CONSERVATION OF MURALS IN THE ALAMEDA THEATRE: REVIVING FORMER CUTTING-EDGE FLUORESCENT PAINT AND BLACK-LIGHT TECHNOLOGY

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ABSTRACT

The murals that decorate the auditorium of the Alameda Theatre in San Antonio, Texas, painted in 1948, are examples of one of the earliest uses of fluorescent paints. These are 'black-light' murals, which provided a spectacle in theatres of the 1940s and 1950s, combining the impact of lively fluorescent color and strategically positioned ultraviolet light. Paints by Switzer Brothers Inc. were probably used for the Alameda murals — products that have become synonymous with the brand name Day-Glo Color. The Switzers invented daylight fluorescent pigments and patented their production technique in 1949. Since then, the light-sensitivity and instability of daylight fluorescent paints have caused widespread concern. Surprisingly, these early examples do not exhibit evidence of fading, although the murals are damaged by leaks due to neglect of the building and by abrasion resulting from architectural alterations. The development of a new museum has provided the initiative to restore the original fabric of the theatre. A team of specialists has collaborated to investigate the technique and to devise a method to preserve and present the paintings.

INTRODUCTION

The Alameda Theatre in San Antonio, Texas is a stunning theatre palace built for Spanish-language entertainment including movies, vaudeville acts, mariachi musicians and flamenco dancers. After a financially unsuccessful conversion to a triplex movie theatre in the 1960s, the Alameda spent decades in disrepair. It is now suffering from serious water-damage, requiring urgent reconstruction of the fabric of the building.

The theatre is part of the Casa de Mexico International building, which once housed the offices of the Consul General, the Chamber of Commerce and other Mexican officials. The Casa de Mexico International building was bought by the city in 1995, in celebration of Latino achievement and prosperity in San Antonio. It is a fitting site for the new Alameda National Center for Latino Arts and Culture, a performing arts center allied with the John F. Kennedy Center in Washington DC, dedicated to showcasing Latino performances. As part of this commitment, the Museo Americano (scheduled to open in 2005), a Smithsonian affiliate museum, will feature art and objects from the Smithsonian Institution which highlight the achievements of Latinos in the United States. Once the conservation is complete, the theatre, which is situated around the corner from the Museo Americano, will be the main stage and base of the performing arts center.

Constructed in 1947 with a seating capacity of 2400, the theatre contains wonderful period features such as curved, streamlined sculptural elements, vibrantly colored tiles on the exterior and interior, a gigantic neon marquee, and painted, delicately-etched Plexiglas. But by far the most exquisite of its features are the murals flanking the stage. Fluorescent paint and black-light illumination, an exhilarating technological and artistic development, would heighten the theatrical illusion as the house-lights dimmed.

THE PAINTINGS

A decorating firm from Chicago, the Hanns Teichert Company, created the paintings. They were designed by Pedro Teran, a sculptor from San Antonio, and painted by Frank Lackner in 1948. The paintings depict scenes that underscore the Mexican heritage at the core of the city of San Antonio. The west wall depicts the history of Mexico: ships bearing colonists from Spain, Cortez as a Christian knight conquering the Aztecs, figures in traditional costume, and regional architecture. The east wall portrays the history of San Antonio (Plate 69), including the covered wagons of the pioneers, roaming cattle, the Alamo, the 'Saga of the Seven Flags', the battle of San Jacinto, cowboys, the discovery of oil, the cotton industry, and the tower of Randolph Air Force Base. These scenes were outlined in black and painted in fluorescent paints, giving them a spectacular, glowing, three-dimensional appearance under ultraviolet illumination (Plate 70).

The ceiling and walls are dark, in keeping with the atmosphere we are accustomed to in modern cinemas. This dark backdrop exaggerates the transformation of the fluorescent paint when it is illuminated by ultraviolet light. The background color for the entire auditorium is a vivid blue, described by the artist's contractor, Hanns R. Teichert, as 'a deep sapphire'. Pink, orange and red-orange, 'carnelian rose', 'garnets' and 'ruby' colors are prevalent in the decoration. 'Gold', 'topaz' and 'diamond' colors are used as highlights. 'Chrysolite green' outlines the composition [1]. Although the decorating contractor is clearly glamorizing the accomplishment of the overall effect, his is a perplexing description since there is no evidence of green in the palette and the color variation overall — distinguished most clearly in the individual colors of the seven painted flags — does not appear to be as extensive as described. One explanation for this is that the viewer's perception of color is influenced by the blue-violet output of the ultraviolet light. At a distance, the cream outlines appear light green. This influence was also observed when a modern array of daylight fluorescent pigments was viewed under ultraviolet illumination, leaving the authors with the belief that there is no wide variation in the red hues. Teichert's first-hand observation of the palette is important, since the exact original appearance of the paintings is now unknown due to a variety of factors such as changes to the original lighting and changes in the paint as a result of natural aging — in particular, fading of the fluorescent paints.

Teichert also describes how transparent glazes over opaque forms give the shapes a sense of depth. No evidence of these glazes has been found in this investigation. However, the transparency of the paints is a characteristic of the pigments. The application of fluorescent pigments should not be too saturated, since too high a concentration of fluorescent dyes results in quenching, whereby the fluorescence is reduced [2].

The entire interior was painted by one artist working independently and is therefore unified in style, color and execution. The composition was blocked out in a separate white paint (neither water-soluble nor fluorescent), using setting-out devices such as string compasses and snap-lines or straight-edges. Lackner did not mix the paints but rather layered them to produce a blended effect. The fluorescent paint was applied with both sponge and brush; the application is at times only cursory and in some instances more worked.

BLACK-LIGHT PAINTING: TREND AND TECHNOLOGY

The style called black-light decoration quickly became very popular in theatres of the 1940s and early 1950s. Although this popularity can be confirmed by contemporary advertisements (hundreds are cited by one source of 1949 [3]), there is no indication of the number of murals that were painted using this method. Few of these paintings now survive; styles evolve and interiors are easily renovated with a fresh coat of paint. Indeed, grand theatre palaces promoting Hollywood escapism have become virtually extinct.

As with many technological advances, the supporting technology for this style of presentation vanished when it no longer had a mainstream function. Mercury-vapor lamps were used with filters designed to block out any wavelengths that exceeded 300 nm, thereby inhibiting the visible spectrum and enhancing the fluorescent effect [4]. One contemporary source claimed that a 250 W mercury-vapor lamp was the minimum requirement for adequate illumination of the murals. The Alameda has 14 H-5 mercury-vapor lamps of 250 W. Contemporary lighting specifications reviewed the safety implications of the sensitivity of the human eye toward direct exposure to ultraviolet light, with suggestions for directing the light away from the audience. This angle had a considerable effect on the appearance of the mural.

Some of the promotional leaflets for black-light paintings recommend prefabricated marouflage murals of established proportions. It is difficult to compare a painting on plaster of the monumental proportions of the Alameda with prefabricated images on canvas. The only theatre from this period with paintings that appear to be comparable to the Alameda murals is the Linda Vista Theatre in Mexico City. This theatre, designed in 1942 by Charles Lee, was roughly the same size, and had fluorescent murals of festive dancers similar to the couple portrayed on the Alameda's east wall [5, p. 139]. The Hanns Teichert company created fluorescent murals at the less 'opulent end of the scale' in theatres in Wichita, Kansas and in Logan, West Virginia [1].

The Alameda Theatre project provides an opportunity to survey other fluorescent paintings of the same period, to examine the development, survival and current condition of black-light murals in the US and Mexico, and to develop a model for their conservation. We hope that the re-evaluation of this style will result in the discovery of other exquisite examples of these rare paintings, and that renewed enthusiasm will benefit their preservation.

DAYLIGHT FLUORESCENCE

The uses for high visibility fluorescent products are limitless: highlighter pens, safety equipment, coding for documents such as currency, penetrants for detection of flaws in machinery and medicine, eye-catching packaging and signs, and so on. Daylight fluorescent materials are very brightly colored in visible light and also have the ability to glow in the presence of ultraviolet light. However, they are not able to glow after the light source is removed, as do luminescent or phosphorescent materials. Fluorescent paints absorb radiation from a light-source and re-emit longer wavelengths in an additive effect, producing reflectance values that can be greater than 100% (reflectance of white paper). The term 'daylight fluorescent' was coined by the Switzer Brothers to describe very bright colors that do not require any more energy input than daylight to create this excitation. The Alameda paintings were created as these colors were being developed.

Daylight fluorescent pigments get their distinctive saturated coloration from dyes which, by nature, may be fugitive following prolonged exposure to intense light or water. The first fluorescent dye, Rhodamine B, commonly used in today's fluorescent reds, was discovered in 1877; Naphthalimide Yellows, Brilliant Sulfoflavine FF and Azosol Brilliant Yellows appeared in the late 1920s [6, p. 585].

THE SWITZER BROTHERS, INVENTORS OF DAYLIGHT FLUORESCENT PIGMENTS

Joseph and Robert Switzer first experimented with the fluorescent properties of chemicals under ultraviolet light in 1934. They mixed fluorescent dyes with shellac and immediately recognized the potential of these lacquers in the performing arts. By 1936 they were working on the production of Hollywood movie posters.

Switzer Brothers Inc. patented the first resin-embedded organic pigments in 1949, although the application process began in 1941. Switzer Brothers' pigments were field-tested on signal panels by the US military in World War II and eventually became invaluable to aircraft in avoiding 'friendly fire' and in demarcation of runways illuminated with mercury-vapor lamps to facilitate landing.

The first pigments were dyed thermoset resin. A non-yellowing polymer (butanol-modified urea-formaldehyde) was dyed with a solvent dye which was left to air-dry. The resin was then stacked in sheets and thermoset in a press heated to 135°C, after which it was pulverized to produce pigments which were dispersed in a vehicle paint [7]. In 1957, a melamine-sulfanomide-formaldehyde thermoplastic resin was developed, which resulted in improved humidity resistance and lightfastness. The thermoplastic and thermoset carrier resins have been modified over time in commercial fluorescent pigment production to improve strength, heat resistance (for plastics), varied solubility resistance and particle size (for printing inks). The earliest pigments were notably coarse. Typical modern particle size is 3.5 µm.

Switzer Brothers Inc. was one of several companies capitalizing on the variations of the black-light theatre decoration concept. Black-light murals, in addition to other theatrical props such as fluorescent curtains, flags and carpet fibers, were in prominent use in theatres as early as 1942 [4]. A patent with an application date of November 1942 for a Switzer Brothers' product describes a mechanism for fixing dyes to fabrics to increase stability in response to light and humidity [8].

The Alameda Theatre murals were likely to have been painted using Switzer Brothers Inc. pigments both because of their early date and because the plaques on the back of the lights in the Alameda theatre confirm them to be Switzer Brothers' Glo-Craft products. Glo-Craft was the precursor of the manufacturer's daylight fluorescent product lines, and Switzer Brothers Inc. later became Day-Glo Color Corporation.

A wide variety of fluorescent colors was available at this time [9]. The only addition to the original color range is magenta. One early Switzer Brothers Inc. brochure describes the color sampler as follows: Aurora Pink, Neon Red, Rocket Red, Fire Orange, Blaze Orange, Arc Yellow and Saturn Yellow, omitting Signal Green and Horizon Blue, which are listed in a separate publication of roughly the same date [10, 11]. These names reflect the impact of the colors which generated the impression of hyperactive, space age, futuristic products. They might, of course, also be described more prosaically as fluorescent pink, cerise, red, red-orange, dark orange, light orange, yellow, light green and blue.

In *Theatre Catalog 1948-1949* the pigments are described by a Switzer Bothers Inc. representative:

> Artists and decorators had to forget the old color rules and learn new ones. In fluorescent black light art, blue and yellow do not make green, but a clear white. Red and blue produce brown rather than purple. [3]

Examination of cross-sections of the mural under reflected visible and ultraviolet light reveal coherent layers; there is no indication of a mixture, except in the case of yellow and pink layers which overlap to produce one of the orange tones. It has been noted that a mixture of fluorescent pigments of different resin types or with ordinary pigments can reduce the tendency of fluorescent pigments to fade [11].

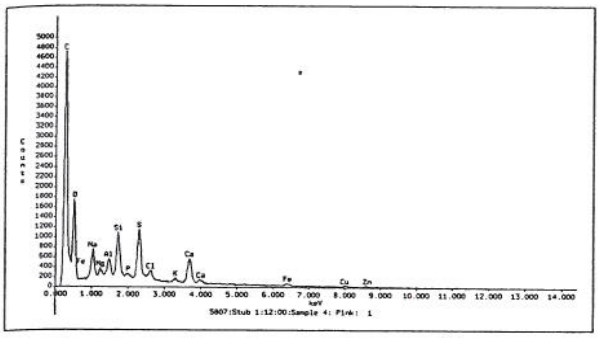

Fig. 1 EDS spectrum of a sample of the pink paint.

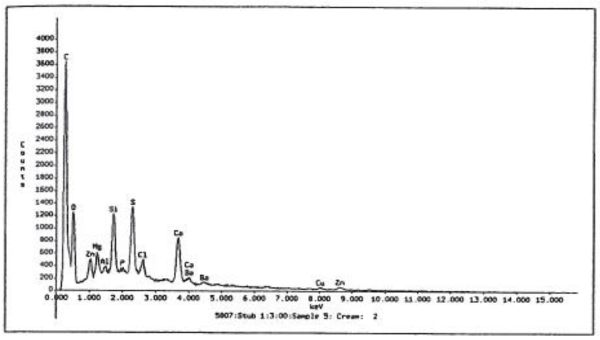

Fig. 2 EDS spectrum of a sample of the cream paint.

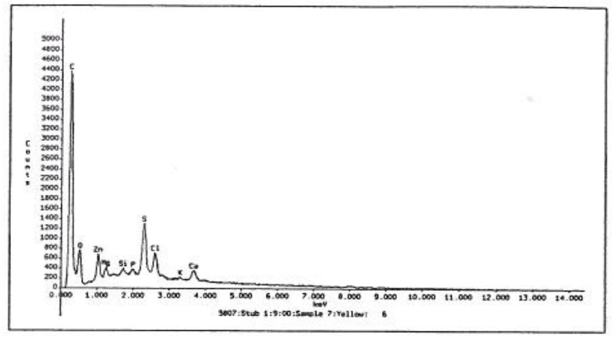

Fig. 3 EDS spectrum of a sample of the yellow paint.

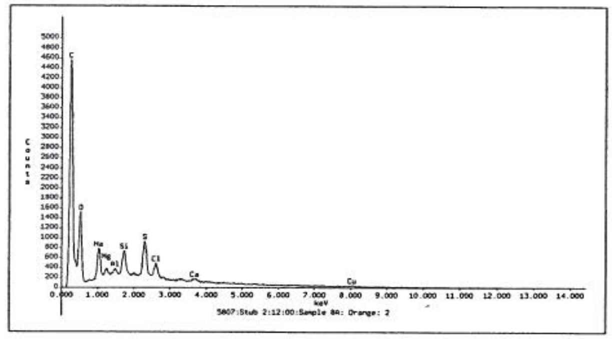

Fig. 4 EDS spectrum of a sample of the orange paint.

MATERIAL ANALYSIS OF THE MURALS

Figures 1-4 show the energy dispersive X-ray spectra (EDS) of several selected particles of paint from the mural. Light microscopy and EDS analysis show the fluorescent particles to be complex mixtures of a fluorescent organic dye and other inorganic components. Initial interpretation of the inorganic portion of the spectra indicates the mural substrate: calcium sulfate (gypsum), zinc sulfide (lithopone) and silicates, as well as possible salts, sodium chloride and magnesium sulfate. Some of these are intentional fillers while other salts may have diffused into the paint layer from the substrate due to moisture from high relative humidity, condensation or infiltration, or have been deposited as pollution from the air. Further characterization is continuing.

Minor changes in the pigmentation of the painted surface could be uniform overall and might well be overlooked; however, the cross-sections give no indication of any alteration of pigmentation within the paint layers. The color is consistent throughout the layer rather than lighter near the surface, as is usually seen in light-fading. This indicates that the paint, in general, is about the same as when applied. Connors *et al.* have found that fluorescence and color both fade at the same rate, with an overall effect of lightening, and that some colors deteriorate faster than others [12]. These changes were not observed in this case.

The paintings were painted directly on the gypsum plaster wall surface. Although there is a slight variation in the color, the auditorium background paint is consistent throughout, including both walls and ceiling. This deep blue pigment has been examined using optical microscopy, microchemical testing, EDS and X-ray diffraction analysis (XRD), and has been identified as artificial ultramarine. The fillers gypsum and lithopone were included to provide opacity.

Fourier transform infrared spectroscopy (FTIR) has shown the presence of protein as a binder in the mural (Fig. 5). Casein is the expected binder since the Hanns Teichert Company frequently used and preferred this medium.[1] Further testing is being done to identify the binding medium unequivocally. The distemper background has a dull, matt, opaque finish. The entire auditorium was left unvarnished, as would be expected, to avoid specular reflection in such a gigantic space.

IMPLICATIONS FOR CONSERVATION

The preliminary results of the analysis have immediate repercussions for the treatment of these paintings. The paint medium is water-soluble so no aqueous cleaning methods are possible. (Dry cleaning methods such as Wishab conservation sponges, brushes and erasers have been tested but without substantial improvement to the overall effect.) It will be necessary to develop a plan to tone out stains and losses while avoiding any aqueous treatment.

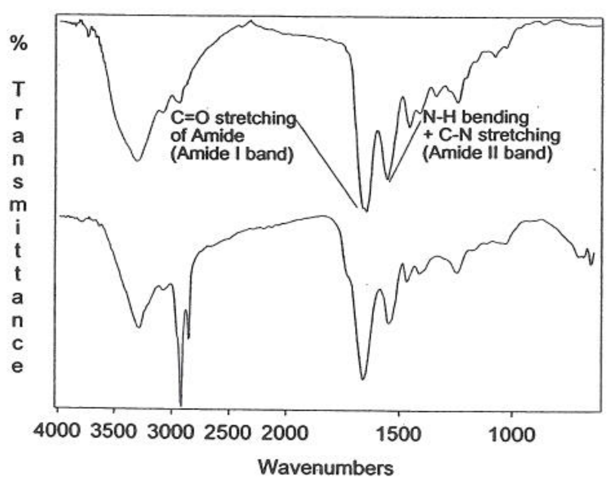

Fig. 5 FTIR spectra: comparison of a sample of the Alameda paint (lower trace) with a proteinaceous binder (upper trace).

[1] George Murray, a friend of the artist, Pedro Teran, states in an unpublished manuscript: 'Teichert developed a cheap, casein, water-based paint, that was used for the Chicago World's Fair at considerable cost savings'.

The areas of reintegration will be particularly problematic for the conservators of the paintings, since their presence will naturally be emphasized by the obligatory use of an ultraviolet light source. It is ironic that the tool customarily used for exposing previous restorations must in this case be the primary lighting source for the presentation of the paintings. Metamerism will pose a particularly unusual challenge since the paintings will be seen both in visible and in ultraviolet light, and the retouchings will have to suit both.

In tackling this conundrum it was first necessary to establish the overall lighting scheme. The original light fixtures and filters were all recovered and carefully repositioned. The adaptation of technology has left substantial gaps in our knowledge, so that it was necessary to hypothesize the original light levels and angles of incidence. With the lighting in place it is now possible to reconstruct some of the losses.

The lightfastness of modern fluorescent pigments, used for the inpainting, is inevitably of concern. Recent studies have found that fading occurs rapidly at first and then diminishes for aged material [13, p. 2]. Therefore, the inpainting materials are likely to change more rapidly than the original at first. Whilst the choice of the most suitable materials for inpainting will reflect current research, the paint used for retouching is expected to change color as it ages, in part as a consequence of fading — perhaps to an unacceptable degree. With so many factors involved, longevity of the retouching may not be possible. Following reintegration, levels of light exposure for both the original painting and the retouching will be monitored *in situ* over time, as will the intensity of the colors (using a portable spectrophotometer), to gauge the lightfastness of the modern fluorescent pigments and inpainting materials.

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REFERENCES

1 Teichert, H., 'Custom-tailored décor with black', *Box Office Magazine* November (1949).

2 Smith, T., 'Luminescent and fluorescent pigments', *Manufacturing Chemist* (July 1982) 62-63.

3 Elliott, R.J., 'Black lighting made easy; the elementary facts about theatre use and introducing a new "packaged" mural with theatre possibilities', *Theatre Catalog* (1948-1949) 316-317.

4 Cutler, C.M., and Chanon, H.J., 'The uses of "black light" its effects and applications; two leading authorities make an up-to-date survey of its progress and development as a medium of showmanship', *Theatre Catalog* (1942) 12-16.

5 Valentine, M., *The Show Starts on the Sidewalk. An Architectural History of the Movie Theatre, Starring S. Charles Lee*, Yale University Press, New Haven (1994).

6 Streitel, S., 'Fluorescent pigments (daylight)' in *Encyclopedia of Chemical Technology, Volume 15*, 4th edn (1995) 585-607.

7 US Patent 2,475,529, J.L. Switzer, 5 July 1949.

8 US Patent 2,417,383, J.L. Switzer, 11 March 1947.

9 Richardson, J.C., 'Use of black light modernizes theatres; judicious use of invisible "light" rays makes any house shine with a new luster', *Theatre Catalog* (1945) 216.

10 *The Magic of Day-Glo Daylight Fluorescent Pigments*, Technical Booklet No. 1170, Day-Glo Color Division, Switzer Brothers Inc. (1957) 1-24.

11 'New dazzle ingredient...fluorescent dry colors', *Oil and Chemical Paint Review* March (1958) 2-7.

12 Connors, S., Morris, H., and Whitmore, P., 'Characterization and evaluation of fading behavior for fluorescent colorants' in *Abstracts of Papers Presented at the 31st AIC Annual Meeting, Arlington, Virginia, June 5-10, 2003*, American Institute for Conservation, Washington DC (2003) 31.

13 Yoshizawa, A., 'Daylight fluorescent pigments in works of art: properties, history, and fading', unpublished thesis, MA Conservation, Queens University, Kingston, Ontario (2000).

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