for $CaSO_4$ and $CaCO_3$ and the absence of peaks for any organic binders), as described by Wright.

One sample was taken from an area of efflorescence on the west wall where salts have been deposited on the surface by water wicking out through the plaster substrate and the textured green plaster. This water carries soluble salts from the plaster which then dry on the surface leaving a powdery white deposit. The plaster substrate and the green plaster finish layers are particularly friable in this area.



The red Formica door panels on the west wall cabinet in the living room have a very darkened, blotchy appearance. Cross-section analysis showed that there is a thin, irregular layer of an autofluorescent synthetic finish coating (perhaps acrylic) on top of the red Formica. This layer may have been originally applied as a protective coating to the Formica, or to increase the gloss, but it has turned brown over time, resulting in an unsightly brownish, uneven effect that is likely very different from its original smooth, bright orange-red color. The same type of coating appears to have been used on the red Formica door panels in the dining room as they have the same unsightly, blotchy look.

One area that has changed dramatically is the Purple Bedroom. Wright originally stapled purple-dyed fabric to the walls. But, according to Ann Wright, his daughter, the purple color had faded dramatically so she repainted the walls approximately ten years ago with a purple oil or alkyd bound paint which she feels is close in color to the original intense purple. A protected section of the unpainted textile which remains purple can be found in the ceiling of the closet. There are few textile dyes which are completely light-fast, so it is not surprising that the color was lost from light exposure. It might be possible to identify the specific dye through gas chromatography (GC) if there is interest in reconstructing the original color. The current paint on the fabric may replicate the original color but the texture of the textile has been lost under the thick paint coating, and the reflective quality of the paint is very different from that of the original textile covering.

The studio woodwork has the same type of slightly pigmented/flatted synthetic resin found on the woodwork in the main entry, the main hall, the Harem Bathroom and on the top of the kitchen table. However, this flatted varnish is the second generation in the studio as there are remnants of an earlier sealant or plant resin varnish coating trapped in the fibers of the wood. The Wrights moved into the completed studio while work on the house was progressing, so this second matte finish layer was perhaps applied at the same time Wright was applying woodwork finishes in the house. Or, perhaps he first tested out this coating in the studio before using it in the house.

The textured green ceiling in the studio space looks very much like the green walls in the living room. The dark green layer was applied on top of the plaster substrate, and it also has pine needles embedded in it. Based on the lack of biological staining reactions this appears to be a green plaster like the living room paint. But there is one important difference. There is a varnish coating mixed into the top surface of this green plaster, perhaps to give it a sheen or to

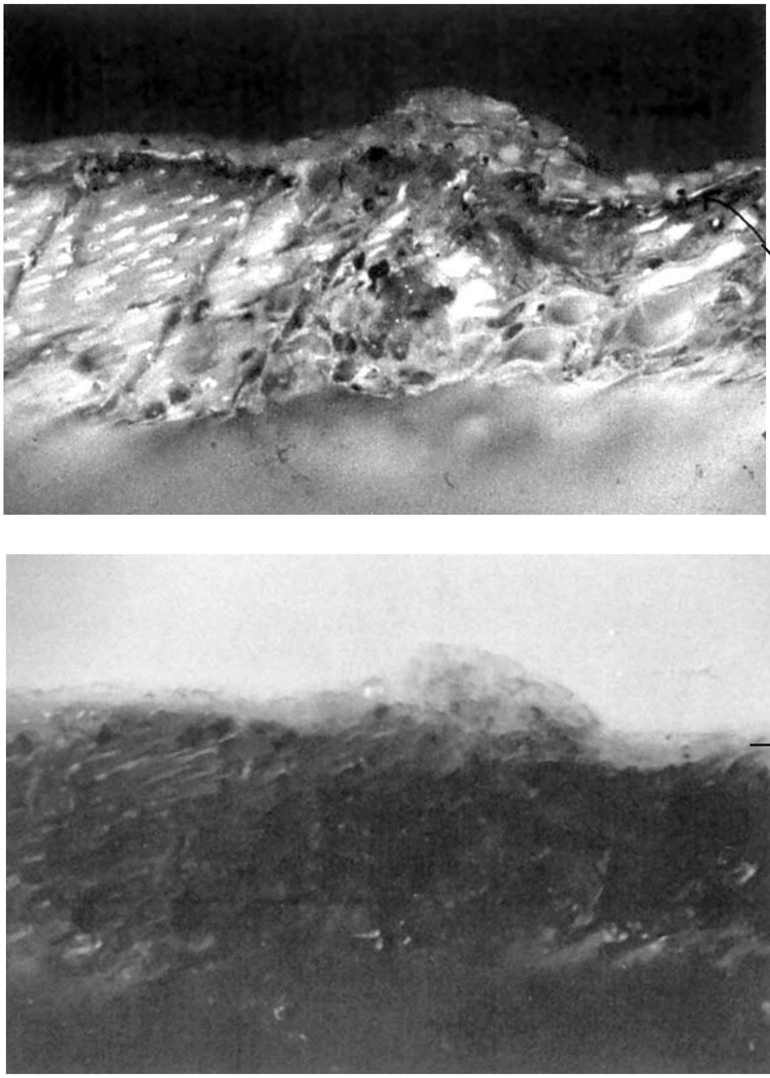


Figure 5. A synthetic varnish with flatteners was used on the wood surfaces in the studio and house to create a natural, matte appearance, but still provide a protective, washable surface. Top: UV light, bottom: visible light

make it more durable. There are mold spores growing in this varnish material, which is a clue to high levels of RH and/or moisture problems in this space. In the 1950s and 1960s when synthetic resin varnish coatings were being tested and reformulated, additives such as glycols had a tendency to foster mold growth if there was no fungicide (such as a phenol) in the formulation as well.

The stucco-like wall on the east wall under the window, the thickly textured wall on the north side near the sink, and sand paint wall in the main entry are all similar in layer structure, but are not at all like the sand paint wall in the bar/bath or in the hallways of the house. The difference in the texture of the sand paint surfaces in the studio appear to be due to the different methods of paint application and not the materials. There are also mold spores growing in the white paint layers in several of the samples. Perhaps these walls represent Wright's first experiments with textured sand paints, which he further refined in the house.

Recommendations for Conservation and Repair

The finishes which survive in the house and studio are particularly significant because they were made and applied by Russel Wright. Despite the degraded nature of some the surfaces, the first priority must be to stabilize and preserve the existing materials. The first steps for preserving the surface coatings in the house and studio should address the stabilization of peeling, actively degrading surfaces and elimination of the causes of further damage from excessive moisture and high light levels. Then it is important to establish guidelines for the proper care and maintenance of the surviving surfaces to ensure that there is no further degradation and that none of the important original surfaces are lost through stripping and/or repainting efforts. The following recommendations were presented to the Executive Director and the Board of Directors of Manitoga as part of the final report, they are listed in order of importance.

1. Investigate and correct the sources of moisture traveling through the living room green plaster and the stucco-like paint in the hall.

2. Determine the best methods for shielding the most vulnerable areas of the house and studio from excessive visible and UV light exposure. Install UV blocking materials as soon as feasible, and install light-reducing shades where possible.

3. After the moisture problems in the walls have been identified, test alternative methods for consolidation of the flaking plaster and peeling stucco-like paint in the living room and hallways.

4. Investigate methods to reduce the RH levels in the studio and to increase air circulation, to limit mold growth in this space.

5. Leave the panel with the butterflies in the fully retracted position as much as possible to limit light damage and vibration.

6. Investigate conservation methods to reattach and stabilize the fragile butterflies.

7. Develop guidelines for the care and maintenance of all finished surfaces. This would include designating the types of materials for use on woodwork (paste wax coatings only), restricting refinishing and repainting work in both the house and studio, and establishing a review committee for all maintenance and repair activities.

8. Conduct further examinations of the darkened coatings on the red Formica panels, and if appropriate, test clean selected areas to determine how best (and if it is appropriate) to remove them.

9. There are a number of intriguing materials used in this house which deserve further investigation, if only to better understand the selections Wright made in terms of modern coatings. In addition, the scope of this project did not allow for time to conduct binding media analysis of all the various coatings, nor to identify metal alloys.

Acknowledgments

One of the greatest pleasures of a team project of this type is the opportunity to work with colleagues in related professions. Pam Hawkes and Tobin Tracey of Ann Beha Associates, Architects, and Michael Henry of Watson & Henry, made this a particularly stimulating and interesting collaboration. In addition, Janice Carlson, Senior Scientist, of the Winterthur Museum, and Professor Richard Wolbers of the University of Delaware Program in Art Conservation, both made substantive contributions to a better understanding of Wright's intentions through interpretation of FT-IR spectra.

Notes

1. Garrison Slide Lecture by Russel Wright, April 1961, p. 6.

2. Morgan, John. *Conservation of Plastics.* Gainsborough, Lincolnshire: G.W. Belton Ltd., Museums and Galleries Commission. 1991, p. 16.