AN INVESTIGATION OF THE USE OF ACRYLIC POLYMER PAINTS IN PRINTING PHOTOGRAPHIC SILK SCREEN IMAGES

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Blue, Monte L., *An Investigation of the Use of Acrylic Polymer Paints in Printing Photographic Silk Screen Images*. Master of Arts (Art), May, 1972, 55 pp., 8 tables, 18 plates, bibliography, 17 titles.

This study investigates the adaptability of plastic paints to photographic silk screen materials and methods. The problem was to experiment with and further develop another technique for the artist, the silk screening of photographic images directly onto the painting surface with acrylic polymer paint.

Chapter I served as an introduction to the study. The silk screening materials and the methods used for producing photographic images were reviewed in Chapter II. In Chapter III, the testing methods of printing silk screened photographic images using acrylic polymer paint were discussed. The testing was divided into three steps.

Step one involved the formulation of combinations of paint and retarder to determine the effect of the retarder on the paint. Results of this testing suggested that the drying time of polymer paint could be retarded long enough for images to be silk screened before the drying process would become a prohibiting factor.

In step two photographic images were silk screened with combinations of retarder and paint on illustration board to determine the best formula for printing and to determine

if both line and halftone images could be successfully silk screened with acrylic polymer paint. The data derived from silk screening images indicated that photographic line images can be successfully silk screened with acrylic polymer paint. However, the paint proved impractical when used for printing fine halftone images.

In addition, the data derived from silk screening images with various colors indicated that results should be identical regardless of the particular color of polymer paint chosen. The successful results that were obtained when gel medium was mixed with the paint indicated that gel medium can be used as a transparent base.

In step three, images were printed on masonite, canvas, and an impasto surface. This testing indicated that, for best results, silk screening with acrylic polymer paint should be attempted only on a flat surface, such as masonite or illustration board.

Applications of photographic silk screen techniques in combination with traditional painting methods were examined in Chapter IV. These applications were not intended to become shortcuts to realism, but rather to suggest how the qualities of photographic images could be useful to the artist.

In Chapter V, the study was summarized, and recommendations were made for further related research.

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Thesis

Presented to the Graduate Council of the
North Texas State University in Partial
Fulfillment of the Requirements

For the Degree of

MASTER OF ARTS

By

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May, 1972

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CHAPTER I

INTRODUCTION

In recent years, the tremendous impact that plastic paints have had on the art world has prompted contemporary artists to greet the paints with great enthusiasm. In fact, "plastic paints have caused a revolution" which could possibly contribute as much to the art media in our age as oil paints contributed to the Renaissance period (2, p. 13).

Easel painters, muralists, and illustrators have turned to the synthetic painting media for several reasons. Certain plastic paints can duplicate the oil medium's vaunted visual effects, but in a technique that is much freer and more comfortable to handle. A new world of esthetic expression has been opened by the synthetic paints, because of their own special characteristics. The luminosity and transparency of color which they exhibit were previously unknown in any medium. When handled properly, plastic paints apparently offer greater durability than any other medium in the history of art (6, p. 7).

Modern photographic silk screen materials and methods have provided the capability for producing a large variety of visual images. The commercial silk screen industry has developed photographic silk screen printing into a highly specialized process. Until a few years ago, these procedures were primarily used by the commercial market. In recent years, serigraphers have begun to explore the possibilities of photographic silk screen techniques. Although, in the area of fine arts, the serigraphers have been the primary beneficiaries of these methods and materials, their potential in the field of painting deserve further investigation.

The Problem

This study was undertaken to investigate the adaptability of plastic paints to photographic silk screen materials and methods. In the field of painting, the artist has the brush and the palette knife as the primary tools for executing a painting. In this thesis the problem was to experiment with and further develop another technique, the silk screening of photographic images directly onto the painting surface with acrylic polymer paint.

The problem was studied in three phases. First, the materials used for silk screening procedures and methods for producing photographic images were reviewed. Second, a satisfactory paint formula for silk screening photographic images directly onto the painting surface with acrylic polymer paint was developed. The third phase involved four applications of photographic silk screen techniques in combination with traditional painting methods.

The painter who is able to silk screen photographic images with the same painting medium would be able to produce a large variety of visual images. The purpose of this study was to give the painter this capability with the assurance of permanence, so that a different source of visual expression might be utilized.

Limitations of the Study

The media were limited to Hyplar and Liquitex acrylic polymer paint. To provide consistency in the data collected during the development of the paint formula for silk screening photographic images, only one color of paint was used and the same image was maintained throughout the experiment. The surfaces screened were limited to canvas, masonite, and illustration board, since these are the primary surfaces utilized by the painter.

Definition of Terms

The following terms are defined as they are used in this study:

Acrylic gesso.--Acrylic gesso is titanium white, ground into an acrylic base emulsion used to size and prime the surface to be painted (4, p. 31).

Acrylic polymer emulsion.--According to Woody, polymer paint, acrylic paint, plastic paint, and synthetic medium are all terms that refer to the three general types of acrylic polymer emulsion paints (acrylic resin base, polyvinyl acetate base, and copolymers). These paints have polyvinyl acetate or acrylic resin, or a combination of these, as their binding vehicle (6; 1, p. 17; 53).

Acrylic resin.--"Acrylic resins are thermoplastics derived from acrylic and melacrylic acids" (2, p. 46).

Base medium.--The base medium, sold under various trade names, is used as a binder, glaze, color vehicle, or adhesive and is the most versatile of the acrylic materials (4, p. 27).

Copolymer.--Different classes of monomers are combined chemically to form a polymer. For use in artist paints, acrylic and vinyl monomers are combined chemically (6, p. 152).

Fresco.--A true fresco is the technique of painting on a surface of freshly spread, wet plaster with water mixed pigments (1, p. 47).

Gel medium.--Gel medium is a thick viscous polymer emulsion which dries transparent (6, p. 153).

Negative and positive images.--In photography, a negative image records lights and shadows opposite to the original subject. The positive image shows the lights and shadows as they appeared in the original subject (5, pp. 665, 774).

Oil paint.--Oil paint is composed of finely ground or divided pigment particles dispersed in an oil vehicle (3, p. 130).

Photographic images.--Photographic images are produced on sensitized surfaces, such as film in a camera, by the action of light (5, p. 748).

Polyvinyl acetate.--Polyvinyl acetate is a plastic resin of the vinyl family which requires a plasticizer to make it flexible (6, p. 155).

Development of Plastic Paints

Man's search for better colorants and vehicles brought forth a variety of media. In the fifteenth century when the use of oils emerged, great strides were made in the technology of paint-making. Traditional oil color has remained the principal medium from the time of the Van Eyck brothers in the fifteenth century to the time of Picasso in the twentieth century (2, p. 15).

During the 1920's, in Mexico, the famous mural movement was born, creating the need for an art medium capable of withstanding outdoor exposure. This medium had to be permanent, resist atmospheric changes and oxidation, have quick drying characteristics, and possess ease of handling and application. Oil paints were rejected because they yellowed, cracked, oxidized, and clearly lacked the durability required for large outdoor works of art. There was a return to fresco for a while, but it limited the muralists technically and lacked durability. This quest for a medium led artists, such as José Gutiérrez and David Siqueiros, to the laboratories of science, where a man-made synthetic paint vehicle, rather than a natural one, was sought (2, p. 16).

In the laboratory it was found that resilient plastics offered the qualities which the artist demanded. Some synthetic vehicles proved to be completely stable during early paint formulations. The combination of synthetic media and pigments worked well horizontally and vertically through the paint film. Horizontally, molecular ingredients were given cohesiveness, while vertically, the paint film was given adhesiveness to the painting surface to which it was applied. The paint's drying action required no chemical process that might later crack or darken the painted surface. Evaporation alone was responsible for the drying of the new synthetic medium (2, p. 17).

Many experimental paintings and murals were executed in both the United States and Mexico, as formulas were developed and paints were compounded. At first, artists were skeptical and somewhat reluctant to try the new plastic materials. However, in Mexico today, a great majority of the muralists are using plastic paints, which are produced by almost all major manufacturers of artists' paints (2, pp. 17-18).

Structure and Characteristics of Polymer Emulsions

Polymer emulsion paints are divided into three general types: acrylic resin base, polyvinyl acetate base, and copolymers. In the early stages of emulsion development, paint with a polyvinyl acetate base was most prevalent. At the present, however, those paints with an acrylic resin base and the copolymers are most widespread (6, p. 17).

As with oil media, the pigmentation of polymer paint requires a different emulsion with each pigment to produce a good paste with correct brushing qualities. In most colors the same pigments used in oil paints can be used in polymer emulsions. Since the acrylic emulsion is alkaline and will react chemically with the pigments, some traditional pigments, such as viridian and alizarine crimson, cannot be used in an acrylic emulsion (6, p. 17).

As previously stated, polymer emulsion paints dry by the evaporation of water. The paint film is formed as spheres of plastic resin approach and touch each other while the water evaporates. If the polymer emulsion is diluted with too much water, the spheres of plastic resin are spread too far apart to touch and form a film at the final stage of evaporation. Therefore, very thin layers of paint must be produced by adding emulsion and water or pure emulsion to maintain resin concentration. Because of its drying properties, each layer of paint adheres to the succeeding layer, forming a united surface that expands and contracts as one. Consequently, the "lean" to "fat" rules of oil painting do not apply, since the danger of cracking has been removed (6, p. 20).

The base medium of polymer emulsions is non-toxic, without aroma, and non-inflammable (4, p. 28). Since only minute quantities of other chemicals, such as ammonia, are added to the emulsion, they cannot harm the user (6, p. 20).

Paint manufacturers test acrylic polymer paint in the research laboratory by placing full color, tints, and shades of paint samples in the sun, under arc lights, and in the dark. During a given period of time, these samples are subjected to climatic changes of humidity and temperature. To simulate the passage of many years, the product is aged scientifically. Photo-electric and reflection meters carefully measure any changes in the materials (2, p. 24). The dried paint film of a polymer emulsion is unaffected by light, heat, or weather. If the basic rules of each paint manufacturer are followed, the painting will not crack, yellow, or darken with age (6, p. 20).

An acrylic resin base paint, Liquitex, and a copolymer, Hyplar, the two most used of the three general types of polymer emulsion paints, were used for this study. The medium for the pigments in Liquitex artists' colors is an aqueous emulsion of an acrylic ester polymer. The acrylic resin in the transparent plastics known as Lucite and Plexiglass is of the same chemical nature as the acrylic resin in Liquitex. A high copolymer plastic latex emulsion is used to formulate Hyplar plastic colors and mediums (2, pp. 86, 89).

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CHAPTER II

MATERIALS AND METHODS

Initially, the painter, like the serigrapher, may be attracted to silk screening photographic images for many practical reasons. Silk screening is an art medium in which duplicate copies of virtually any subject may be made in a variety of colors with relatively simple equipment. The basic techniques are not complex, and the mechanical apparatus need not be elaborate (2, p. 9). In this chapter the silk screening materials and the methods used for producing photographic images will be discussed. There will be no attempt to provide a definitive treatment of basic silk screen techniques. For an understanding of silk screen fundamentals, books on methods and procedures, such as Biegeleisen's The Complete Book of Silk Screen Printing Production, should be consulted.

Materials

After a review of the fundamental groups of materials and their characteristics, the following materials were selected for use in this study.

The screen frame was constructed of wood, the primary material used for printing frames (3, p. 2). Because the baseboard needed to be flat and smooth, plywood served as a good surface. To maintain an accurate alignment of the stencils applied to each print, register tabs were used. Alignment blocks were needed to prevent racking and distortion during the printing process (2, pp. 10, 16).

Because the silk screen printing was executed on flat surfaces, the square-edged squeegee was used (1, p. 78). Silk fabric with a mesh count of 16XX was employed for the photographic screen because films adhere well to the fabric as do medium range halftone dots (5, p. 53).

In addition to the materials used for the silk screen procedures, photographic positives were made, the indirect photographic stencil method was utilized, and criteria for evaluating the success of acrylic polymer paint were compiled. The following examination may provide insight into the method employed for preparing the photographic stencils and the criteria utilized for evaluating the paint.

Photographic Silk Screen Positives

Transparent photographic positives were used to expose the indirect screen process printing stencils. The area that appeared opaque in the positive became open on the printing screen, and the area that seemed clear or transparent in the positive became solid on the printing screen. The light passed through the transparent areas of the positive to the stencil below (8, p. 96).

For the purpose of this study, the two forms of positives for making stencils, the line positive and the halftone positive, were produced photomechanically. For the image, silk screened in the experiments in Chapter III, a photoengraver was employed to convert a continuous tone photograph into a line positive, a sixty-five line halftone positive, and an eighty-five line halftone positive to insure that the positives would be of a professional quality.

Line art is composed of lines, areas of a solid color, and areas of white. When a continuous tone photograph is converted into a line reproduction, only the darkest elements of the original photograph will print, leaving the lighter areas white (6; 4, p. 4; 24).

When a continuous tone photograph is converted into a halftone, a series of very small dots breaks up the tonal grays of the smoothly graduated original. This dot pattern gives the impression of graduated tone, because the dots in the lighter areas are smaller and farther apart, while the darker areas are composed of larger dots closer together. Thus, there is a reduction in the amount of white space allowed to register on the eye in the darker areas, although the pattern of individual dots may not be noticeable from a normal viewing distance (7, p. 9).

In screen printing there is a difficulty in using very fine screens. The fine dots which produce the highlights or lightest areas are difficult to affix to the square mesh of the screen to enable them to remain secure during long runs. Therefore, since the dot structure is comparatively larger, sixty-five and eighty-five line screens were used to make photographic halftone positives for screen printing stencils (7, p. 11).

Photographic Silk Screen Stencils

The production of photographic printing plates, which are used in reproducing visual images, includes both the arts and processes of photography and photographic screen process printing. Photographic screen process printing is based on the principle that some substances such as gelatin, albumin, polyvinyl alcohol, or glue harden when exposed to light if they are coated or mixed with such salts as potassium bichromate or ammonium bichromate. Water will not dissolve the hardened or exposed areas, but will wash or "etch" out the unexposed parts. The areas washed out during the development stage will become the areas through which the paint will be forced by the action of the squeegee (8, pp. 53, 69).

Photographic screen process printing plates have many names and trade names, but generally there are two types in use, the transfer or indirect type and the direct type. The direct type is so called because the screen fabric is made into the screen process printing plate by coating either sensitized or unsensitized emulsion directly onto the fabric.

The indirect type is affixed to the screen fabric after being prepared on a temporary support such as a transparent plastic or paper (8; 9, p. 70; 56). Although the direct photographic stencil was the first one used, the indirect photographic stencil is employed more frequently today. The indirect method became more standardized in its preparation and is somewhat easier to prepare. Detail and halftone reproductions including color separation work may be printed by the indirect method (8; 9, p. 88; 62).

Because the indirect method produces good quality line and halftone stencils, the indirect photographic method was used for the purpose of this study. A presensitized emulsion was employed, eliminating the steps of sensitizing the film and drying the emulsion. A general description follows of the procedures used with presensitized indirect photographic stencils. However, because the instructions may vary, it is recommended that the directions for indirect photographic films produced by the various manufacturers be strictly followed.

Presensitized Indirect Photographic Stencil Method

Although the emulsion material may be gelatin, polyvinyl alcohol, glue, some lacquers, or even shellac, gelatin was chosen because it is the most common emulsion material (9, p. 56). A presensitized photo stencil film manufactured by McGraw Colorgraph Company was used.

To expose the gelatin film, the same procedure used in making a contact print was employed. Although glass mounted in a covered wood frame is generally used for the printing frame, a rubber mat and a heavy piece of glass were used as substitutes. The rubber mat was placed on a table top with the film, gelatin side up, on top of it. The positive was placed on top of the film with the glass holding the two in firm contact. The exposure was made with a number two photo-flood bulb with a reflector suspended above the printing frame. The distance of the light source from the frame was eighteen inches, and the exposure time was ten minutes (5, pp. 54-56).

Because the exposure time and distance of the light source from the printing frame were not provided by the film manufacturer, this information was ascertained by the tape method. Narrow strips of opaque tape were placed on the contact frame glass, covering the entire positive, and the strips were then removed at equal intervals of time. While the unit was being exposed, a range of exposure times were recorded. The correct time was noted when the film was developed (8, p. 83).

After the exposure had been completed, the film was removed and placed in a basin of Colorgraph Fast Washout Developer. While the development took place, the film was gently agitated. As previously stated, the area protected by the positive was developed, while those areas exposed to the light were unaffected. About five minutes was sufficient time for the film to develop. After development, the film was sprayed with warm water (115 - 120 degrees Fahrenheit) until all the unexposed gelatin was removed. The film was then washed in cool water (70 - 75 degrees Fahrenheit) to fix the remaining gelatin in place (5, p. 56).

To begin the affixing process, the wet film was placed in register on the screen base, gelatin side up. The screen frame was lowered in place, and newsprint placed over the screen fabric. By gently rubbing the newsprint, excess moisture was absorbed through the screen, and the film adhered to the silk due to the gentle pressure of the blotting action. The blotting action with the newsprint was repeated until no additional moisture could be removed. The screen was unhinged and propped in a vertical position in front of an electric fan for approximately fifteen minutes to dry the film thoroughly. After the drying process was completed, the frame was reversed, and the transparent backing gently peeled away from the gelatin. To prevent tearing the gelatin in the open areas, the work was performed slowly and with great care. The screen was rehinged, and the open meshes of the screen fabric around the edges of the film blocked out with block-out lacquer and gummed tape. When the block-out material dried, the printing operation was begun (5, pp. 57-58). After the image was printed, the screen was cleaned with water to remove the paint. Although the gelatin was water soluble, it was not affected during the cleaning process of the water soluble polymer paint because cold water was used.

The photographic silk screen was reclaimed after each printing by removing the photographic emulsion. Because the paint was removed from the screen fabric immediately after printing so that it did not dry and harden the emulsion and fabric, the most important part of the reclaiming operation was accomplished (8, p. 85). The block-out lacquer around the stencil was dissolved with lacquer thinner. To remove the gelatin stencil, a stiff hand brush was used to scrub both sides of the screen with a commercial solution, McGraw Colorgraph Stencil Remover (5, p. 58).

Indirect Photographic Stencil Failure

Indirect photographic stencil failure can usually be attributed to one or more factors. Because the following precautions were maintained, the likelihood of stencil breakdown was avoided. The positive and the glass in the printing frame were kept free from dust to prevent weak spots or pinholes on the stencil that would be transferred to the fabric. Because the stencil film was not overexposed, poor adhesion to the fabric, turned up edges, and closing of fine detail were avoided. Because the stencil film was not underexposed, very thin stencils which tend to break down were avoided. Poor adhesion, loss of dimensional stability, and turned up stencil edges were prevented by keeping the temperature in the area where the stencils were made between seventy and seventy-four degrees Fahrenheit (10, pp. 41-42).

The Paint

For the purpose of this study, acrylic polymer paints were substituted for silk screen paints. There are several characteristics a good photographic silk screen paint must have. Because acrylic polymer paint was substituted for silk screen paint, it, too, had to possess the following characteristics: (1) During the printing operation, the paint had to pass through the screen fabric without clogging it; (2) When the paint was used for fine halftone printing, the dots had to be obtained without blurring or smearing; (3) The printing had to be sharp with no ragged or serrated edges; (4) The paint had to retain its true color; (5) The drying time of the paint had to permit a successful printing operation and had to allow the screen to be thoroughly cleaned without drying and clogging the fine mesh (10, pp. 31-32); (6) For the printing operation the paint had to be lump-free and about the consistency of molasses (5, p. 30). These six characteristics were used to evaluate the results of silk screening acrylic polymer paint.

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CHAPTER III

TESTING AND TESTING RESULTS

In the preceding chapter, the materials and methods used in silk screening photographic images were reviewed. In this chapter the testing of silk screened photographic images with acrylic polymer paint and the results of these tests will be discussed.

Testing in this problem was divided into three steps. Step one involved the formulation of compounds of paint and retarder to determine the effect of the retarder on the paint. In step two photographic images were silk screened using these combinations of retarder and paint to determine the best paint formula for silk screening and to determine if both line and halftone images could be successfully silk screened with acrylic polymer paint. In step three the successful formulas were silk screened on masonite, canvas, and an impasto ground to determine which painting surfaces can be successfully screened.

Step I--Evaluating the Effect of Retarders on the Paint

As stated in the preceding chapter, if acrylic polymer paint was to be a successful silk screening medium, the paint had to produce results as successful as screen process colors. Since one of the primary characteristics of acrylic polymer paint is rapid drying, a basic consideration was to slow the drying time while retaining a workable consistency. Because polymer paint dries by the evaporation of water, an agent must be added to the paint that will reduce the rate of evaporation. The three agents that were used in this study are as follows: Liquitex Retarding Medium, manufactured by Permanent Pigments, Inc., was used with Liquitex acrylic polymer paint; Hyslo, manufactured by M. Grumbacher, was used with Hyplar acrylic polymer paint; and propylene glycol, a general retarding agent, was used with both the Liquitex and Hyplar paint.

To provide consistency in atmospheric conditions, a room temperature of seventy to seventy-four degrees Fahrenheit was maintained. The only attempt to control humidity, which could slow the drying time of acrylic polymer paint, was to avoid testing when the atmosphere was humid. The same color, burnt umber, was used in all testing to maintain a constant viscosity in the paint.

To determine how much the drying time of Liquitex and Hyplar paint could be lengthened by the addition of the three retarders, tests were conducted in the following manner. One teaspoon of paint was used, and the amount of retarder was proportionately increased in each series of tests. The drying time was measured in three ways. First, one-half teaspoon of the mixture of paint and retarder was spread in a thin layer with a palette knife on a piece of illustration board coated with gesso. When the entire layer of paint was dry, the elasped time was recorded. The rest of the mixture was poured on the same piece of board forming a paste mixture to simulate the preparation to be used in the actual silk screening procedure. From this mixture two drying times were recorded: the time that elasped before a thin "skin" began to form on the drying paint and the amount of time that elasped before the entire mixture was dry.

Propylene glycol, which has the viscosity of glycerin and is relatively inexpensive, was the first retarder used with Hyplar paint. In the first test the retarder was not added to the paint so that the total effect of the propylene glycol could be evaluated. Because of the low viscosity of the propylene glycol, the substance was added to the paint with an eye dropper. Since large amounts of propylene glycol can create uneven drying patterns in the paint film of acrylic polymer paint, the greatest amount experimented with was twenty-five drops (1, p. 23).

The results, as shown in Table I, indicate that although the propylene glycol was added in increments of five drops, the extended period required for drying of the thin layer increased in greater proportion as more retarder was added. In the thin layer, the increase in drying time from no retarder to twenty-five drops of propylene glycol, was twenty-two minutes. The film on the paste followed no discernible pattern.

TABLE I

PROPYLENE GLYCOL MIXED WITH HYPLAR PAINT

Prop Glycol	Hyplar Paint	Drying Time		
		Thin Layer	Film on Paste	Paste
0 drops	1 tsp.	24 min.	35 min.	2 hrs. +
5 drops	1 tsp.	26 min.	43 min.	2 hrs. +
10 drops	1 tsp.	28 min.	49 min.	2 hrs. +
15 drops	1 tsp.	32 min.	59 min.	2 hrs. +
20 drops	1 tsp.	37 min.	67 min.	2 hrs. +
25 drops	1 tsp.	46 min.	70 min.	2 hrs. +

The same experiment was then conducted using propylene glycol with Liquitex paint. The drying times, as shown in Table II, were somewhat different from the times recorded with the propylene glycol and Hyplar paint mixture. The time required for the Liquitex, without any retarder, to form a film on the paste and dry in a thin layer was approximately five minutes longer, in both cases, than the time required for Hyplar paint. The amount of time required before a film began to form on the paste mixture was only fifteen minutes, a much shorter time than the thirty-five minutes required for the Hyplar paint mixture, but the drying time of the thin layer increased much like that of the Hyplar mixture with a total difference of twenty-five minutes.

TABLE II

PROPYLENE GLYCOL MIXED WITH LIQUITEX PAINT

Prop. Glycol	Liquitex Paint	Drying Time		
		Thin Layer	Film on Paste	Paste
0 drops	1 tsp.	30 min.	40 min.	2 hrs. +
5 drops	1 tsp.	32 min.	42 min.	2 hrs. +
10 drops	1 tsp.	35 min.	45 min.	2 hrs. +
15 drops	1 tsp.	40 min.	48 min.	2 hrs. +
20 drops	1 tsp.	47 min.	51 min.	2 hrs. +
25 drops	1 tsp.	55 min.	55 min.	2 hrs. +

In the next series of tests, Hyslo was mixed with Hyplar paint. Since Hyslo is somewhat thicker than propylene glycol,

TABLE III

HYSLO MIXED WITH HYPLAR PAINT

Hyslo	Hyplar Paint	Drying Time		
		Thin Layer	Film on Paste	Paste
0 tsp.	1 tsp.	24 min.	35 min.	2 hrs. +
1/8 tsp.	1 tsp.	41 min.	45 min.	2 hrs. +
1/4 tsp.	1 tsp.	45 min.	50 min.	2 hrs. +
3/8 tsp.	1 tsp.	49 min.	73 min.	2 hrs. +
1/2 tsp.	1 tsp.	55 min.	95 min.	2 hrs. +
5/8 tsp.	1 tsp.	62 min.	99 min.	2 hrs. +

increments of one-eighth teaspoon were used to dispense the Hyslo. The results, as shown in Table III, indicate that five-eighths teaspoon of Hyslo, the greatest amount of Hyslo added, increased the drying time of Hyplar paint in the thin layer thirty-eight minutes. It took sixty-four minutes longer for a film to form on the paste mixture than when no retarder was added.

Liquitex paint was mixed with Liquitex Retarding Medium in the final series of tests. Because the Liquitex Retarding Medium has a consistency similar to Hyslo, the increments of one-eighth teaspoon were again used. The results of this experiment are shown in Table IV.

TABLE IV

LIQUITEX RETARDING MEDIUM MIXED WITH LIQUITEX PAINT

Liquitex Retard. Med.	Liquitex Paint	Drying Time		
		Thin Layer	Film on Paste	Paste
0 tsp.	1 tsp.	30 min.	40 min.	2 hrs. +
1/8 tsp.	1 tsp.	44 min.	2 hrs. +	2 hrs. +
1/4 tsp.	1 tsp.	48 min.	2 hrs. +	2 hrs. +
3/8 tsp.	1 tsp.	55 min.	2 hrs. +	2 hrs. +
1/2 tsp.	1 tsp.	61 min.	2 hrs. +	2 hrs. +
5/8 tsp.	1 tsp.	63 min.	2 hrs. +	2 hrs. +

The drying times of the thin layer of Hyplar paint mixed with Hyslo and Liquitex paint mixed with Liquitex Retarding Medium were almost the same, thirty-eight minutes for Hyplar and forty-one minutes for Liquitex. The Liquitex Retarding Medium prevented a film from forming on the paste area for over two hours, a longer period than in any of the three previous series of tests.

Since only one to three silk screen runs were necessary for this investigation, the results of this testing showed that the drying time of polymer paint could be retarded long enough for images to be silk screened before the drying process would become a prohibiting factor. Because the retarders lack the viscosity of the polymer paint, they act as thinners. These formulations of paints and retarders were used as a starting point for the actual screening discussed in step two. Therefore, one of the primary considerations was to determine how much retarder could be added before the mixture became too thin to silk screen satisfactory images.

Step II--Silk Screening Line and Halftone Images to Determine the Best Formula of Retarder and Paint

A photographic image suitable for silk screening was selected. The original continuous tone photograph, Figure 1, was converted into a line positive, Figure 2, a sixty-five line halftone screen positive, Figure 3, and an eighty-five line halftone screen positive, Figure 4.

Figure 1--Continuous tone photograph

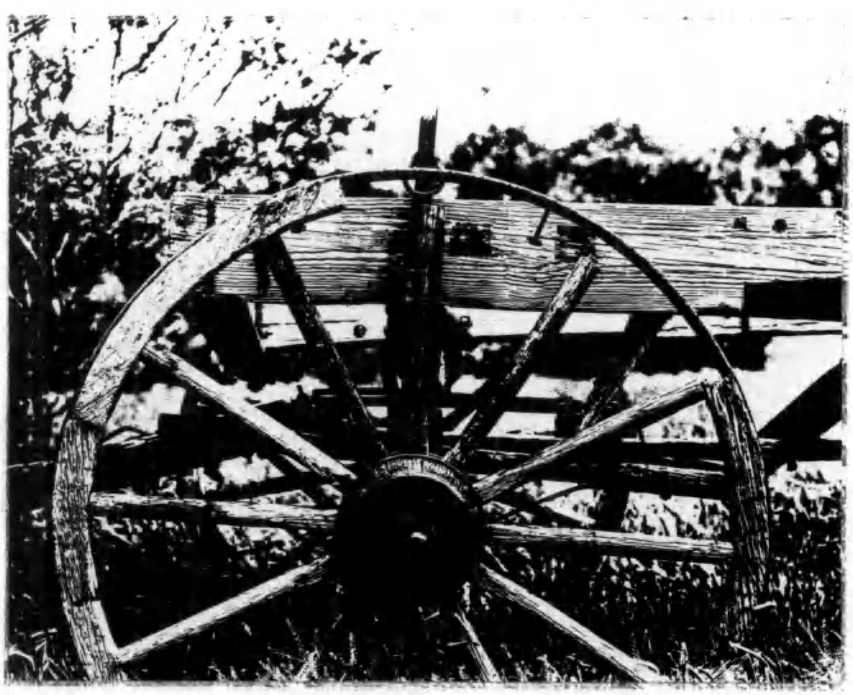

Figure 2--Line positive

Figure 3--Sixty-five line halftone positive

Figure 4--Eighty-five line halftone positive

The line image was silk screened first. Hyplar paint was screened using propylene glycol as the retarder. The mixtures of retarder and paint are listed in Table V in the order they were screened. The first mixture was the consistency of molasses which is recommended for screen process colors; but when the mixture was screened, the image had a bubbled texture and bled at all edges, as illustrated in Figure 5. A fair image with a flat textural surface was produced in screening number five, but the paint continued to bleed at the edges. An excellent image, which is

TABLE V

MIXTURES OF PROPYLENE GLYCOL AND HYPLAR PAINT THAT WERE SILK SCREENED

Order of Screening	Prop. Glycol Retard. Med.	Hyplar Paint	Evaluation
1	50 drops	2 tsp.	Poor
2	40 drops	2 tsp.	Poor
3	30 drops	2 tsp.	Poor
4	20 drops	2 tsp.	Poor
5	15 drops	2 tsp.	Fair
*6	10 drops	2 tsp.	Excellent
7	5 drops	2 tsp.	Poor
8	0 drops	2 tsp.	Poor

*Successful formula

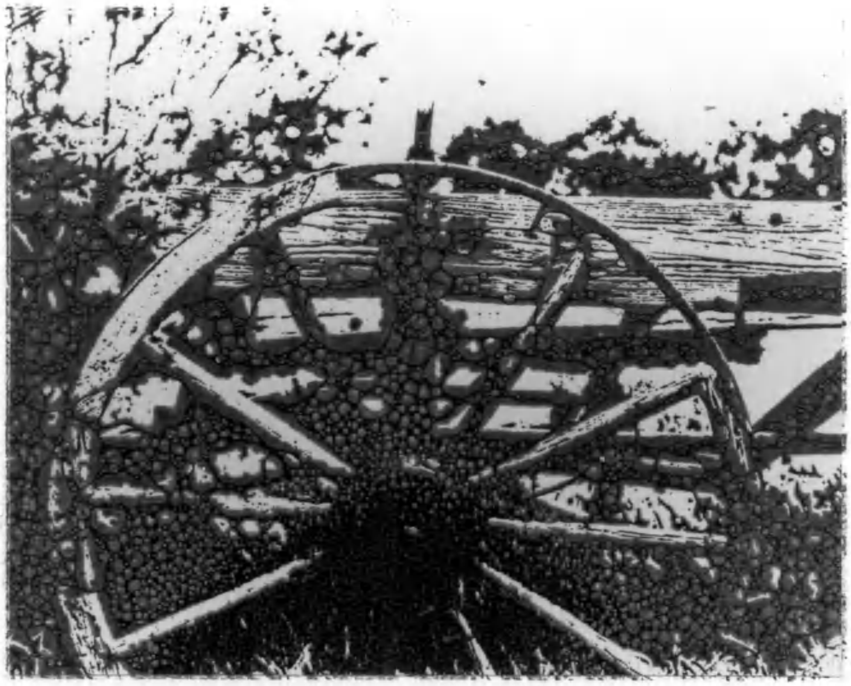

Figure 5--Wet, bubbled image

illustrated in Figure 6, was produced in screening number six. The image produced was exactly the same as the positive. The consistency of the paint was much thicker than screen process colors, but the paint could be removed if the screen were cleaned immediately. In screenings seven and eight, the paint became too thick, clogged the fabric, and produced a pale unusable image as seen in Figure 7. The fabric could not be completely cleaned with these mixtures.

Liquitex paint and propylene glycol retarder were screened next. The combinations of paint and retarder screened are recorded in Table VI. The results were the

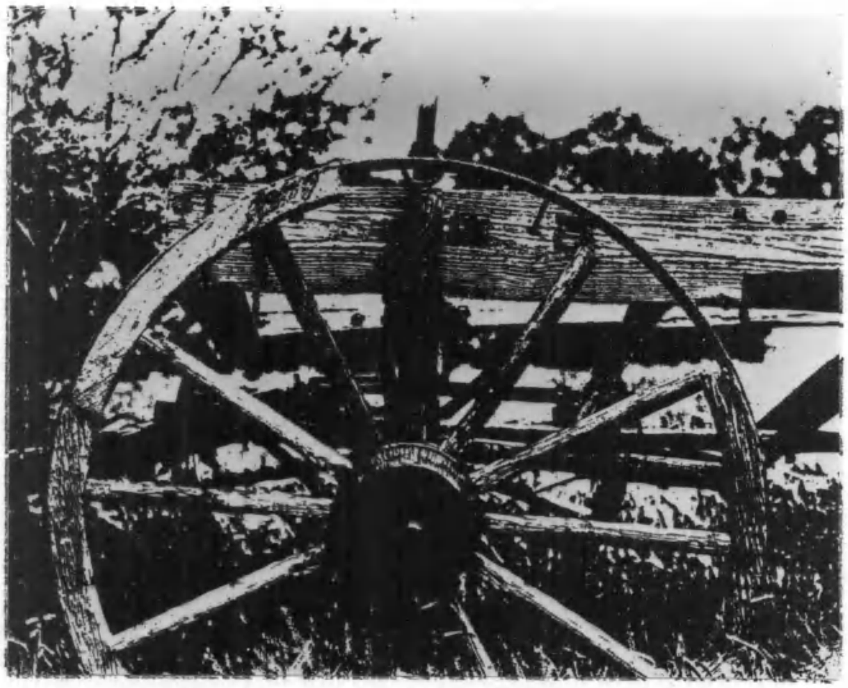

Figure 6--Image rated excellent

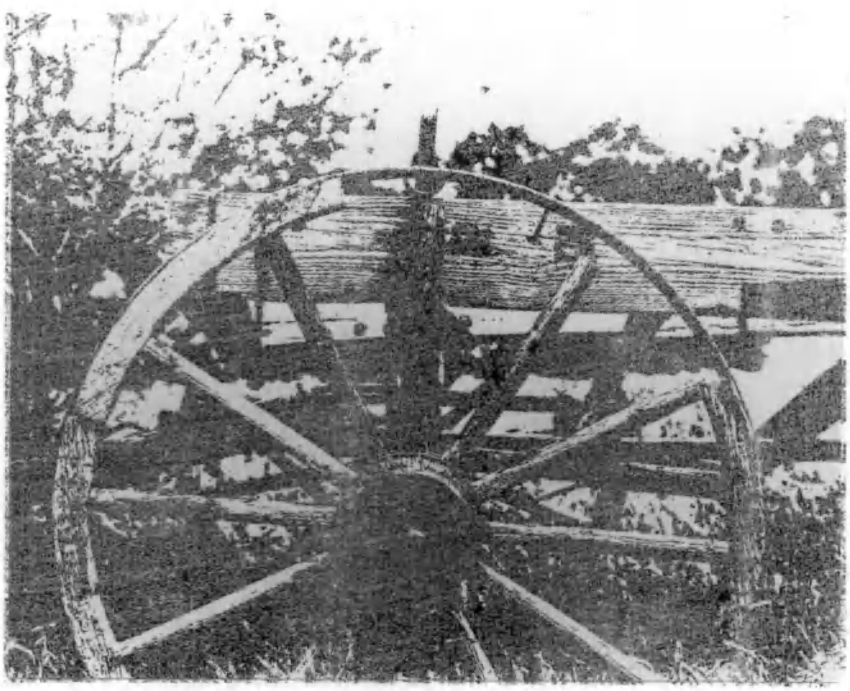

Figure 7--Dry image

same as the Hyplar paint and propylene glycol mixtures. The first mixture was too thin, producing an uneven bubbled texture. The last two mixtures screened, numbers seven and eight, were too thick, producing a pale, unacceptable image. An excellent image was screened with a mixture of ten drops of propylene glycol and two teaspoons of Liquitex paint. The paint could be successfully removed from the fabric.

TABLE VI

MIXTURES OF PROPYLENE GLYCOL AND LIQUITEX PAINT THAT WERE SILK SCREENED

Order of Screening	Prop. Glycol Retard. Med.	Liquitex Paint	Evaluation
1	50 drops	2 tsp.	Poor
2	40 drops	2 tsp.	Poor
3	30 drops	2 tsp.	Poor
4	20 drops	2 tsp.	Poor
5	15 drops	2 tsp.	Fair
*6	10 drops	2 tsp.	Excellent
7	5 drops	2 tsp.	Poor
8	0 drops	2 tsp.	Poor

*Successful formula

The third type of mixture screened was Hyplar paint and Hyslo. The results are recorded in Table VII. The first mixtures were too thin, producing an image with uneven texture and serrated edges. The only formula that produced a good quality image was number five. This combination of paint

TABLE VII

MIXTURES OF HYSLO RETARDING MEDIUM AND HYPLAR PAINT THAT WERE SILK SCREENED

Order of Screening	Hyslo Retard. Med.	Hyplar Paint	Evaluation
1	1 1/2 tsp.	2 tsp.	Poor
2	1 1/4 tsp.	2 tsp.	Poor
3	1 tsp.	2 tsp.	Poor
4	3/4 tsp.	2 tsp.	Fair
*5	1/2 tsp.	2 tsp.	Excellent
6	1/4 tsp.	2 tsp.	Poor
7	0 tsp.	2 tsp.	Poor

*Successful formula

and retarder produced an image with flat, even textures in the large areas, as well as very fine lines in the detailed areas. Again, the paint could be successfully removed from the fabric.

The final combination of paint and retarding medium screened was Liquitex Retarding Medium and Liquitex paint. The formulas screened are shown in Table VIII. The results were the same as the three previous series of tests. The first combination of paint and retarder was too thin with the last one being too thick. The most desirable formula was number five, which produced images with good quality texture and fine line detail.

TABLE VIII

MIXTURES OF LIQUITEX RETARDING MEDIUM AND LIQUITEX PAINT THAT WERE SILK SCREENED

Order of Screening	Liquitex Retard. Med.	Liquitex Paint	Evaluation
1	1 1/2 tsp.	2 tsp.	Poor
2	1 1/4 tsp.	2 tsp.	Poor
3	1 tsp.	2 tsp.	Poor
4	3/4 tsp.	2 tsp.	Fair
*5	1/2 tsp.	2 tsp.	Excellent
6	1/4 tsp.	2 tsp.	Poor
7	0 tsp.	2 tsp.	Poor

*Successful formula

To further test the four successful formulas rated excellent in Tables V through VIII, other colors (a red, blue, yellow, and green) were selected to determine if the same formulas used with burnt umber would be equally successful. Each of these colors produced the same fine quality image that burnt umber produced when mixed in the same proportions as the four successful combinations of paint and retarder.

After the four successful formulas for line images were obtained, gel medium was mixed with the paint to determine if the mixture could be used as a transparent base. The mixture was tested with the formulas in combinations up to 50 per cent paint and 50 per cent gel. Successful results were obtained with all four formulas, thereby allowing the value of the paint to be changed while retaining the transparent quality of the paint without introducing white paint.

Halftone images were screened in the next series of tests. The same combinations of paint and retarder used to test line images were used to test both the sixty-five line and eighty-five line halftone screen images. In none of the four series of tests could an acceptable halftone image be successfully screened. The images were either too liquid, as illustrated in Figure 8 and Figure 9, or the paint became too thick, producing very pale images, as seen in Figure 10 and Figure 11.

The most acceptable halftone images were produced with the same formulas found most successful for line images. However, these images, as seen in Figure 12 and Figure 13, were not successful. The halftone dots had moiré quality in the light areas, while in the dark areas the paint ran together destroying the quality of the original halftone image.

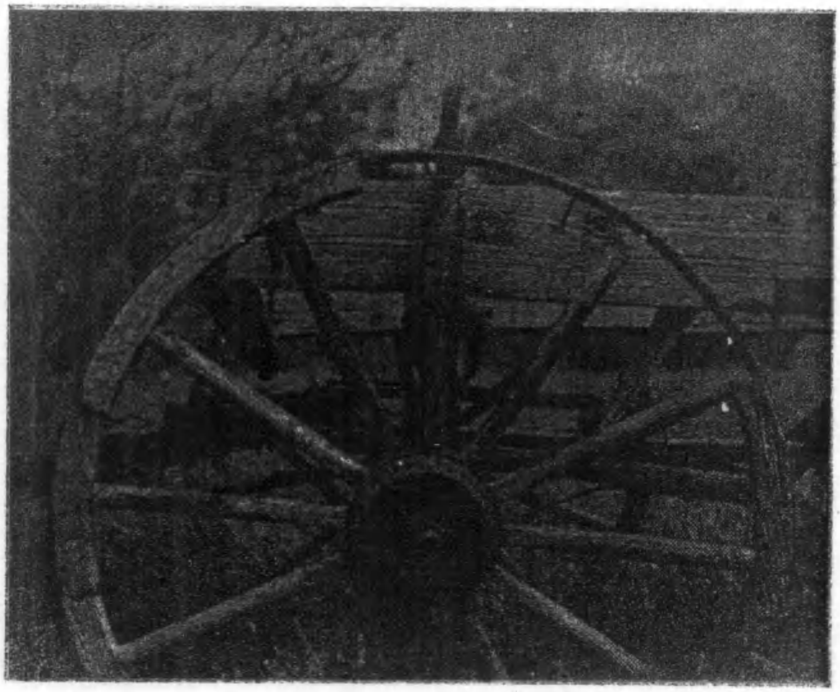

Figure 8--Sixty-five line halftone image, too liquid

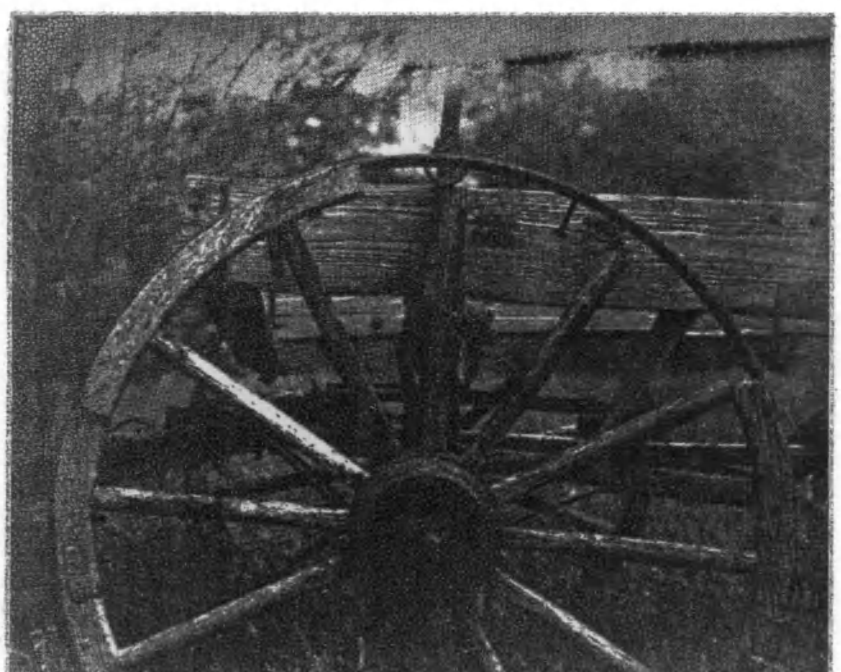

Figure 9--Eighty-five line halftone image, too liquid

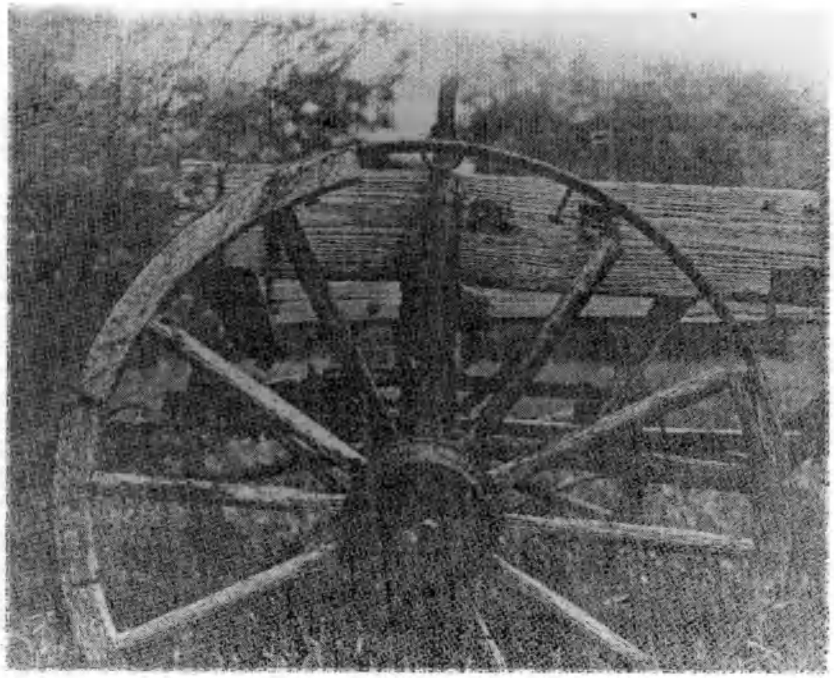

Figure 10--Sixty-five line halftone image, too thick

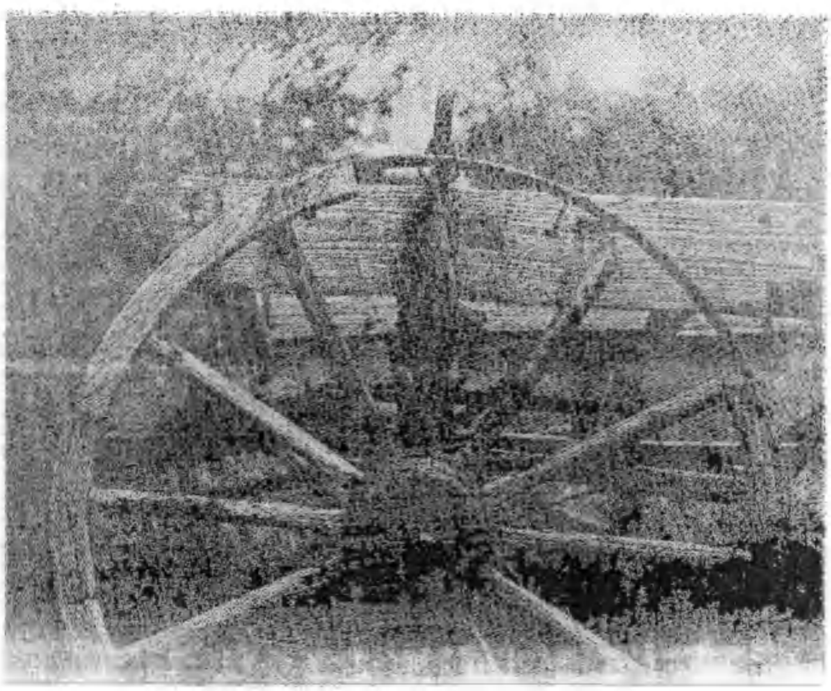

Figure 11--Eighty-five line halftone image, too thick

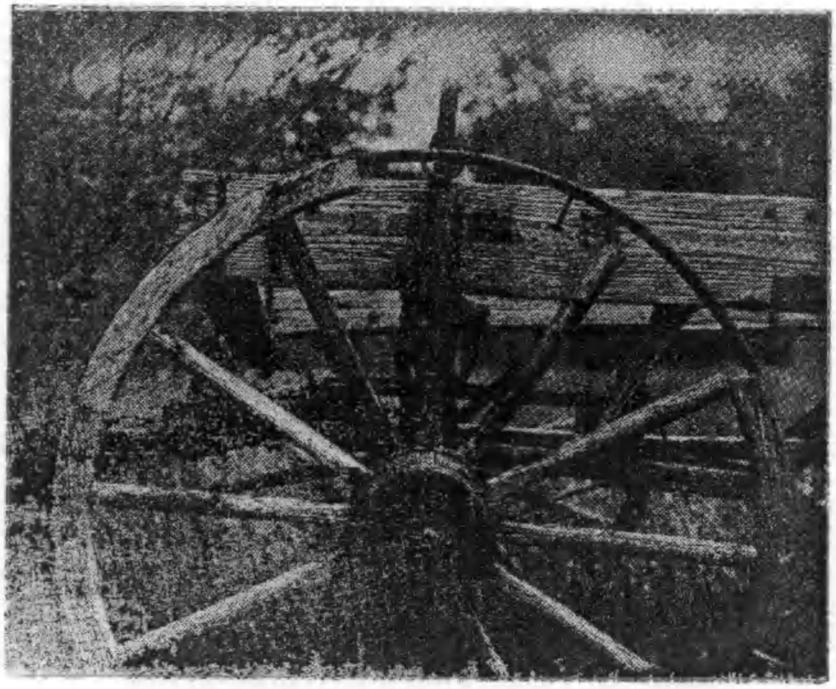

Figure 12--Best sixty-five line halftone image, unacceptable

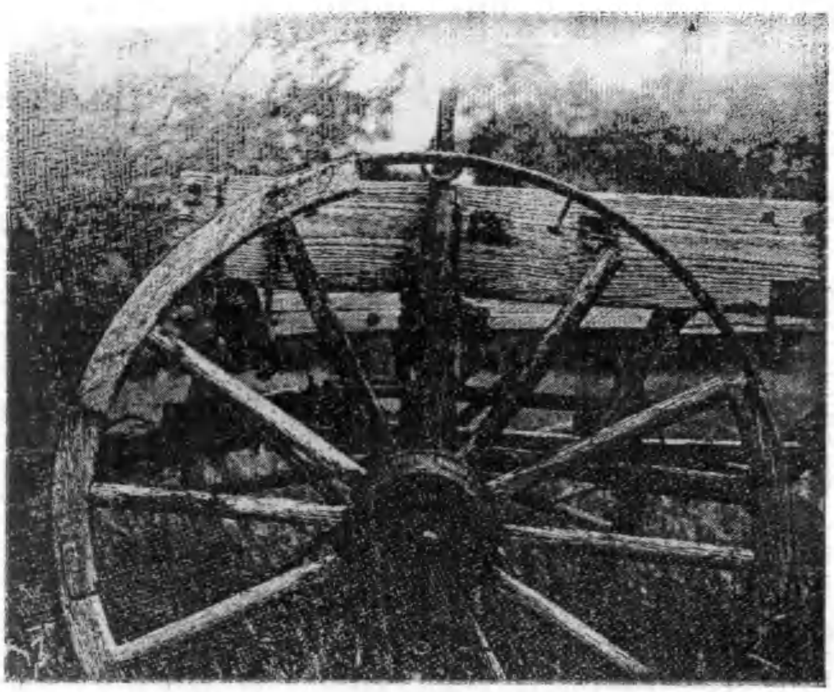

Figure 13--Best eight-five line halftone image, unacceptable

Step III--Silk Screening on Different Painting Surfaces

In addition to the testing done on illustration board, the four successful formulas used with the line images were screened on masonite and canvas. The same high quality image that was produced on the illustration board was produced on the masonite. However, the image screened on the canvas was not acceptable. Because of the uneven texture, the detailed areas filled in with paint and only the basic shape was printed, as illustrated in Figure 14.

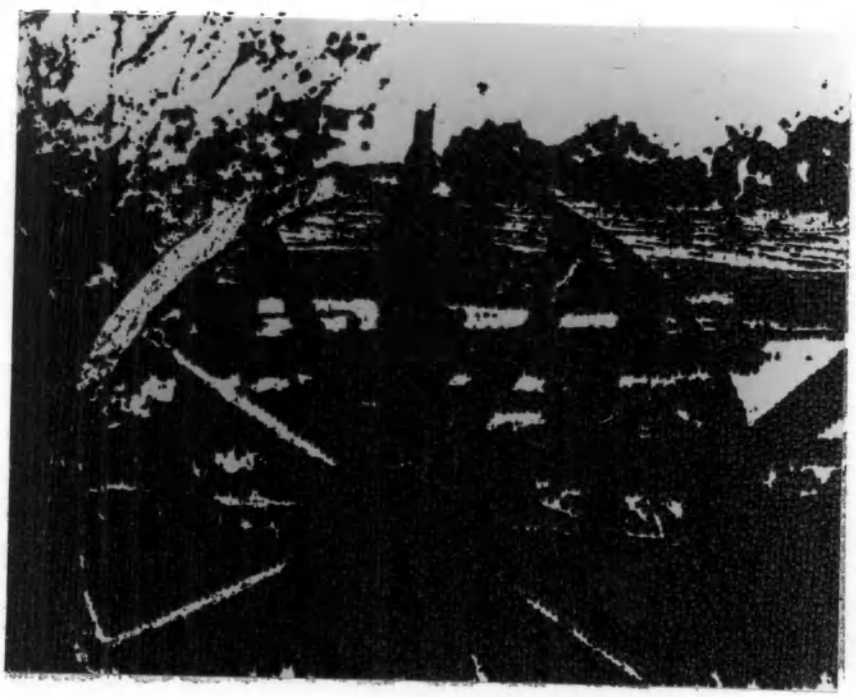

Figure 14--Silk screening on canvas

To conclude the testing, gesso was spread on a piece of illustration board with a palette knife, forming an impasto surface. The line image was then silk screened on the prepared board. The image was not discernible, indicating that photographic images could be most successfully screened on flat surfaces.

Conclusion

Photographic line images can be successfully silk screened with acrylic polymer paint. The paint passed through the fine screen fabric without clogging it, and images were produced with good sharp edges. The paint retained its true color and was lump-free, although it had to be worked in a consistency somewhat thicker than that of molasses. The drying time of the paint permitted successful screening and a thorough cleaning of the fabric. However, acrylic polymer paint proved unsuccessful when used for fine halftone printing. Fine dots could not be obtained without blurring and smearing.

When screening line images, various colors can be used. For best results, silk screening with acrylic polymer paints should be done on a flat surface, such as masonite or illustration board.

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CHAPTER IV

APPLICATION OF TECHNIQUES

The third phase of the investigation, as discussed in this chapter, involved the application of photographic silk screen techniques in combination with traditional painting methods. The medium of acrylic polymer paint was used. These applications were not intended to become shortcuts to realism, but rather to suggest how the qualities of photographic images could be of use to the artist.

A four by five inch continuous tone negative was made for each photographic image to be silk screened. The negatives were converted into line positives by using a commercial process produced by General Analine Corporation. A darkroom and its supporting equipment were necessary. The image was enlarged to the desired size and exposed on a high contrast black and white negative film (GAF Reprolith Ortho Type B film). The exposure time and f stop of the lens varied with each photograph, depending upon the size of the enlarged image. The development time for each photograph was three minutes. The method for exposing the silk screen film was described in Chapter II, with the exception of Figure 3 and Figure 4, which were exposed with an arc light.

In each of the four applications, Hyplar paint was used with Hyslo as the retarder. These substances were mixed in the same proportions used in the successful paint formula developed for Hyplar paint and Hyslo recorded in Table VII. Each application was screened on illustration board coated with gesso. The production notes are given below with a color photograph of the completed application.

Figure 15--Application I

Production Notes for Application I

In this application, as seen in Figure 15, the tree was the image which was silk screened. The positive for the tree was exposed at f 32 for thirteen seconds and was enlarged 182 per cent. The sky was painted first to provide the underpainting for the tree. The image of the tree was then overprinted on the sky, followed by the painting of the ground. The final step was to add the highlights and shadows to the silk screened image of the tree.

Figure 16--Application II

Production Notes for Application II

The second application is illustrated in Figure 16. The image silk screened in this application was the dark area of the grass and the dark area of the tennis shoes. The positive of the grass and tennis shoes was exposed at f 22 for twelve seconds and enlarged 175 per cent. The board surface was underpainted yellow-green except for the area of the tennis shoes. The area occupied by the tennis shoes was masked off and allowed to remain white. The dark areas of both the grass and the tennis shoes were then silk screened on the painting surface. A light mixture of yellow-green was again washed over the grass. The final step was to apply a wash of pale pink over the tennis shoes.

Production Notes for Application III

The image silk screened in this application, as seen in Figure 17, was the face and hair of the woman. The positive for the woman was exposed at f 22 for six seconds and enlarged 210 per cent. The first step was to underpaint the board surface a yellow-orange color. The image of the woman's face and hair was then silk screened, allowing the highlights of the face and hair to appear yellow-orange. To complete the application, the background, hat, dress, and portions of the hair and face were painted.

Figure 17--Application III

Figure 18--Application IV

Production Notes For Application IV

The image silk screened in this application, as illustrated in Figure 18, was the dark area of the face and hair of the young girl. The positive for the girl was exposed at f 11 for six seconds and enlarged 160 per cent. The board surface was underpainted pale blue. The image of the girl was silk screened over the color, and the background was then painted a darker blue.

CHAPTER V

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

Although in the area of fine arts the serigraphers have been the primary beneficiaries of photographic silk screen techniques, the potential of these techniques in the field of painting deserved further investigation. This study investigated the adaptability of plastic paints to photographic silk screen materials and methods. This chapter will present a summary of the experiments, offer some conclusions about the results, and make recommendations of possible areas for further related research.

Summary and Conclusions

In this thesis the problem was to experiment with and further develop another technique for the artist, the silk screening of photographic images directly onto the painting surface with acrylic polymer paint. The problem was studied in three phases.

The first phase, discussed in Chapter II, was concerned with a review of the materials and methods that were used for silk screening photographic images. The second phase, discussed in Chapter III, was concerned with the testing of silk screened photographic images with acrylic polymer paint. Testing in this phase was divided into three steps.

Step one involved the formulation of compounds of paint and retarder to determine the effect of the retarder on the paint. The retarding agents used were Liquitex Retarding Medium with Liquitex acrylic polymer paint, Hyslo with Hyplar paint, and propylene glycol with both Liquitex paint and Hyplar paint. The same color, burnt umber, was used in all testing to maintain a constant viscosity in the paint. This testing suggested that the drying time of polymer paint could be retarded long enough for images to be silk screened before the drying process would become a prohibiting factor.

In step two photographic images were silk screened with combinations of retarder and paint on illustration board to determine the best paint formula for silk screening and to determine if both line and halftone images could be successfully silk screened with acrylic polymer paint. An original continuous tone photograph was converted into a line positive, a sixty-five line halftone screen positive, and an eighty-five line halftone screen positive. The images were silk screened with various combinations of Hyplar paint with propylene glycol, Liquitex paint with propylene glycol, Hyplar paint with Hyslo, and Liquitex paint with Liquitex Retarding Medium. The combination of paint and retarder that produced an image rated excellent was designated as the successful paint formula. The results indicated that photographic line images can be successfully silk screened with acrylic polymer paint. The paint passed through the fine screen fabric without clogging it, and images were produced with good sharp edges. The paint retained its true color and was lump-free, although it had to be worked in a consistency somewhat thicker than that of molasses. The drying time of the paint permitted successful screening as well as a thorough cleaning of the fabric. However, acrylic polymer paint proved unsuccessful when used for fine halftone printing. The fine dots could not be obtained without blurring and smearing.

In addition, other colors were selected for silk screening to determine if the same acceptable formulas would be equally successful. The same fine quality line images were produced when screened with various colors. Testing of the four successful formulas was continued when gel medium was mixed with the paint to determine if the mixture could be used as a transparent base. Successful results were obtained, thereby allowing the value of the paint to be changed while retaining the transparent quality of the paint without introducing white paint.

In step three the successful formulas used with line images were screened on masonite, canvas, and an impasto surface. The same high quality images that were produced on the illustration board were produced on masonite. However, the images were not as successful on the canvas. Because of the uneven texture, the detailed areas filled in with paint and only the basic shape printed. The line image which was silk screened on the impasto surface was not discernible, indicating that photographic images could be most successfully screened on flat surfaces.

The third phase of this investigation, discussed in Chapter IV, involved applications of photographic silk screen techniques in combination with traditional painting methods. The medium of acrylic polymer paint was used. These applications were not intended to become shortcuts to realism, but rather to suggest how the qualities of photographic images could be of use to the artist.

Recommendations

This study suggests only a few of the possible applications of combining the silk screening of photographic images with conventional painting techniques. In addition to this study of line negatives, a study could be undertaken that would employ line screens, combinations of positive and negative images, posterization, and solarization. As a result, the additional research could possibly offer other forms of visual expression.

It is also recommended that the sensitized gelatin emulsion used in the direct method of silk screening photographic images be applied directly to the painting surface, thereby allowing photographic images to be exposed and developed on the painting surface. After development, the photographic emulsion would remain in the negative space and the original board surface in the positive space. Thus, experiments could be conducted to determine if the direct emulsion remaining in the negative spaces would serve as a mask, allowing the photographic images to be painted directly onto the painting surface. After the painting in the positive areas is completed, the board could be reclaimed, thereby removing the emulsion (mask) in the negative spaces and leaving a painted photographic image in the positive spaces. This approach would offer the artist the creative use of the camera, combined with a variety of brushing techniques.

Further research might be conducted to determine if by varying silk screen materials and methods, discernible photographic images can be reproduced on impasto surfaces. A variety of combinations of squeegee shapes, types of paint, and fabrics with different mesh counts could be employed to execute the experimentation. If successful results were obtained, silk screened photographic images could be combined with visual and tactile texture.

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