

INPAINTING OF PHOTOGRAPHIC PRINTS

4.0

This outline addresses the inpainting of damaged *original* photographic surfaces and is designed to provide a list of materials and techniques used by photographic conservators. This outline does not address compensation methods and techniques for losses in a primary support or retouching techniques used in the production of copy photographs (non-originals).

4.1 Purpose:

To restore visual unity to a damaged photographic image.

4.2 Factors to consider

- 4.2.1 Nature and type of photograph and its intended use in relation to exhibition and storage, as well as its relationship to the collection and/or institution in which it is housed.
- 4.2.2 Conservator's treatment must be governed by informed respect for the aesthetic, conceptual, historic, and physical integrity of the photograph. This respect is based on thorough understanding of the object that comes from careful examination, curatorial consultation, and historical research. Inpainting must be consistent with the photographer's original intent. It may be necessary to consult with a living photographer prior to compensation.
- 4.2.3 Type of photographic process and its associated component structure, character, and condition in terms of tonality, opacity, surface character or reflectance, solubility parameters, and solvent sensitivity.
- 4.2.4 Stability, reactivity, solubility, workability, and reversibility of selected media. Preference may be influenced by conservator's experience with specific inpainting media. Likewise, the effects of subsequent conservation treatment procedures on inpainting must be considered. It is imperative that the potential reactivity between all considered or proposed inpainting media (including isolating layers and coatings) and the photograph requiring treatment be very carefully assessed.
- 4.2.5 Techniques and materials should not, to the best of current knowledge, impede future treatment or scientific investigation or react with components of the photograph to cause deterioration such as staining, fading, or discoloration. Photographic activity testing may be required to evaluate the possible effects of various inpainting materials on

photographs. Light and dark stability testing is required to assess fading characteristics of inpainting media.

4.2.6 Size, nature (visual impact), and location of damage.

4.2.7 Accurate and thorough documentation prior to inpainting. Inpainting should be detectable by common methods of examination, including microscopic, ultraviolet light, raking and/or specular light.

4.3 Isolating Layer

4.3.1 General

- A. An isolating layer helps to protect the underlying photograph from inpainting materials applied to the surface and allows greater ease in reversing inpainting.
- B. Materials used as an isolating layer will be extremely difficult to remove entirely.
- C. An isolating layer also acts as a sizing agent on exposed or abraded paper fibers.
- D. Consideration must be given to the solubility parameters of the photographic binder, the isolating material, and the intended inpainting media. Ideally, the photograph's binder should not be affected by the application or removal of these additional materials.

4.3.2 Gelatin

- A. Gelatin is the most traditional isolating layer used, because of its compatibility with proteinous binders.
- B. Its tendency to swell but not dissolve in cold water can allow removal of water-soluble inpainting materials without loss of the isolating layer itself.
- C. It can be difficult to apply more than one layer of water-based media over gelatin, as it can "pick up" or become lumpy.
- D. It may be difficult to safely remove a gelatin isolating layer from a gelatin binder because the two will, by definition, have the same or very similar solubility parameters.

4.3.3 Cellulose Ethers

- A. Cellulose ethers are generally water-soluble materials with relatively long shelf lives. For more in-depth discussion of these materials, please refer to the Paper Conservation Catalogue section that describes cellulose ethers (46.3.1.C.1-7).
- B. These materials are very easily reversed in water, yet resistant to most other solvents.
- C. It can be difficult to apply more than one layer of water-based media over methyl cellulose, as it is water-soluble and tends to "pick up."
- D. It is possible that sodium carboxymethyl cellulose may form insoluble complexes in the presence of metal ions.

4.3.4 Acrylic Emulsions

- A. An acrylic emulsion is defined in ASTM D4302 as a stable aqueous dispersion of polymers or copolymers of acrylic acid, methacrylic acid, or acrylonitrile--also called latex, acrylic latex, or polymer emulsion paint. Manufacturers add unspecified amounts of other ingredients as thickeners, wetting agents, fungicides, and so on.
- B. Acrylic emulsion coatings should remain readily soluble in toluene, acetone, petroleum benzene, or alcohol.
- C. Once dry, acrylic emulsions become insoluble in water. If an acrylic emulsion is used on a photograph with a water-soluble binder, it is thus possible to remove the isolating layer and the inpainting on top of the layer with an organic solvent that will not disturb the binder. It may be inappropriate to use acrylics with solvent-sensitive binders such as collodion or on coated/waxed photographs.
- D. Because of the hydrophobic nature of acrylics, it can be difficult to paint on top of the layer with more than a single coat of water-based media.
- E. Acrylic emulsions have a tendency to shrink when they dry owing to the evaporation of the water in the system. It may be difficult to get a smooth and even coating.

4.3.5 Acrylic Resins

- A. Acrylic resins such as Acryloid B-67 or B-72 can be dissolved in organic solvents selected by the conservator using them.
- B. They can be applied in very thin coats and tend to dry fairly quickly.
- C. If an acrylic resin is used on a photograph with a water-soluble binder, it is possible to remove the isolating layer and the media on top of the layer with an organic solvent that will not disurb the binder.
- D. Because of the hydrophobic nature of acrylics, it can be difficult to paint on top of the layer with water-based media.
- E. If used on photographs with very thin binder layers or no binder at all, acrylic resins can quickly penetrate the paper surface and darken the paper.

4.4 Inpainting Media

4.4.1 Transparent and Opaque Watercolors

A. *Inherent Characteristics, Standards, and References*

1. Pigment dispersion in water-soluble gum/resin may include plasticizer, glycerine, wetting agent, and preservative. Opaque watercolors (gouache) contain similar ingredients, with the addition of chalk (calcium carbonate).
2. ASTM D5067 Standard Specification For Artists' Watercolor Paints. This standard establishes requirements of composition, physical properties, performance, and labeling of artists' watercolor paints. Requirements are included for accurate pigment identification, lightfastness, and consistency.
3. The Wilcox Guide to the Best Watercolor Paints

This guide provides a series of paint assessments for tube watercolors in a wide range of colorants and by numerous manufacturers. In combination with ASTM D5067, it allows the conservator to evaluate lightfastness and pigment formulations of current working palette; to identify the appropriate or "best" manufacturer when a specific colorant (such as a

magenta or cobalt blue) is required; to establish "equivalency" between artist-quality and second-range paints when possible (many of the earth colors, for example, may be of similar quality yet differ substantially in unit price); and to evaluate workability of a particular watercolor paint (many of the synthetically formed iron oxides are significantly less grainy than their natural counterparts). **It should be noted that much of the specific pigment content information contained within this useful guide is likely to be outdated.**

4. Many manufacturers will provide references on lightfastness and other characteristics upon request.

B. *Brands and Specific Qualities*

1. Photographic retouching materials (See 4.4.8)
2. Winsor & Newton pan watercolors appear to be more transparent than tube watercolors. (Tube watercolors often contain a higher percentage of pigment; however, these pigments should be identical in composition.) The representative at Daniel Smith, Inc., stated that the Winsor & Newton Cotman series colors contain less pigment and more synthetics than Winsor & Newton Artist series colors. Therefore, he felt that the Cotman series colors tended not to be as light stable as the Artist series colors. In consulting The Wilcox Guide to the Best Watercolor Paints, one may find that this statement is not necessarily true. For many colors, the Cotman series rated as good and occasionally better than the Artist series colors (ivory, black, and burnt umber to name a few) (Derby).

C. *Lightfastness and Stability Characteristics*

1. Watercolors are at great risk to damage (fade or color shift) from light exposure because pigments are not well protected by binder (as in oil or acrylic paints). Small quantities of pigment utilized in inpainting may further contribute to their reactivity. Specific and useful information on lightfastness is available.
2. In ASTM D5067, pigments meeting lightfastness requirements (ASTM4303) are provided and identified by common name, color index, name and number, and lightfastness category. Note specifically the inclusion in this list of a wide range of red, orange, and purple pigments - tonalities often essential to the "successful" inpainting of printed-out photographic print materials.

3. Upon exposure to light, mixtures of colors may fade at a faster rate (compared with non-mixtures) or may develop color shift.
4. Potential reactivity between specific pigments and a photograph's final image material must be evaluated. Some pigments may require additional photographic activity testing (Dobruskin and Hendriks).

D. *General Observations, Techniques, and Special Applications*

1. Watercolors are easily applied to and compatible with traditional isolating layers of methyl cellulose or gelatin. An isolating layer is essential. (For example, if paper fibers from the photograph's primary support are exposed, pigment may bind to the fibers and become difficult to remove safely.)
2. A wide range of colorants are available. Colorants can be manipulated and layered to create a translucent effect that is often "photographic" in nature. Conservators should note that some pigments are inherently more transparent than others. Careful pigment selection is extremely important. (Burnt sienna is a transparent pigment, whereas burnt umber is semi-opaque. Likewise, quinacridon scarlet is a transparent pigment, whereas cadmium red is considerably more opaque.)
3. Methyl cellulose may be added to increase "bulk" and reduce wicking of the colorant. Watercolors can be applied using a dry brush technique with small brushes designed for retouching work. When necessary, transparent washes or glazes of color may also be achieved.
4. Watercolors can be further modified (to increase viscosity and/or gloss) by the addition of diluted gelatin, methyl cellulose, or gum arabic solutions. (The tendency of gum arabic to yellow and crack with age must be considered.)
5. Watercolor combined with gelatin may be diluted and applied in thin washes, layer by layer, to achieve desired translucency (Turchan).
6. Watercolor is more readily reversible in water when applied over an isolating layer. Complete reversibility is not always possible. Reversibility in water may be

problematic in those cases in which a photograph's binder layer is severely reactive to moisture.

Application of moisture may cause the outer edges of a loss to swell, resulting in planar distortion, a modification of surface gloss, and/or fragmentary loss of binder. Application of moisture to a silver mirrored area may cause localized (irreversible) modification of the fragile surface.

7. Repeated layering of transparent watercolors to achieve high density may be difficult. Opacity is more easily achieved with opaque watercolors. Glossy collodion chloride and silver gelatin printing-out papers may require opacity in inpainting.
8. Insufficient gloss can be a problem. It is difficult to achieve a "high gloss" with watercolors. Additional coatings may be required to achieve gloss (see 4.5).
9. It may be difficult to "wet" onto glossy surfaces. In some cases, it may be difficult to get watercolor paints to flow and adhere evenly onto a smooth surface. (This is often true in inpainting of glossy collodion chloride photographs.) The addition of a small amount of wetting agent to the watercolor may improve its flow characteristics. Likewise, ethanol may be added to improve penetration (Lee).
10. Continuity of a large, smooth surface may be difficult to replicate with brush-applied media. The use of water may roughen the surface of some losses.

4.4.2 Dry Pigments and Pastels

A. *Inherent Qualities and Characteristics*

1. Pastels consist primarily of pulverized pigments combined with a base or filler, primarily white chalk and mixed into a paste. After the addition of a glutinous binder such as gum tragacanth (traditional), the material is rolled into cylinders and left to dry. Fillers could include chalk, clay kaolin, plaster of paris, titanium and zinc whites aluminum, silica, etc. Other traditional binders include gum arabic, sugar, milk, beer, fish glue, etc. (Watrous, 1957). Modern binders include methyl cellulose and other cellulose derivatives.
2. Pigments can be divided into two main groups, organic and inorganic. Organic pigments are of vegetable, animal or synthetic origins, whereas inorganics are mineral, native earth or synthetic in origin. In 1856,

aniline dyestuffs were introduced providing brilliant and much expanded palettes.

3. Pigments are particulate materials which do not dissolve, but remain dispersed or suspended when mixed with a liquid. They are intended primarily to be held on the surface to which they have been applied by the inclusion of a binder, otherwise they have little affinity for the surface and are easily removed.
4. Pigment particle size is dependant on the degree to which they have been ground. Very finely- ground pigments are generally more appropriate to use as a retouch medium for photographs as they more closely match the size of the silver grains.

B. *Brands and Specific Qualities*

1. Schmincke pastels are manufactured in Germany and are generally considered to be high quality with regards to pigment filler ratio. They are available primarily in soft grade.
2. Sennelier pastels are handmade in France and are also considered high quality using only pigments chosen for their lightfastness and brilliance in natural binders. They are primarily available in soft grade.
3. Rowney pastels are apparently made with a variety of fine European chalks by the extrusion method as opposed to being pressed or molded making them smoother.
4. Rembrandt pastels are manufactured in Holland by Talens.
5. Grumbacher pastels
6. Winsor & Newton Artists' Dry Ground Pigments
7. Kremer Pigments
8. Daniel Smith Dry Pigments
9. Conservation Materials, Ltd. Dry Colors

C. *Lightfastness and Stability Characteristics*

Synthetic, aniline dye-based pigments are notoriously susceptible to light damage as are organic lake pigments (Maheux, 1988). The most light-stable

pigments tend to be inorganic ones, primarily white, yellow, green, and brown. The least stable tend to be organic pigments in the violet, blue and red range.

D. *General Observations, Techniques and Special Applications*

1. Pastels and dry pigments are most appropriate for use in the retouching of crayon enlargements/solar prints which have been handcolored with pastels, chalks, charcoal, etc. They can also be used for coloring inserts for particularly large areas requiring even toning, prior to being attached.
2. Pigments and pastels are difficult to control as retouch media. The ability to adhere to paper is not consistent and is dependant on how they are applied and what has been done to the paper prior to retouching. For example, a burnished area of an insert will hold the pigment differently than a nonburnished area.
3. Pigments and pastels are difficult to control on small areas and could become permanently imbedded in the cracks of an albumen emulsion as well as other emulsion types that are damaged. For this reason, they are not recommended for use with these materials.
4. Pastels can be shaved from the stick and the pigment applied to the paper with a fine, dry brush or with a tightly wound cotton swab. Some conservators may prefer the use of stomps or tortillions for spreading and smoothing the pigments and pastels.
5. Pastels and dry pigments are friable. Pigment particles can easily be detached from their support.
6. Pastel or dry pigment particles that are considered too large or coarse can be more finely ground in a mortar and pestel.

4.4.3 Graphite Pencils

- A.** Graphite pencils are used by some photographic conservators to retouch fine detail and small losses in black-and-white prints. The degree of hardness and associated gloss must be carefully controlled and selected. These materials may smudge following application, which can be problematic.

4.4.4 Colored Pencils

A. *Inherent Qualities and Characteristics*

1. In colored pencils, pigments are mixed with clay binders. Modern colored pencils are composed of pigments, fillers, cellulose gum, and wax. Proportions of these components vary significantly.

B. *Brands and Specific Qualities*

1. Carb-Othello Schwan Stabilo colored pencils (commonly referred to as colored chalks) are composed of:

- 2.5% water-soluble cellulosic binder (added for durability)
- 70% mineral compounds (responsible for chalk character of these pencils)
- 10%-30% organic and inorganic pigments
- 2% metallic soaps
- 1% preservative

(Correspondence with manufacturer, April 1992.)

These pencils are chalky and friable. As a result, they may spread across the surface of a photograph if retouched areas have not been coated or "fixed." These pencils are soluble in both water and organic solvents.

2. Rexel Cumberland Derwent Studio pencils are composed of a natural clay filler, hydroxypropylcellulose binder, and inorganic pigments (e.g., iron oxides) and organic pigments (lakes). The hardness of these pencils is controlled by the addition (about 15%) of wax. **(Correspondence with Rexel Cumberland Derwent, April 1992.)**

These pencils are not friable and will yield a slightly glossy surface. These pencils are generally insoluble in water (component parts may be readily water-soluble) and are slightly soluble in some organic solvents. Individual pencils must be carefully tested for solvent sensitivity and solubility.

Derwent will provide the consumer with a lightfastness chart that includes a rating system based on the British Standard Blue Wool Scale (BS 1006) Method of measuring colorfastness to light.

Rexel Cumberland Derwent watercolor pencils are made with water soluble dyes.

3. Berol Prismacolor pencils are composed of a methyl cellulose binder, kaoline and bentonite (for additional strength) clays, and 20%-30% wax and are heavily pigmented with both inorganic and organic pigments. (The high percentage of pigment results in immediate coverage during use.) These pencils are slightly soluble in both water and organic solvents. (Correspondence with manufacturer, May 1992.)

C. *Lightfastness and Stability Characteristics*

1. Lightfastness should be of greatest concern with the use of colored pencils. (There are currently no ASTM standards for the labeling of these materials, although it is possible that a standard may be developed and adopted in the near future.) In general, the earth colors (including grays) exhibit excellent to very good lightfastness. Blues, greens, and often yellows, however, are very inconsistent, with stability varying significantly from one manufacturer to another. Finally, the violets, reds, oranges, and pale tints are often problematic and most susceptible to significant fading upon exposure to light. Purple magenta and dark violet are examples of lake pigments. The sheer brightness of these colors can be achieved by no other technique. The lightfastness of these lake pigments is poor.

It must be noted that colored pencil manufacturers are interested primarily in matching a particular hue, and therefore, if necessary, they will readily alter the specific colorants or pigments utilized. **For this reason, it becomes imperative that conservators perform individual lightfastness testing on the specific pencils (especially non-earth colors) that they wish to use.** In doing so, the method of application may also have to be considered. A variety of application densities may yield different light stability characteristics.

2. See "The Disappearing Fuchas: in Pen, Pencil & Paint (Fall 1993) for a discussion on lightfastness testing conducted on a wide variety of colored pencils using the ISO Blue Wool Reference and ASTM D5383. The main conclusions from this testing were:
 - almost half of the pencils in any line fade significantly
 - some brands are not suitable for fine arts
 - no one brand is clearly superior to all others.

3. A draft document entitled on Standard Practice for the Visual Evaluation of the Lightfastness of Art Materials by the User (ASTM DO 1.57.10) may be adopted in the near future. This standard describes methods for exposing artists' materials to the sunlight and procedures for subjectively interpreting lightfastness by direct comparison with The British Standard Blue Wool Scale. If adopted, this standard could be used easily by the practicing conservator to evaluate specific (and suspect) inpainting materials.
4. Many colored pencil manufacturers have performed lightfastness testing on their products. This information is often available only as a "comparative" rating (one pencil may be ranked excellent when compared with another from the same manufacturer identified as "average") and within specific product lines.
5. Photographic activity testing (PAT) of specific colorants may be required. Preliminary testing performed by the Image Permanence Institute on various gray pencils (from the manufacturers discussed in 4.4.2B) previously yielded excellent results.
6. Because of the high wax content of some colored pencils, there is the slight possibility that upon exposure to high relative humidity conditions, "bloom" formation may occur. This should be of greater concern to the practicing artist when large quantities of these materials are used. Exposure to high relative humidity levels may cause some colored pencils to bleed slightly.

D. *General Observations, Techniques, and Special Applications*

1. One great advantage to colored pencils is their "containability," i.e., they do not soak into the binder layer or paper fibers of a photographic print. For this reason, they may be considered ideal for the inpainting of small scratches, particularly in situations in which the photograph's binder layer is highly solvent or water-reactive.
2. Isolating layers (methyl cellulose or gelatin have been used) are required to ensure improved reversibility of colored pencils. Selection of the isolating layer should be influenced by the solubility parameters and reactivity of the photograph's binder layer.

3. High density or opacity may be difficult to achieve with colored pencils only. (Derwent Studio pencils tend to be less opaque compared with Berol Prismacolor pencils.)
4. Although a limited palette is available, most of these pencils are very "blendable," allowing for adequate color variation.
5. If used incorrectly, some harder pencils may incise a photograph's glossy or matte surface. Derwent Studio pencils, for example, may be inappropriate if the photograph's paper support is soft or impressionable. For this reason, they are often unsuitable for the inpainting of matte-surfaced photographs but may be considered "ideal" for albumen photographs.
6. Colored pencils may be easily modified with other media. Photographic conservators frequently layer watercolor and colored pencils to create the desired tonality, reflectivity, and opacity. Acrylic emulsion paints may also be used in this manner.
7. Derwent Watercolor Pencils may be applied dry and then blended locally with a wet brush or dipped into water and applied damp in a spot-wise manner. Reversibility of these materials decreases when they are used as a wash (Schenck).
8. For greater control of hue and application, loose media can be shaved or sanded from Carb-Othello pencils and then, much like dry pigments, can be combined with water, methyl cellulose, or an acrylic dispersion binder and applied with a brush. Dry pigments may also be used in this way, allowing for greater control over pigment content and lightfastness characteristics (Harnly).
9. Colored pencils (applied directly or with stumps) are particularly suitable for the inpainting of small damages in matte-surfaced photographs such as salted paper and/or platinum prints.
10. Colored pencils may be sharpened to a fine point and dipped directly in water or an organic solvent, yielding a more matte and dense effect (Schenck).
11. Areas inpainted with colored pencils can be burnished with a bone folder or Teflon burnisher to improve gloss (Reinhold).

12. It may be difficult to inpaint with pencils at the very edge of a loss. In these cases, a fine brush seems best and less damaging (Reinhold).
13. The slight gloss and good range of brown tones of Derwent pencils make them highly suitable for inpainting tiny losses on albumen photographs (Derby).

4.4.5 Acrylic Emulsion Paints

A. *Inherent Qualities and Characteristics*

1. Acrylic emulsion paints are defined in ASTM D4302 as paints containing a stable aqueous dispersion of polymers or copolymers of acrylic acid, methacrylic acid, or acrylonitrile, sometimes termed latex, acrylic latex, or polymer emulsion paint.
2. Acrylic emulsion paints are typically used by photographic conservators for toning inserts but rarely as an inpainting medium applied directly to a photograph's damaged surface.
3. Acrylic emulsion paints should remain readily soluble in toluene, acetone, xylene, petroleum, benzine, or alcohol. (Solubility appears to be a function of how paints were diluted during use.)
4. These paints may not be appropriate to use with surfaces (e.g., wax may dissolve in benzine and varnish or lacquer in acetone due to similar solubility parameters). Likewise, acrylic emulsion paints must not be used for the inpainting of contemporary color photographs, as these materials may be adversely affected by organic solvents.
5. Barrier layers may be used to ensure reversibility.

B. *Brands and Specific Qualities*

1. Liquitex and Golden Artist Colors, Inc., brands of acrylic emulsion paints are typically used by photographic conservators. Both brands are formulated with an acrylic dispersion binder (Rhoplex) modified with additives such as anti-foaming agents, thickeners, fungicides, wetting agents, etc. The difference between these brands of paint appears to be how the paint is "loaded," or the binder/pigment ratio. Owing to ASTM standard D4302, many acrylic emulsion paints are labeled to include pigment

identification, common name, color index name, and lightfastness rating, making careful selection of appropriate pigments possible.

C. *Lightfastness and Stability Characteristics*

1. Yellowing of an acrylic emulsion binder may occur, although this yellowing is often not a function of binder degradation. Yellowing appears to be primarily caused by diffusion or migration of discoloration products from the support and/or exposure to airborne particulates and pollutants. (James Hamm at Buffalo State College has performed extensive tests to evaluate yellowing of the acrylic emulsion binder.)

D. *General Observations, Techniques, and Special Applications*

1. Acrylic emulsion paints change color dramatically as they dry due to the gradual increasing transparency of their milky white binder. This tendency to darken upon drying makes them more difficult to master.
2. Acrylic emulsion paints are opaque and are used by some photographic conservators to replicate the lost baryta layer. Watercolors can be successfully placed on top to create a translucent photographic effect; however, even application may be problematic.
3. With acrylic emulsion paints, it is difficult to modify tone by use of multiple layers.
4. The surface character or final reflectivity of these paints can be modified by additions of gloss or matte media. Photographic activity and further stability testing of these materials is required. (See McCabe and Schenck for discussion of PAT testing of acrylic emulsions and adhesives.)

4.4.6 Acrylic Resin Paints

A. *Inherent Qualities and Characteristics, Standards, and References*

1. These paints are typically used by paintings and decorative objects conservators. In all cases, they consist of pigments bound in an acrylic resin(s).

B. *Brands and Specific Qualities*

1. LeFranc and Bougeois Restoration Colors (recently

renamed Charbonell Restoration Colors) may be preferred. These pigments, which have been preselected for lightfastness, are bound in a resin mixture consisting of isobutyl methacrylate and cyclohexanone. By combining two different resins, working properties may be manipulated and improved, resulting in a final resin with greater flexibility, increased gloss, and less yellowing. These paints remain soluble in benzine. They generally exhibit good saturation, and translucent effects are possible with increased dilution.

2. Bocour manufactured a line of pigments called Magna until recently, when the company went out of business. Magna paints are soluble in xylene and toluene.

C. *Lightfastness and Stability Characteristics*

D. *General Observations, Techniques, and Special Applications*

1. Acrylic resin paints may be most suitable for the retouching of water-sensitive binder layers where opacity is required. For example, these paints may be used very successfully for the retouching of glossy silver gelatin printing-out photographs. Use of these paints is also appropriate if reversibility of water-soluble inpainting medium is problematic due to the sensitivity of the particular photographic media.
2. To ensure reversibility (or additional protection to the edges of the damaged binder layer), an isolating layer may be used. This could be accomplished with Acryloid B-72. **Caution:** The use of acrylic resins may be problematic with collodion binder layers, contemporary color materials, and waxed/varnished photographic prints as their solubility characteristics may be similar.
3. Reflectivity or surface character of acrylic resin paints may be modified by the addition of an acrylic varnish or by glazing. With such modification, saturation of colors can be improved.
4. If used directly, acrylic resin paints will typically yield a dry, matte surface. These paints are characteristically leanly bound.

4.4.7 Dye-Based Photographic Retouching Material

A. *Inherent Qualities and Characteristics, Standards, and References*

B. *Brands and Specific Qualities*

1. SpoTone (Retouch Methods Co., Inc.) is composed of water-soluble dyes mixed with distilled water (information from manufacturer). The dyes will penetrate or imbibe into a gelatin emulsion. Surfactants may be added to SpoTone to improve "wetability."
2. Ilford Cibachrome Transparent Retouching Dyes are the same as those used in silver-dye bleach prints, according to the manufacturer. They therefore offer the advantage of having the same lightfastness and spectral response as the incorporated azo dyes. According to the manufacturer, these dyes may be removed by immersing the print in a water bath for 30 minutes until the dye lifts out. See Technical Information, Retouching Cibachrome Materials, Ilford Photo Corporation, Copyright 1988, for additional details
3. Kodak Retouching Colors are water-soluble organic dyes related chemically to dyes used to make dye transfer prints.

C. *Lightfastness and Stability Characteristics*

1. SpoTone dyes are not readily reversible. Some success may be achieved by immersing the retouched photograph face down in a water bath or by local application of ammonia water. Neither technique is generally recommended for historic or deteriorated photographs, as possible consequences could be catastrophic.
2. Although the most lightfast dyes possible are utilized (according to manufacturer), these dyes will shift in color or tonality upon aging (especially with light exposure), often shifting to a warmer, orangish tonality.
3. Kodak Retouching Colors, according to Kodak, have dark stability and light stability characteristics comparable to those of dyes in Ektacolor papers.

4. Retouching dyes are designed to be absorbed into the emulsion layers of prints. Reversibility may be difficult.
 5. Cibachrome transparent retouching dyes should have superior dark stability characteristics (when compared with those of dyes utilized in most chromogenic color prints).
 6. Stability characteristics of the retouching medium should match those of the photograph requiring inpainting to ensure that these materials fade at a similar rate.
- D. *General Observations, Techniques, and Special Applications***
1. Dye-based materials may be preferred by photographers because "retouched" areas are not readily visible when the photograph is examined in raking light. Their use is very limited for conservators.

4.4.8 Pigment-Based Photographic Retouching Material

A. *Inherent Characteristics, Standards, and References*

B. *Brands and Specific Qualities*

1. Schmincke Positive Retouching Colors (H. Schmincke & Co., Germany)

a) These paints are available in matte and glossy series and, in a broad sense, may be identified as gouaches. The colors are composed of pigments bound with gum arabic, dextrin, or "sugary substances." The gloss is controlled by the binder/pigment ratio (**correspondence with manufacturer, May 1992**). X-ray fluorescence analyses of these paints indicate the presence of iron, calcium, and copper in the brown-black and blue-black colors. (Detected elements are very similar to those observed in the Marabu Retouch Sets.)

2. Marabu Retouch Set

a) It is possible that these materials are identical in composition to the Schmincke Positive Retouching Colors. Further research is required.

3. Gamma Photo Retouch Kit

C. *Lightfastness and Stability Characteristics*

1. Many of these materials appear to be *lightfast*. The Schmincke Retouching Colors have been tested by the manufacturer and compared favorably with the British Standard Blue Wool Scale (BS 1006).
2. In 1984, colorants from both the Marabu and Gamma Retouch Kits were exposed to 96 hours in Sunlighter II at the Library of Congress. (Twenty-four hours in Sunlighter II are equivalent to approximately 9 hours in a standard fadometer.) No perceptible change was noted in these materials.

D. *General Observations, Techniques, and Special Applications*

1. Many of these photographic retouching sets are most suitable for inpainting of modern black-and-white photographic materials. The glossy series often works exceptionally well for the inpainting of glossy contemporary black-and-white photographs.
2. The opacity of these paints combined with their increased granularity (compared with watercolors) makes them difficult to use in situations in which translucent effects are required.
3. These paints can be combined with watercolors (to modify tonality) and/or with gelatin or gum arabic to improve gloss. Modification of tonality is often required because the palette is preselected to reflect silver gelatin developing-out photographic prints in excellent condition.

4.5 *Coating and Additives*

- A. The surface character of an inpainted area may be further modified by the local and controlled application of gelatin, gum arabic, methyl cellulose, acrylic resin, or acrylic dispersion solution.
- B. Coatings must be selected very carefully to ensure their stability, chemical compatibility with all components of the photographic material, and removability if necessary.
- C. Retouch Methods Co., Inc., manufactures a gum arabic-like material called Wondersol. This solution is often used by retouchers in an airbrush to "seal" each layer of airbrushed retouching and is also added to the

gouache itself to assist in its flow. According to the manufacturer, it consists of gum arabic, methanol, water, and a preservative (Moldall). Everything goes into a suspension and the mixture is allowed to settle for 6 months. Undissolved gum arabic is skimmed off the top of the solution before it is packaged in a plastic jar fitted with an eyedropper lid. Use of this material may be considered to increase gloss on finished inpainting (Maxson). This material may be hazardous to health.

4.6 Treatment Variations

4.6.1 Mechanical Surface Manipulation

- A. Gloss may be further increased by gentle, localized burnishing with an agate or Teflon burnisher, or a stainless steel dental tool.
- B. Burnishing through silicone-release polyester film or paper may yield additional control and higher, more uniform gloss.
- C. Rapid, light, and careful buffing with a cotton ball or swab may increase gloss (Messier).
- D. Care must be taken that the original surface character of the photograph is not locally modified. Edges of a loss may appear highly burnished in raking light as a result of this type of modification/manipulation.

4.7 Special Considerations

4.7.1 Silver Mirrored Surfaces

- A. The material that most mimics the way light is reflected from a mirrored surface is graphite. Graphite smudges very easily. When coated or used in a binding medium, graphite loses its reflective characteristics. Graphite may be appropriate for small scratches or losses but should probably be avoided for large areas (Luxner).
- B. Iridescent and interference pigments are generally titanium dioxide coated mica particles and tend to be light stable. They are most often available within acrylic emulsions, but the pigment itself can be mixed with any binder. PAT testing on Golden Interference pigments showed no reactivity with photographic materials. The iridescent pigments work better than the interference pigments. In terms of color, interference colors tend to be too color-specific. The drawback to these materials is that they are

consistently shiny, regardless of viewing angle, whereas a mirrored photograph varies in reflectance depending on the angle of light (Luxner).

- C. "Silver" gouache, a metallic silver dry pigment, cake, or ink, may be added to watercolors to further modify and create a mirrored effect (Wagner).

4.7.2 High-Gloss Surfaces

Reproducing high gloss in inpainted areas of photographs can be achieved by utilizing coating materials in combination with inpainting medium or in a separate application (Gillis).

- A. The manipulation used for achieving gloss on an insert is often unacceptable for use as a technique in areas adjacent to an inpainted loss.
- B. When several layers of coatings are necessary to achieve sufficient gloss, there is a problem with build-up higher than the surrounding areas. The addition of a coating may shift the final color and must be compensated for during inpainting.
- C. The mixing of coating materials into the inpainting medium seems to provide a better solution than coating. When combining medium with coatings, however, the compatibility of medium and coating becomes a factor for consideration in choice of both materials. For example, Soluvar provides a good coating, but it is not completely miscible with water-soluble inpainting materials.
 - 1. Schmincke Retouching Colors (gloss) yield good results when used alone.
 - 2. Possible combinations:
 - a. LeFranc and Bougeois Restoration Colors and Soluvar
 - b. Magna paints and Soluvar
 - c. Watercolor and gum arabic
 - d. Watercolor and gelatin
 - e. Magna paints and Arkon P-90
- D. Materials that can be employed to heighten gloss (as coatings and/or mixed into media) include gelatin, methyl cellulose, gum arabic, acrylic resins, acrylic dispersions, and Arkon P-90.
 - 1. Most of these materials have been discussed above.

2. Arkon P-90 is a hydrogenated alphas-methyl styrene polymer resin with a low molecular weight. It is soluble in a variety of solvents. Experiments have been successful using Arkon P-90 in shellsol and petroleum benzine. Shellsol requires a longer drying time, whereas petroleum benzine decreases the necessary drying time.

- E. To achieve evenness of gloss, drying inserts under weight with silicone-release Mylar can cause a problem by either spreading the coating farther than the inpainted area and overlapping the original surface, or by not spreading it evenly enough over the inpainting. A ring or trough may be created, which only serves to call further attention to the inpainting than had it been left matte.
- F. Barriers may affect gloss, but limit them to compatible materials. Methyl cellulose and PolyVinyl Acetate AYAA in ethanol are promising barriers. Although PVA AYAA in ethanol does not introduce water into the system, it limits inpainting materials that adhere. Preliminary experiments appear to indicate a higher gloss is noticeable when methyl cellulose was used as barrier.

4.8 Case Studies

- A. During preparation for the retrospective exhibition Lisette Model (National Gallery of Canada, 1990), it was observed that nearly all of Model's prints showed corrective retouching of low-density images of particles, fiber debris, and scratches that had been printed from the negatives. Research showed that Model was concerned that her prints be retouched as a finishing procedure and that she had employed many people as retouching technicians over the years. Nevertheless, much of the retouching work observed on vintage Model prints was inexpert, incomplete, or faded. In a limited number of cases, the print chosen for the exhibition had not been retouched at all, despite the presence of many of the printing imperfections noted above. The organizing curator wished to have these imperfections suppressed in a number of the exhibition prints. A preliminary selection of works to be treated in this way was put together by the curator and reviewed by both the curator and a conservator; comparisons between prints within this group and with prints that had been satisfactorily retouched at the time of production helped to clarify the selection criteria and narrow the list. These comparisons were

made under exhibition-type illumination, and specific "spots" to be retouched were discussed and decided upon. The main criteria were, (1) a desire to do as little additional retouching as possible while (2) suppressing imperfections that were distracting or that interfered with appreciation of the print image when viewed at a normal viewing distance. The actual retouching was done out with watercolors over a gelatin separation layer. Records of added retouching were produced on a photocopied reproduction of the print image (McElhone).

- B. An extremely matte silver gelatin developing out print (Bernice Abbott c 1953) exhibited small losses in its emulsion. These damages were distracting, and it was determined that cosmetic treatment would be undertaken. The losses were coated with Soluvar Matte Varnish diluted with naphtha. Damages were then inpainted with Carb-Othello pencils (warm silver gray, ochre, and olive green) carefully blended with a small cotton swab. These inpainted areas remain readily reversible in naphtha (Brown).

- C. The following is a preliminary attempt at compensation of a small loss of emulsion in a shiny black area on a silver gelatin photograph.

A gelatin solution (approximately 2%) was poured onto Mylar and allowed to dry. The dry gelatin film was peeled from the Mylar. Schminke Retouching Colors that matched the area surrounding the loss were applied to the non-shiny side of the film. The loss on the photograph was isolated with methyl cellulose and allowed to dry. The loss area was brushed with a minimal amount of water, and the colored film was placed shiny side up (paint side down) on the loss. The resultant compensation was very successful and merits further investigation (Andrews).

- D. An Ansel Adams mural photograph measuring 48" square was brought to the Northeast Document Conservation Center for treatment. It was a black-and-white photograph of Half Dome and the Merced River in Yosemite National Park, dating 1961. It was adhered to hardboard (i.e., Masonite) with a solvent-based adhesive. As a result of having been glued to the sheet of hardboard, the photograph developed an extended network of cracks in the emulsion, which, in some areas, were severe enough to reveal paper fibers. The photograph was removed from the hardboard and remounted onto a modified

Japanese panel. Completion of the treatment required extensive inpainting along the cracks in the emulsion. Watercolor has always been a primary medium for inpainting and usually gives satisfactory results. However, if one attempts to recoat a photograph with a spray coat (for example, of gelatin) a color shift often occurs as the retouching is saturated, making it incompatible with the surrounding areas.

To avoid such alterations in tone, the conservator may try dry pigments, particularly if the principal tone is black or a variation thereof. Dry pigment can be used in a manner similar to watercolor. It is applied by brush, using either water or ethanol. The excess pigment on the photograph's surface can be wiped or brushed away, leaving the pigment only in the fissures. The dry pigment often dries matte, but if a final coating is to be applied, one will find that the resulting saturation of the dry pigment matches the emulsion surface reasonably well without a significant alteration of tone (Lee).

- E. A very large Polacolor ER (approximately 7.5' x 3.5') photograph was treated for a 14-inch tear. The tear was mended with a strip of Japanese paper applied to the verso with Lascaux 360 HV adhesive. Because of the extreme sensitivity of the dye layer to moisture and concerns about reversibility, the tear was inpainted with dry pigments scraped from pastel sticks with a scalpel. This procedure was performed under a binocular microscope to insure that the pigment was applied only to the paper fibers exposed by the tear and that no residue was left on the surface of the print. The pigment particles were manipulated into place with a fine brush. By no means did this treatment achieve an illusionistic cosmetic effect. Because there are two layers of polyethylene in Polacolor prints, the tear was a very clean split. No attempt was made to fill the tear or match gloss. However, due to the large size of the print, the inpainting did achieve a visual consolidation of the image (Messier).
- F. Unbleached white acrylic emulsion paint has been successfully used to retouch a large group of albumen prints. It may require modification in tone, but it acts as a good base for subsequent inpainting (Albright).

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