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Canadian Conservation Institute

National Museums of Canada

The Care of Black-and-White Photographic Collections: Cleaning and Stabilization

Siegfried Rempel

The Care of Black-and-White Photographic Collections:

Cleaning and Stabilization

by Siegfried Rempel

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The Care of Black-and-White Photographic Collections: *Cleaning and Stabilization*

by
Siegfried Rempel

Editor and Layout: Janet Denton
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Author

Photo by James Stark

Siegfried Rempel is a Conservation Scientist in the Conservation Process Research section of the Canadian Conservation Institute. He graduated from Carleton University with a B.Sc degree in 1973 and joined the Canadian Conservation Institute in 1975.

Abstract

This bulletin outlines the handling and cleaning procedures to be used with black-and-white photographic artifacts found in archival and museum collections. Detailed instructions are also given for preparing these artifacts for storage, as well as achieving the stabilization of deteriorated black-and-white photographs.

The recommendations put forward in this bulletin are based on the inherent structural characteristics of photographic artifacts. The procedures, selected from the existing literature, have been modified to provide practical guidelines for custodians of photographic collections.

1. Introduction

The preservation of black-and-white photographs can be considered as a form of holding action, necessitated by the sheer volume of material held in most collections.

Procedures discussed in this bulletin attempt to ensure that further degradation of these artifacts is minimized until such time as conservation can be undertaken. Such steps include identifying and stabilizing new material accessioned to a museum's collection, and the removal of some contaminants associated with the photographs, prior to their storage.

This bulletin should be read in its entirety before applying the techniques it describes.

2. The Deterioration of Black-and-White Photographs

Black-and-white photographic artifacts, when properly processed and stored, are both stable and permanent. Generally, these two requirements have not been applied to historic photographs.

The permanence of a black-and-white photographic artifact depends upon the following:

—*The stability of the various structural components which make up the artifact.* The normal structure of a photograph includes a support, an image and image layer (binder), as well as a number of other minor components (see Figure 1).

Each of these may have optical, chemical or physical sensitivities which could, in time, lead to instability of an artifact. An excellent example of this is cellulose nitrate*, used as the first flexible transparent support. We now know that its own deterioration results in the eventual destruction of the image which it supports (see Figure 2).

The presence of deteriorated nitrates in a common storage area will also cause the accelerated degradation of other images as well, making nitrate the single most damaging material in a collection.

—*The image fabrication process and the chemicals used to stabilize it.* It is now apparent that residual processing chemicals from the fabrication step – particularly for silver-based processes – may in time attack the image, image layer or support. For silver images, residual thiosulphates and silver thiosulphate complexes may chemically alter the metallic silver image to silver sulphide.

In the early fine-grained silver-print processes, this resulted in an image colour change as well as a loss of image density, particularly noticeable in the highlights.

—*The environment of the artifact after fabrication.* Elevated temperature and relative humidity levels, the presence of harmful gases in the atmosphere or contact with certain types of material can lead to detrimental chemical or physical changes in an artifact (see Figure 3).

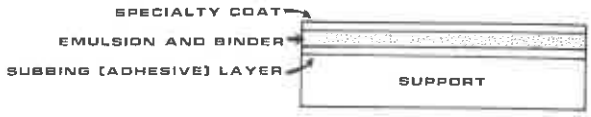

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Figure 1: *Each of the layers in this simplified cross-section will respond differently to environmental changes.*

Figure 2: *This cellulose nitrate negative is in an advanced state of deterioration. The support has become brittle, the emulsion and image stained.*

Figure 3: *The emulsion of this gelatin glass plate has lifted from its support. It was stored in a fluctuating environment.*

*Cellulose nitrate-based materials are often referred to as nitrates.

TABLE I — DETERIORATION EXAMPLES

Chemical	Environmental	Mechanical	Biological
— Eroded or pitted emulsions are due to fingerprints, grease spots or water splashes	— moisture damage is due to poor climate control, relative humidity and temperature; i.e., fluctuating conditions	— spots, holes and scratches are due to mishandling or abrasion against other materials	— holes and pitting are due to bacteria, mould or insect attack
— surface deposits are due to dried-on chemicals or silver clumping, resulting in an image graininess or a rough surface texture	— a relief image is due to differential drying of a wet emulsion*	— shiny areas are due to the emulsion sticking to a smooth, warm surface and often results in the deformation of the image or in a fusing of materials	— matt surface textures are due to fungus growth resulting in irregular, dirty spots or in distinct point-like centers
— brittle artifacts are usually due to an acidic support; e.g., nitrates	— blisters and frilling in emulsions is due to a wet emulsion* and may result in lifting or flaking emulsions	— cracked emulsions are due to extended dry storage resulting in embrittlement which when followed by poor handling results in cracking	
— stains are due to residual processing chemicals and include: oxidation scum, sulphiding, colloidal silver, colloidal sulphur and chemical and dichroic fog. These result in fading or the formation of coloured stains	— reticulation is due to rapid temperature changes of a wet emulsion*	— crazed emulsions are very small cracks in the emulsion due to mishandling	
— the buckling and shrinkage of nitrate and acetate plastic bases is due to a loss of volatile components and results in image deformation and a lifting of the emulsion	— the curling of prints and films is due to dry storage	— broken items are due to the mishandling of brittle materials	

*Often the result of disasters.

Terms used in this table are defined in Faults in Photography, Causes and Correctives by Kurt Fritsche (see Bibliography).

These environmental factors may also compound the effects of the first two conditions. For example, materials containing sulfur, such as rubber cement adhesives, in close proximity to silver images can produce a chemical conversion of the image to silver sulphide. This conversion is accellerated by high relative humidity and high temperature conditions.

Table I lists various forms of deterioration. They can be categorized as follows:

- *Chemical deterioration*, such as the sulphiding of the metallic silver image due to residual processing chemicals.
- *Environmental deterioration*, such as the sulphiding of the metallic silver image due to atmospheric gases containing sulphur.
- *Mechanical deterioration*, such as the breakage of a glass support (due to its inherent brittleness).
- *Biological deterioration*, such as fungal attack, due to incorrect storage with high humidity.

3. Examining and Handling Artifacts

3.1 Examining and Sorting

Artifacts are inspected to determine their condition and schedule their conservation needs; it is important to have space specifically prepared for this. Ideally, this area should have several tables, covered with clean, unprinted newsprint, on which material can be laid out and examined (see Figure 4).

Artifacts are initially grouped according to their supports. The contents of the enclosures* are removed, placed on an auxiliary support (see Section 3.3) on the newsprint, and all information recorded in the accession book (see Figure 5).

*Do not discard the enclosure until the information contained on it has been transferred to the new enclosure and entered into the accession book.

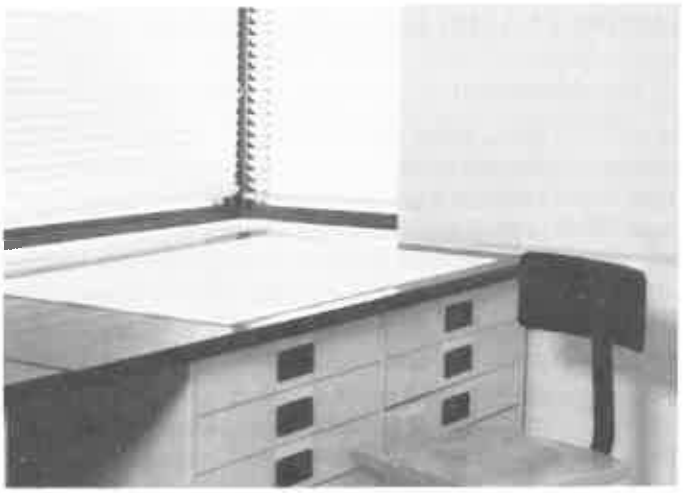

Figure 4: The sorting area, with clean newsprint laid out on the bench, should be kept clean for artifact examination.

Figure 5: The information from the artifact envelope is immediately recorded into the accession book prior to beginning examination.

They are then grouped again, based upon the relative condition and immediate need for stabilization of each individual item (stabilization procedures are given in Section 5). For example, all broken glass plates are placed together to await stabilization.

Once a container has been sorted, the various groups are moved to another clean area; the dirty top layer of newsprint is removed and the auxiliary support cleaned.

The following groupings should result from this process of examination, identification* and sorting:

Plastic Supports
- nitrate materials
- fused materials (items stuck to each other)
- lifting and flaking emulsions
- all remaining items

Metal Supports
- metal supports and case photographs
- lifting of flaking emulsions
- all remaining items

Paper Supports
- mounted and oversize items
- brittle prints
- curled prints
- albums
- fused materials
- lifting and flaking emulsions
- photographic art prints
- all remaining items

Glass Supports
- broken glass plates
- cracked glass plates
- flaking and lifting emulsions
- fused materials
- lantern slides
- all remaining items

*For information on the identifying characteristics of black-and-white photographic artifacts, see Rempel, Siegfried, "The Care of Black and White Photographic Collections: Identification of Processes", Canadian Conservation Institute Technical Bulletin #6 (November 1979): English, 32 pp.; French, 34 pp.

3.2 Handling

During handling, observe the following procedures.

- Work only in the designated area; eating, drinking and smoking are not allowed.
- Staff should wash their hands before work. Hand lotions or creams are ***not*** to be used; cotton gloves ***must*** be worn.
- Always pick up the enclosed artifact with both hands (see Figure 6).
- Large or heavy artifacts must have an auxiliary support of glass. Delicate and torn items ***must*** be handled with an auxiliary support (see Figure 7).
- Heavy artifacts enclosed in envelopes could be glass plates. Never stack these one on top of another. If an enclosure sags when lifted (see Figure 8), a broken plate may be inside. Lay it flat on an auxiliary support for examination (see Section 3.3).
- Always remove the enclosure from the artifact and not the artifact from the enclosure (see Figure 9).
- Don't force the separation of one item from another.

Figure 7 shows the proper use of an auxiliary support for paper and glass artifacts. Figures 10 and 11 show the proper techniques for holding glass and plastic artifacts, respectively.

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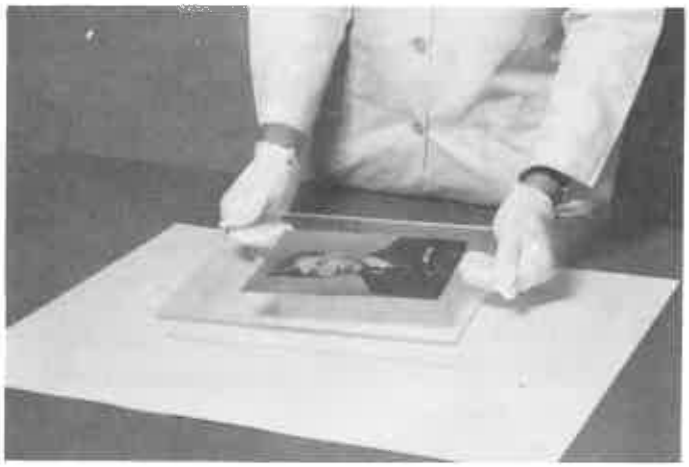

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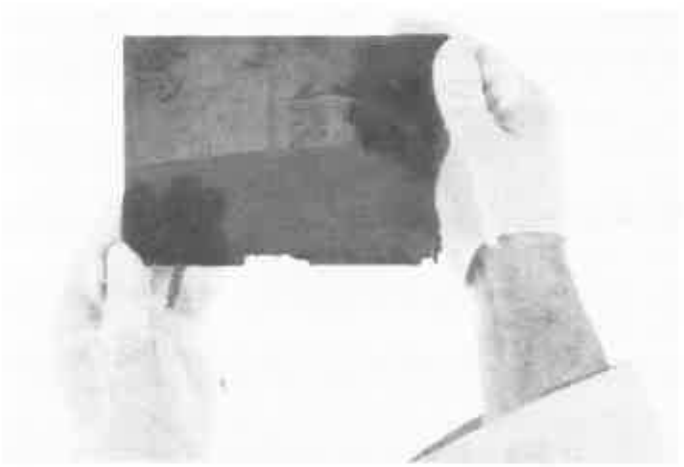

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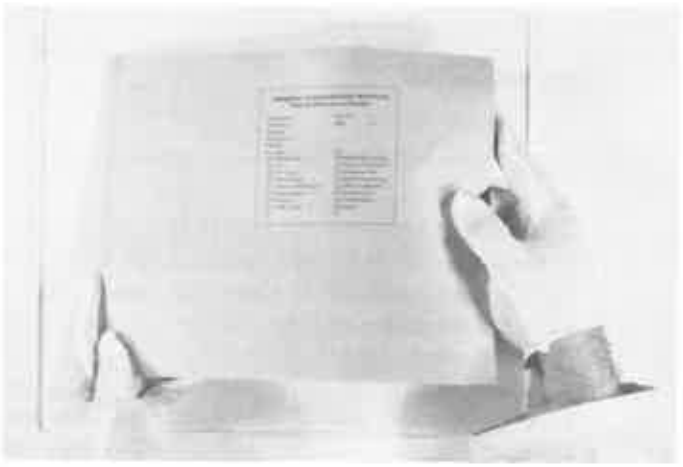

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Figure 6: *Two hands are required when picking up large or brittle items.*

Figure 7: *The auxiliary support is a rigid glass plate. It will minimize damage to the artifact during handling.*

Figure 8: *An envelope which sags when picked up should be put down on an auxiliary support. (Try to minimize the movement of the pieces inside the envelope.)*

Figure 9: *The envelope should be pulled away from the artifact (which is held down on the auxiliary support).*

Figure 10: *The use of both hands to hold a glass plate will minimize the possibility of dropping the plate.*

Figure 11: *A plastic support, lighter than glass and unbreakable, can be held by one hand.*

3.3 Using the Auxiliary Support

The auxiliary support provides a rigid surface to work upon: its main purpose is to minimize damage to the items during examination. A broken-glass plate can be placed on it and, after cutting open the enclosure (see Section 5.3), be examined without disturbing the broken pieces.

The auxiliary support allows an item to be turned over with a minimum risk of slippage during lifting. It also is used to transfer an item from one surface to another; for example, a new support.

In the case of a broken-glass plate (see Section 5.3), the broken piece is slid over the edge of the auxiliary support (see Figure 12), allowing a firm grip to be obtained. For a brittle print, the pieces can be slid across the auxiliary support onto a new stabilizing support (see Figure 13), without applying stress to the artifact.

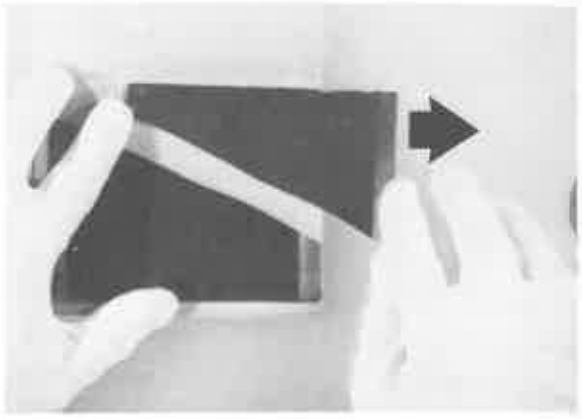

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Figure 12: *The glass fragment, emulsion-side up, can be slid over the edge of the auxiliary support to allow a firm grip.*

Figure 13: *This brittle print fragment would break if picked up. The auxiliary support allows the pieces to be slid onto a stabilizing support without handling.*

4. Cleaning

Cleaning is designed to remove surface dirt and greasy residues from artifact surfaces. The method given is a surface treatment using Kodak Film Cleaner. Neither immersion nor stain removal will be discussed.

The following general cleaning procedure is recommended:

- *Remove the artifact from its enclosure* and place it, emulsion side up, upon an auxiliary support.
- *Dust the emulsion surface with a soft brush*; lift the artifact and dust the auxiliary support; turn the artifact over and dust the non-emulsion side.
- *Repeat a second time.* The artifact should ***not be immersed.*** Never use benzene or ammonia, and water and alcohol should be used only for spot-tests.*

4.1 Paper Supports

4.1.1 *Cleaning the emulsion*

- After examining and lightly dusting the emulsion surface with a soft brush (shaving brush or oriental brush), place the print — emulsion-side up — on a clean auxiliary support. Weigh down the print, placing a clean card between the emulsion and weight (see Figure 14).
- Apply a cotton ball or swab to the emulsion surface, after dipping it lightly into Kodak Film Cleaner* or trichloroethylene*, touching it to the container's rim. These chemicals require a well-ventilated area; the solvent container should be capped between applications.
- The swab should be moved in a light, circular pattern. Rotate the swab between the finger tips during this motion. Discard the swab once it becomes dirty (see Figure 15).
- Replace swabs regularly during cleaning, store discarded swabs in a resealable container (see Figure 16), which should be emptied regularly into a solvent disposal can. ***Do not allow*** an excessive number of these swabs to accumulate in the work area.
- Continue to apply solvent swabs until the cleaning solution no longer streaks on the emulsion and the swab no longer picks up dirt and grease.

Note: *Do not apply this technique to albumen emulsions. The craquelure texture (cracked pattern) of the emulsion may trap material and may lead to fixing impurities or dirt in the cracks. Restrict their cleaning to a thorough dusting with a soft brush.*

*Before applying a solution or liquid to an artifact, conduct a spot-test (see Appendix: Spot-Testing Artifacts).

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Figure 14: *The artifact is weighted to prevent movement during cleaning.*

Figure 15: *Film cleaner is used to clean the emulsion side of the print.*

Figure 16: *The dirty swab is placed into a glass bottle, which is then sealed.*

4.1.2 *Cleaning the paper support*

1. After cleaning the emulsion, place the item emulsion-side down onto another clean auxiliary support. Secure it with a padded weight to minimize movement.
2. Apply eraser powder to the back of the print: move it about with a gentle circular motion of the fingertips. Work from the center outwards (see Figure 17).
3. Tears or raised edges must be carefully worked around in such a fashion so as not to catch the edge, causing further damage.
4. Prevent movement of the print during cleaning and minimize the amount of powder which crawls under the print to the emulsion.
5. Dust* the powder off, and examine the paper surface (see Figure 18). Re-apply fresh powder and continue these applications until the powder no longer discolours.
6. Dust well; if necessary, use a soft eraser on any remaining stubborn scuff marks (see Figure 19). Do not rub with excessive force nor raise the paper fibre.
7. Dust the print, including the emulsion, thoroughly with a soft brush to remove any eraser powder residues.
8. Do not apply film cleaner to the paper support.

Note: *This method of cleaning the paper support can also be used to clean paper mounts to which artifacts are adhered.*

4.2 Glass and Plastic Supports

4.2.1 *Cleaning the emulsion and support*

- After examining and dusting* both sides of the artifact with a soft brush, place it emulsion-side up on an auxiliary support (see Figure 20).
- Then apply solvent** swabs to the emulsion surface, as was outlined in the cleaning of print emulsions (see Figure 15).
- Dust the auxiliary support; turn the item over; apply solvent swabs to the non-emulsion side.
- Any material still adhering to the non-emulsion glass side after swabbing should be carefully removed by scraping with a scapel.

Note: *Do not use a scalpel on plastic materials or the emulsions.*

*Use separate brushes when dusting an artifact and dusting off eraser powder.

**Before applying a solution or liquid to an artifact, conduct a spot-test (see Appendix: Spot-testing Artifacts).

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Figure 17: *The eraser powder removes dirt and loosely adhered material.*

Figure 18: *It is important to brush off all of the fine dust remaining after the use of the eraser powder.*

Figure 19: *Stubborn scuff marks can often be removed with a soft art eraser.*

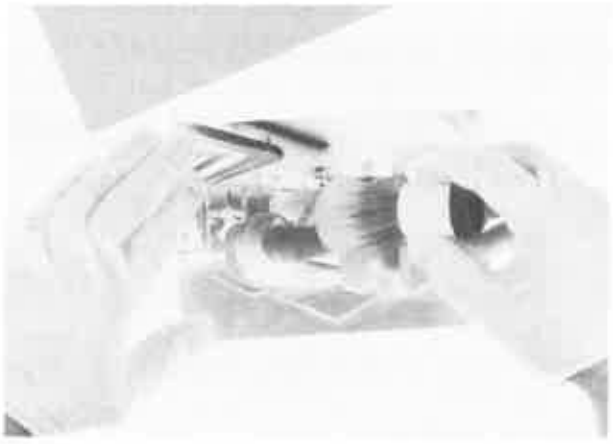

Figure 20: *All artifacts, except the daguerreotype image, are dusted prior to cleaning.*

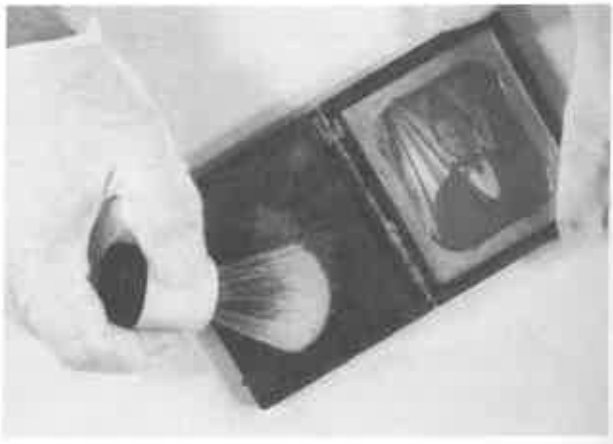

Figure 21: *A daguerreotype encased with a protective coverglass over the image can be dusted.*

4.3 Metal Supports

— Dust both surfaces lightly with a soft brush, holding the artifact by the edges (see Figure 21).
— Photographs contained in cases should not be disassembled for cleaning. See Section 5.13 for detailed instructions.

4.4 Fungus Removal

Remove fungus and mold growth on gelatin emulsions with a film cleaning solution. The area may be etched or pitted: this cannot be altered. Do not allow water to contact gelatin emulsions which have been subjected to fungal degradation, since the emulsion may have become water soluble (see Figures 22 and 23).

Infected areas may be better detected during examination by use of an ultra-violet light. The growths fluoresce as bright blue-white areas.

Do not look at the light source.

4.5 Brush Maintenance

The cleaning process uses two separate brushes, one to remove dirt and the other eraser powder residues. Both of these brushes will require regular cleaning to remove materials accumulated in the brush.

1. Mix 5 to 10 mls. of a mild detergent (Fisher FD-70) in a 1000 mls. of water.
2. Dip the brush into the solution and allow it to drain.
3. Rub the bristles in a gentle, circular motion in the palm of the hand (see Figure 24).
4. Repeat until the lather no longer discolours.
5. Rinse until the rinse water is clean.
6. Air dry the brush with the bristles hanging down.

4.6 Duplication

Duplicates of negatives to produce copies should be made at this point. Large institutions and the holders of large collections should consider this step after cleaning and prior to stabilization. The stabilization procedures isolate the artifact and the image can no longer be observed directly.

This topic is outside the scope of this bulletin, and detailed instructions will be presented in future bulletins.

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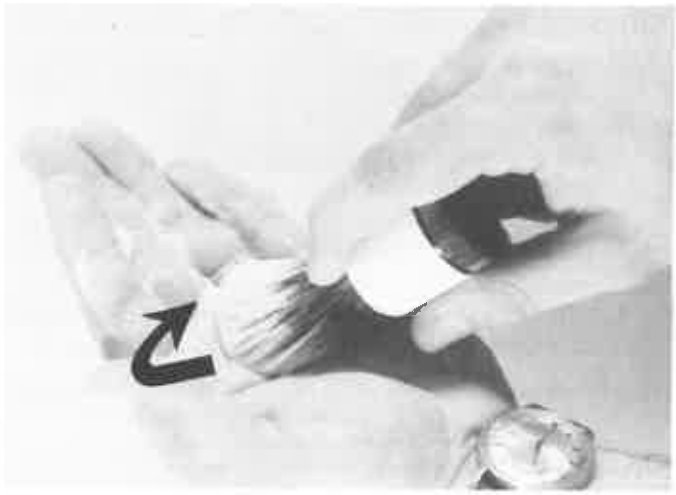

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Figures 22 & 23: *Fungal growth on a plastic support can take place on both sides of the support because there are two gelatin layers, one on each side. These growths are characteristically white by reflected light and black by transmitted light.*

Figure 24: *The dusting brushes must be cleaned at regular intervals.*

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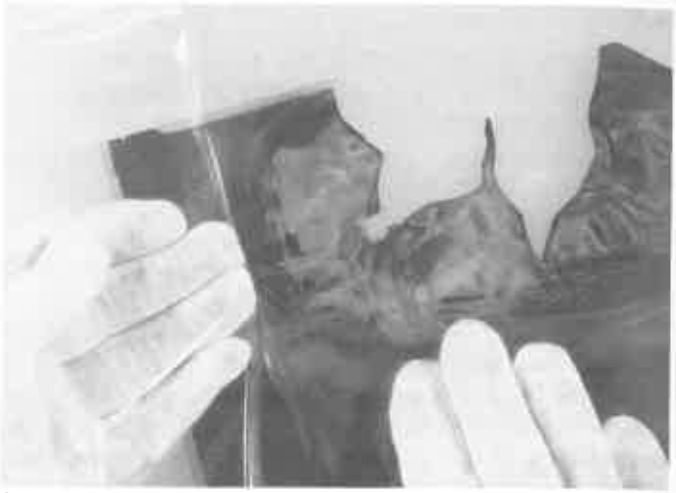

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Figures 25 & 26: *A water soluble nitrate, when spot-tested, will transfer the coloured decomposition materials and the image silver to the blotter. The area of the test will be transparent and colourless.*

Figure 27: *This nitrate negative, in an advance state of degradation, has adhered to the plastic enclosure it was placed into.*

5. Specific Stabilization Procedures

As a result of examining, sorting and cleaning operations, artifacts will have been grouped into well-defined categories (see Section 3.1). Each of these categories requires specific stabilization procedures to prevent further damage. Following are such procedures.

5.1 Nitrate Materials (Plastic Supports)

1. Identify* and isolate them from the collection.
2. Apply a water spot-test to the emulsion. Yellow-brown, discoloured image-layers may have become water soluble (see Figures 25 and 26).
3. Water-soluble emulsions are unstable. Immediately clean and duplicate photographically. Sticky nitrates must be duplicated immediately, if possible, and destroyed;** stable nitrates can be duplicated later.
4. After cleaning, place artifacts into buffered paper envelopes. ***Do not use plastic sleeves*** (see Figure 27).
5. Store in an isolated area separate from other photographic materials. Refrigeration is recommended (preparation for storage is discussed in Section 6.3.
6. Nitrate materials stored at room temperature must not be placed in sealed containers, as the gases produced from decomposition must be allowed to escape. Therefore, the storage area must be well-ventilated, preferably to the outside of the building.

Note: *Nitrate deterioration is described in Table II, page 24.*

5.2 Acetate Materials (Plastic Supports)

1. Identify* and isolate from the collection.
2. Clean and duplicate photographically.
3. After cleaning, place into buffered paper enclosures.
4. Store all of the acetate material in the same storage area. It is not imperative to isolate them from the collection; however, if space is available, store these artifacts in a separate area.
5. Refrigeration is recommended and preparation for storage is the same as that given for nitrate material, (see Section 6.3).
6. Acetate material can be stored at room temperature.

Note: *Acetate deterioration is described in Table III, page 24.*

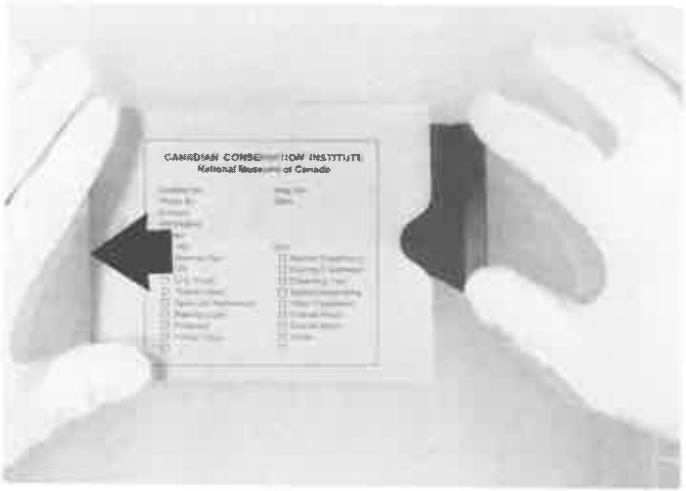
*Op. cit., Rempel, Siegfried.

**For disposal of nitrate materials, contact the Fire Marshall in your area.

5.3 Broken Glass Plates (Glass Supports)

These are identified by a lack of rigidity and homogeneity when handling the enclosure.

1. Lay the enclosure containing the plate onto an auxiliary support larger in size than the artifact, emulsion-side up (see Figure 28).
2. Cut the edges of the paper enclosure with a scalpel along two of the joined sides and lift the cut-paper away from the plate (see Figures 29 and 30).
3. Each piece of the broken plate should be removed, one-at-a-time, and cleaned on both sides, as described. The swabbing motion must begin in the centre and continue outward to the edges (see Figure 31). Care must be taken not to tear or abrade loose pieces of emulsion which may be hanging over the edge of the break. Place the clean pieces on a clean auxiliary support, emulsion-side up.
4. Don't assemble the pieces or allow them to contact each other, since contact may further damage the loose emulsion pieces.
5. Transfer the information from the old envelope to the new enclosures.



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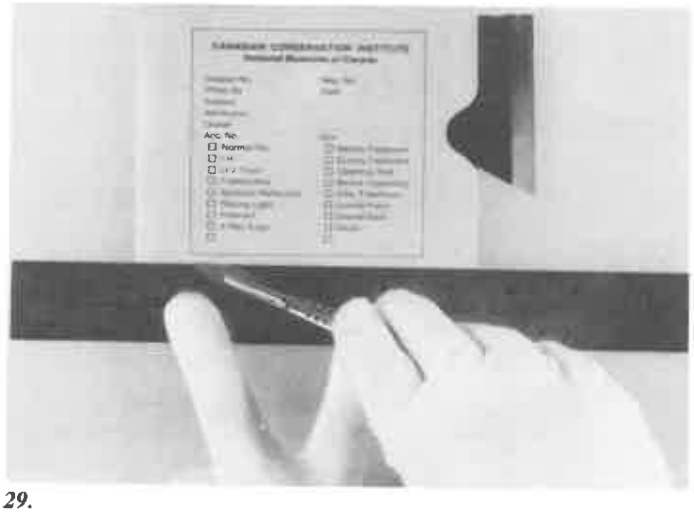

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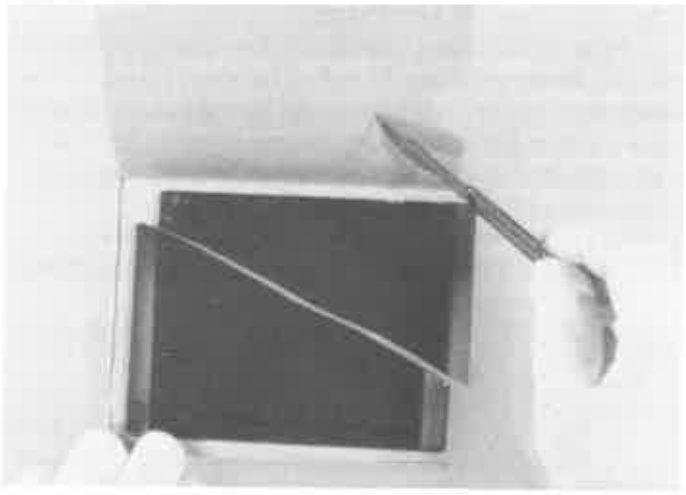

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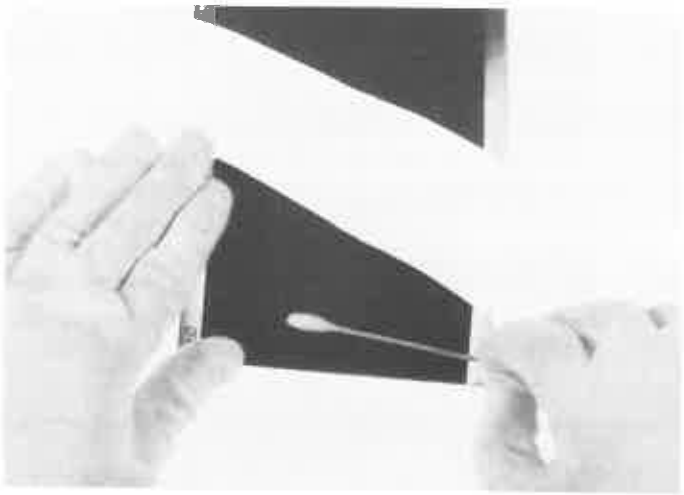

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Figure 28: *Partial removal of the envelope shows that the envelope contains a broken glass plate.*

Figure 29: *A sharp scapel and straight edge is used to carefully cut open the envelope.*

Figure 30: *By cutting two sides of the envelope, it can be opened to allow observation of the contents.*

Figure 31: *Care must be taken while cleaning the edges of the break. The cotton swab may catch and damage the small unsupported emulsion pieces.*

6. Once cleaned, wrap each piece in acid-free paper (see Figure 32), and transfer them to a labelled document envelope of an appropriate size (see Figure 33).
7. During storage, keep all glass splinters together, each group in its labelled envelope.

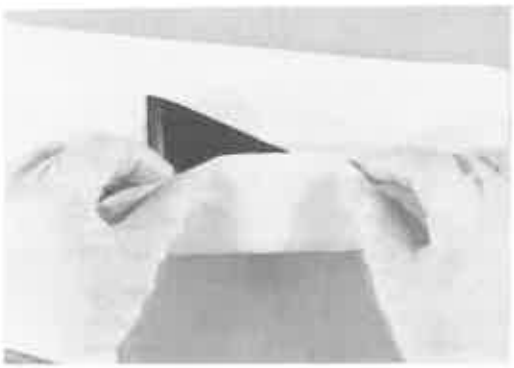


Figure 32: Wrap each broken piece separately.

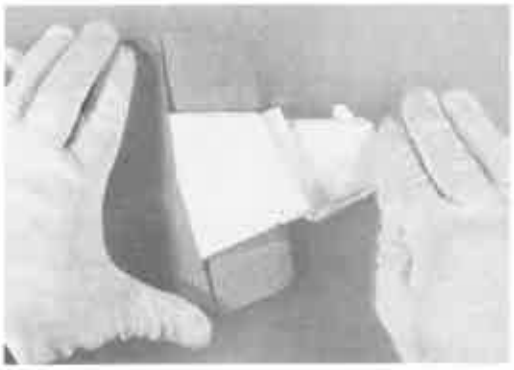


Figure 33: Place each wrapped piece into a document envelope.

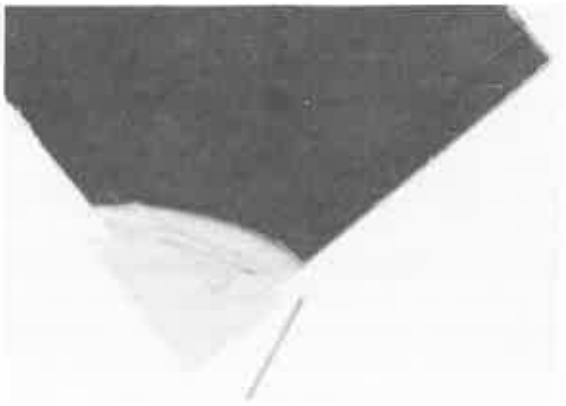
5.4 Cracked Glass Plates (Glass Supports)

With a cracked plate, a stabilizing support is required to prevent further cracking. The glass may be cracked, but the image-layer is still complete and the emulsion is holding the plate together. Stabilizing supports must be exactly the same size as the artifact: these are taped together with the artifact to provide additional rigidity.

1. Lay the enclosure containing the plate onto a flat, rigid auxiliary support larger in size than the artifact, emulsion-side down (see Figure 34).
2. Cut the paper-envelope edges, as instructed for broken plates (see Section 5.3).
3. Clean the glass side of the artifact.
4. Place a 3 mm. ($\frac{1}{8}$-in.) glass stabilizing support of the same size as the artifact on top of the plate: carefully turn both over by sliding them over the edge of the auxiliary support to attain a proper grip.
5. Clean the still-intact emulsion. Place a piece of 4-ply mattboard — cut to size — on top; tape the assembly together with Filmoplast tape along the edges (see Figure 35).
6. Label the new enclosure, as well as the artifact, and store it horizontally for future conservation.
7. If a loss exists, trace the outline of the loss on a 2-ply mattboard; cut out and insert, using a cotton batting plug, between the artifact and the mattboard (see Figures 36 and 37). The mattboard should be approximately the same thickness as the artifact.

Figure 34: The crack (adjacent to the pointer) will continue if the glass plate is stressed. It is imperative to stabilize the plate with a rigid assembly. The lower corner has already been lost and will require a plug.

Figure 35: Filmoplast tape is used to bind the stabilizing supports to the artifact.



36.

37.

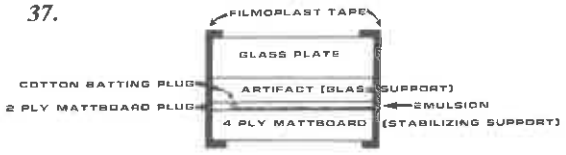
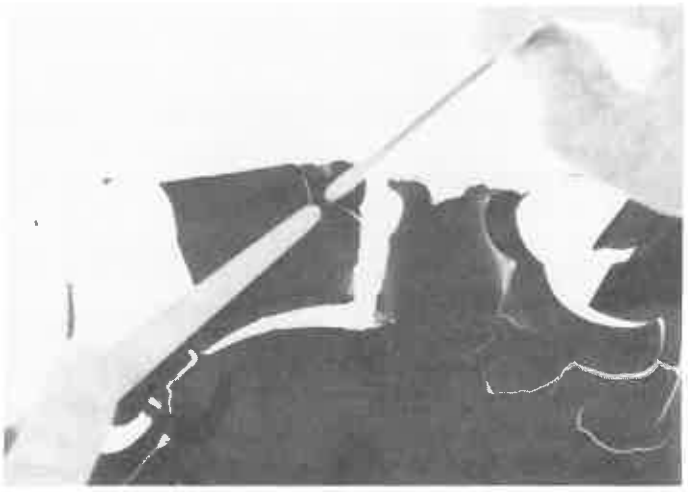


Figure 36: *A plug for the missing corner of the artifact is required to build up the loss.*

Figure 37: *This is a cross section of a stabilized glass plate. It is imperative that the glass plate be immobilized by using a rigid stabilizing support.*

5.5 Lifting Emulsions (Most Supports)

1. Clean the emulsion without increasing the degree of lifting and, if possible, flatten the emulsion down into its proper position (see Figure 38).
2. Place a 4-ply mattboard stabilizing support onto the emulsion, first laying down and then repositioning the raised emulsion. It may be necessary to advance the mattboard slowly, laying down the emulsion immediately in front of the board (see Figure 39).
3. Turn over and check the positions of the loose pieces; re-position them as necessary (see Figure 40).
4. Tape with Filmoplast.
5. Clean the glass side; place in a paper enclosure; label and store for future conservation (see Figure 41).



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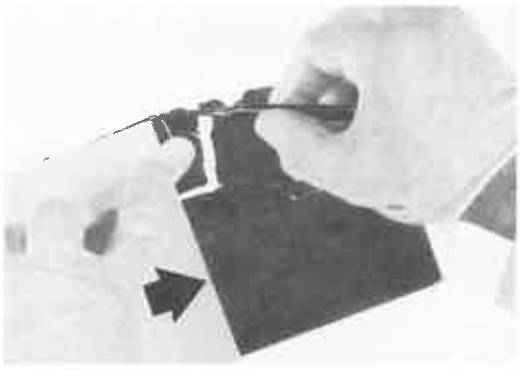


39.

40.

41.

Figure 38: *A bone folder is used to pin down the loose emulsion while it is cleaned.*

Figure 39: *A piece of lifting emulsion is placed back on the support before being covered by the mattboard.*

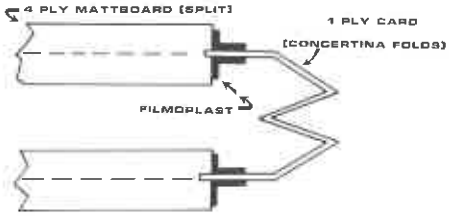
Figure 40: *In turning over the artifact, pieces of loose emulsion may have slid over the edge. These must be re-positioned.*

Figure 41: *This cross section shows the stabilized emulsion. In this condition, loose pieces will remain with the plate until treatment is undertaken.*

42.

43.

44.



45.

5.6 Flaking Emulsions (Most Supports)

Do not attempt to clean a flaking emulsion. The delicate pieces will be further damaged through handling. Isolate the emulsion by using the sandwiching procedure outlined in Section 5.10 on "Brittle Prints".

5.7 Fused Material (Most Supports)

1. ***Do not attempt to force separation of material fused to another surface.*** If forced to release, the emulsion is usually torn from its support, but is still adhered to the other item.
2. Lightly dust exposed surfaces.
3. Clean all other exposed surfaces without placing the fused joint into a position of stress.
4. Place in an enclosure, label and put aside for conservation.
5. Store horizontally; don't place anything on top which might apply pressure to the surfaces.

5.8 Lantern Slides (Glass Supports)

1. Clean the coverglass surface.
2. If a coverglass is broken or cracked, carefully cut the tape binding the assembly; remove and clean its various components.
3. Replace the coverglass (if broken, have a new one cut); retape the assembly, using Filmoplast tape.

5.9 Mounted Prints (Oversize) (Paper Supports)

1. Do not attempt to remove a print from its mount, even if lifting corners provide an opportunity to do so (see Figure 42).
2. Handle this type of artifact with both hands and place it on an auxiliary support. The mount may be brittle; if a corner is broken off because of mishandling, it may take a piece of the print with it (see Figures 43 and 44).
3. A mounted print with a strong bowing or curvature should be cleaned and placed between two pieces of buffered mattboard with concertina folds (see Figure 45); this allows it to be stored without being pressed flat. If pressed, it may break.

Figure 42: *Mechanical removal of a dry-mounted print by peeling back lifted corners could tear the print.*

Figures 43 & 44: *This front and back view shows a print mounted on poor quality board. The mount has become very brittle; one corner broke off after being picked up.*

Figure 45: *This cross section shows the construction of a concertina fold, which protects a curved, mounted print during storage.*

4. Place the print emulsion-side down on a clean sheet of paper over a flat rigid surface; then place several padded weights on it.
5. Clean the back of the mount with eraser powder, as described earlier. Don't allow eraser powder to get onto the emulsion.
6. Dust well and turn over. Remember to use an auxiliary support for brittle materials. Apply eraser rubbings to mount areas on the front; again, do not allow eraser powder to contact the emulsion.
7. Clean the print emulsion with film cleaner and store in an appropriately sized, buffered enclosure. It may be necessary to prepare a custom hand-cut enclosure: instructions for this appear in Section 6.2.
8. Transfer all of the information to the new enclosure and store for conservation.
9. Store flat in a horizontal drawer or solender box. Don't allow these items to pile up, one on top of another, if they are either brittle or curved.

5.10 Brittle Prints (Unmounted) (Paper Supports)

1. Brittle prints often result from storage of a nitrate negative in the same enclosure with a print. Such a print will be very fragile (see Figure 46), necessitating that the envelope be cut away with a scalpel. Take care not to cut the print (see Figure 29).
2. Measure the print and cut two stabilizing supports of buffered 4-ply mattboard, slightly larger in size.
3. Slide the various print pieces, emulsion-side up, across the auxiliary support onto the mattboard.
4. Sandwich the print by laying it on the second board and tape one long edge with Filmoplast tape (see Figure 47 and 48).
5. Check the position of the pieces by opening the hinged mattboard (see Figure 49). Finish taping the unit.
6. Label and store for conservation.

Note: *It is not necessary to isolate the pieces, as for broken glass plates, because they do not slide, once the sandwich is taped closed.*

46.

Figure 46: *This brittle, unmounted print, broken into a number of pieces, has a fracture (adjacent to the pointer) and has completely lost one area.*

47.

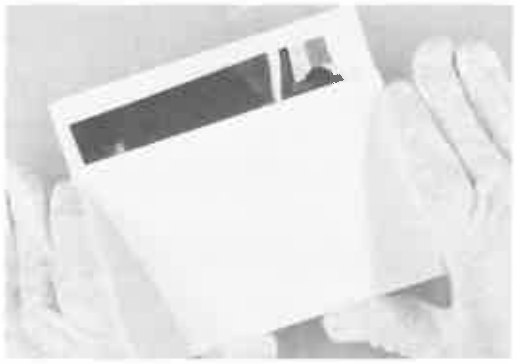


Figure 47: *The print is isolated between two pieces of buffered mattboard and taped closed.*

Figure 48: *Close the sandwich with Filmoplast tape.*

Figure 49: *It is necessary to check, before sealing, that pieces are not contacting each other.*

48.

49.

5.11 Curled prints (Paper Supports)

These are often panorama prints, usually large group photos with unusual dimensions; for example, 8 x 16 inches. This unusual format often meant that they were rolled for storage.

Curled prints are the result of extended storage, rolled, and in a dry environment.

5.11.1 *Strongly-Curled Prints*

1. If rigid, do not try to force the print to uncurl; the emulsion and print may crack or tear (see Figure 50).
2. Place the print over a mailing tube which has been wrapped with acid-free paper (see Figure 51) and has a diameter about the same as the rolled print. The tube should extend at least one inch beyond the edges of the print (see Figure 52).
3. Roll the print onto the tube. After the first revolution, add a sheet of acid-free interleafing tissue (see Figure 53).
4. Wrap the outside of the print with acid-free tissue and secure it with several wide strips of 6 mm. (1/4 in.) unbleached cotton tape to secure the print (see Figure 54).
5. Tuck excess tissue paper into the tube end.
6. Store.

5.11.2 *Mildly-Curled Prints*

1. These prints can be unrolled without cracking or breaking the print emulsion (see Figure 55).
2. Place onto a clean sheet of blotting paper, emulsion-side down and weigh down with padded weights (see Figure 56).
3. Place a fresh sheet of blotting paper over it and slowly remove one weight at a time, re-weighting the blotter.
4. Place a sheet of glass, larger in size than the print, on the blotting paper.
5. Leave for several days, checking at intervals, to see if the curl has been reduced.
6. Clean and place in an appropriately sized enclosure.

5.12 Albums (Paper Supports)

Albums generally contain prints, but may include photographs with other base supports. An album should be maintained as a unit.

1. Clean bindings by dusting with a cotton cloth.
2. Dust any accessible print surfaces, but do not remove photographs from their pages. Interleaf each page with acid-free tissue, cut to size.
3. Loose items stored between pages should be cleaned and placed into labeled enclosures. These should be stored with the album, with a notation of the page on which they were found.
4. Prints that are becoming loose should be removed from the album and handled separately, especially if damage may result either to them or the album from their inclusion.
5. The size of some albums — particularly very thick ones — may necessitate wrapping them in several sheets of acid-free tissue, then binding them with unbleached cotton tape (see Figure 57).
6. Attach a label to the cotton tape and store horizontally.

5.13 Case Photographs (Metal and Glass Supports)

If a photographic artifact has a metal support, it is either a daguerreotype or tintype. The daguerreotype and the ambrotype (a photograph on glass) are almost always found in an ornamental case.

Photos, Opposite Page

Figure 50: *This tube is too small in diameter. A print, rolled onto a tube smaller than it in diameter, will crack.*

Figure 51: *Acid-free mailing tubes are available only in one-or two-diameters. However, by first wrapping a tube in acid-free paper, any size and type of tube can be used.*

Figure 52: *Ensure that a tube extends beyond the print's edges.*

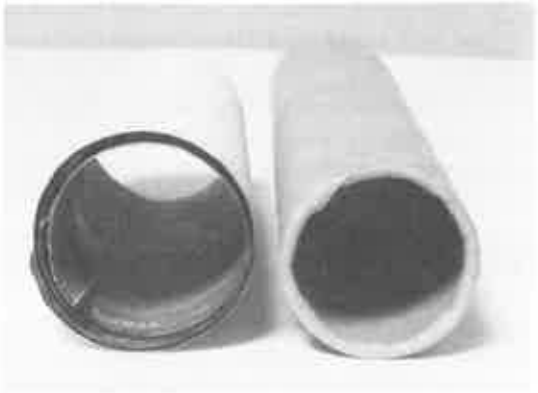
Figure 53: *Acid-free tissue will prevent contact between the emulsion and the back of the contaminated print.*

Figure 54: *The cotton tapes should hold the assembly without applying pressure.*

Figure 55: *This print can be flattened without cracking the emulsion or tearing the print.*

Figure 56: *The weights will minimize the movement of the print while a glass sheet is positioned over it.*

Figure 57: *This album was wrapped in acid-free tissue, then tied with cotton tape.*



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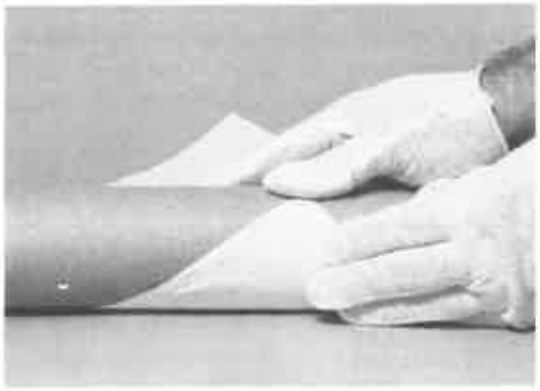

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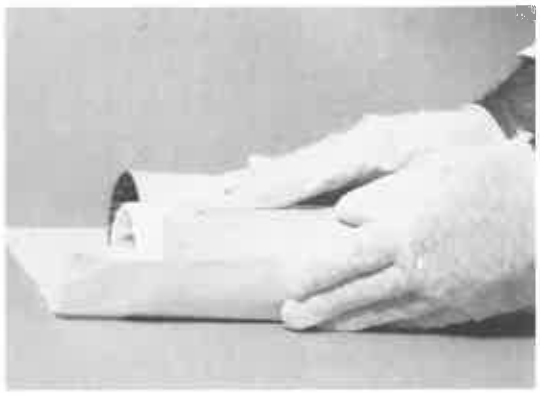

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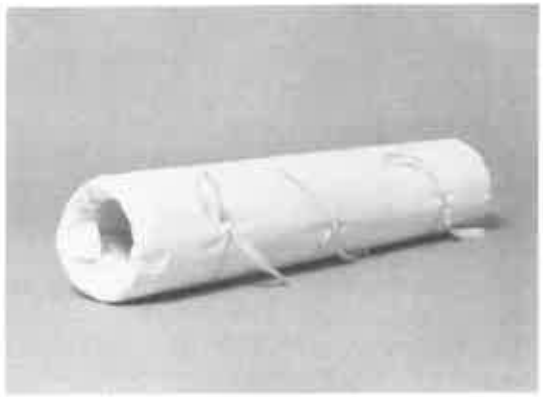

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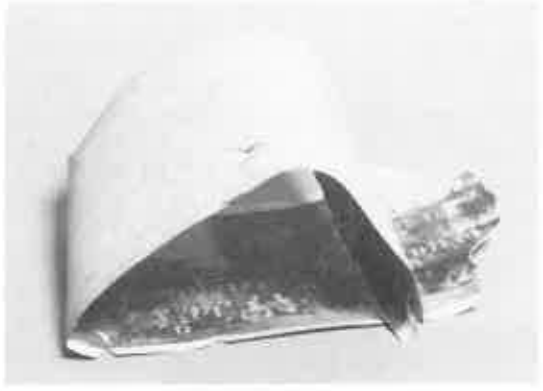

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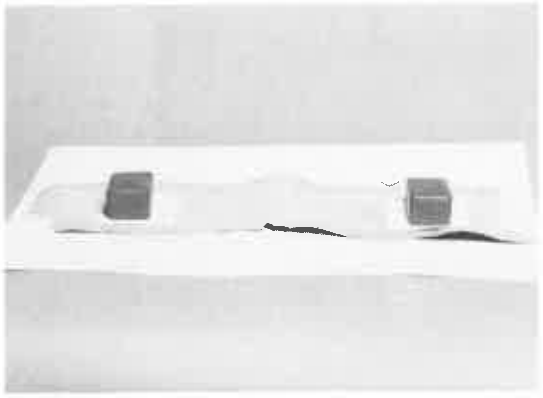

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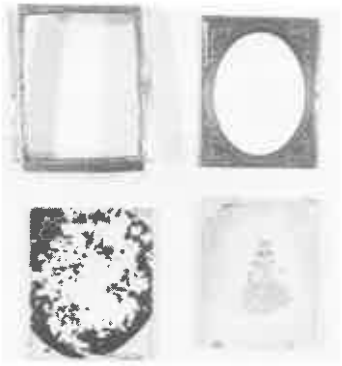
57.

5.13.1 *Removal of the Artifact from the Case*

1. Open a case by releasing the side clasps on the case, but be careful — the case may be in two parts, due to a torn hinge (see Figure 58).
2. Slide a flat spatula-end into the space between the case and metal frame holding the artifact; gently pry up (see Figure 59). Don't apply excessive pressure or the case walls will collapse.
3. Once raised sufficiently to allow handling, remove the matt assemblage. This unit consists of four items: the photograph, matt, coverglass and outer metal border matt (see Figure 60).
4. Do not disassemble the unit unless the cover glass is broken, cracked or missing.
5. To remove the outer metal border matt, gently flex the lips which extend onto the back of the unit (see Figure 61). If flexed too far or too often, the corners will break. Do not take this assembly apart unless it is absolutely necessary.
6. The remaining parts of the assembly are usually bound with paper tape. Carefully slit this tape with a scalpel.
7. The coverglass is now free, as is the matt and the photograph.
8. The coverglass is cleaned or replaced. (Use the cleaning solution in Section 4.5). If the matt is missing, it is replaced with one 2-ply mattboard, similarly cut. The outline of the original matt is probably apparent on the image.
9. Clean the various photographic items. (See subsequent sections for details.)
10. Reassemble the unit and close by binding it with Filmoplast tape. Replace the outer metal border and carefully insert it back into the case (see Figure 62).
11. Place the two halves of a broken case together without locking the clasps. Wrap in acid-free tissue and tie up with 6 mm. (¼-in.) unbleached cotton tape (see Figure 63).
12. Store horizontally.

58.

59.



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Photos, Opposite Page

Figure 58: *This case photograph (containing an ambrotype) is held together by only a small portion of the hinge.*

Figure 59: *The flat spatula-end should be inserted along the long dimension to minimize the amount of pressure applied to pry out the assemblage.*

Figure 60: *This is an unusual configuration. The black lacquer was usually applied to the back of the image plate. Here it has been placed on the coverglass and the assembly reversed.*

Figure 61: *Carefully flex the matt lips to prevent breakage at the corners.*

Figure 62: *Reinsert the assembly by gently pushing it into place.*

Figure 63: *Wrap and tie up the case to prevent tearing the hinge.*

64.

65.

66.

Figure 64: *A matt for this daguerreotype allows a coverglass to be used to protect its image.*

Figure 65: *Bends in a tintype are a common occurrence.*

Figure 66: *The backing has almost completely fallen off of this ambrotype. Without a backing, the image becomes a negative.*

5.13.2 *The Daguerreotype*

1. Do not attempt to clean a daguerreotype, as its image is sensitive to mechanical abrasion.
2. If the plate is loose (not cased), cut 2-ply mattboard into a window matt, 6 mm. (¼-in.) wide borders, and place over the plate (see Figure 64).
3. Cut a piece of glass to size; place it over the assembly and tape it all together with Filmoplast.
4. Label, wrap and store horizontally.

5.13.3 *The Tintype*

1. A tintype may show bends and folds in the metal (see Figure 65).
2. It may also have a lifting emulsion, with a rusted plate underneath.
3. Both of these situations require the tintype to be sandwiched between two pieces of mattboard (see Section 5.10).
4. For loose tintype plates, a matt and coverglass can be cut and taped together as for the loose daguerreotype.

5.13.4 *The Ambrotype*

1. The ambrotype is a collodion glass plate negative; but in this particular application, the artifact was often given a black-lacquer coating on the non-emulsion side, rendering it a positive image. This black lacquer may be flaking off (see Figure 66).
2. After removal from the case, lightly brush both sides of the assemblage.
3. Before disassembling the unit, lightly rub the flaking surface with a dry cotton swab to dislodge any of the loose lacquer. Dust the unit again.
4. Disassemble the unit and clean the plate and coverglass.
5. Reassemble the unit. Prior to replacing it into the cleaned case, place a sheet of black 2-ply mattboard, cut to size, into the case.
6. Insert the reassembled unit.

5.14 Photographic Art Prints (Paper Supports)

These prints are photographic processes having an image quality which may be confused with graphic prints. They can include any of the following: carbon, carbro, oil, bromoil, oil transfer or gum bichromate.

1. ***Do not attempt to clean these photographs.***
2. If identification has been indeterminate, request the services of a qualified conservator.
3. Figures 67(a) and (b) are examples of this type of photographic image.

(a)

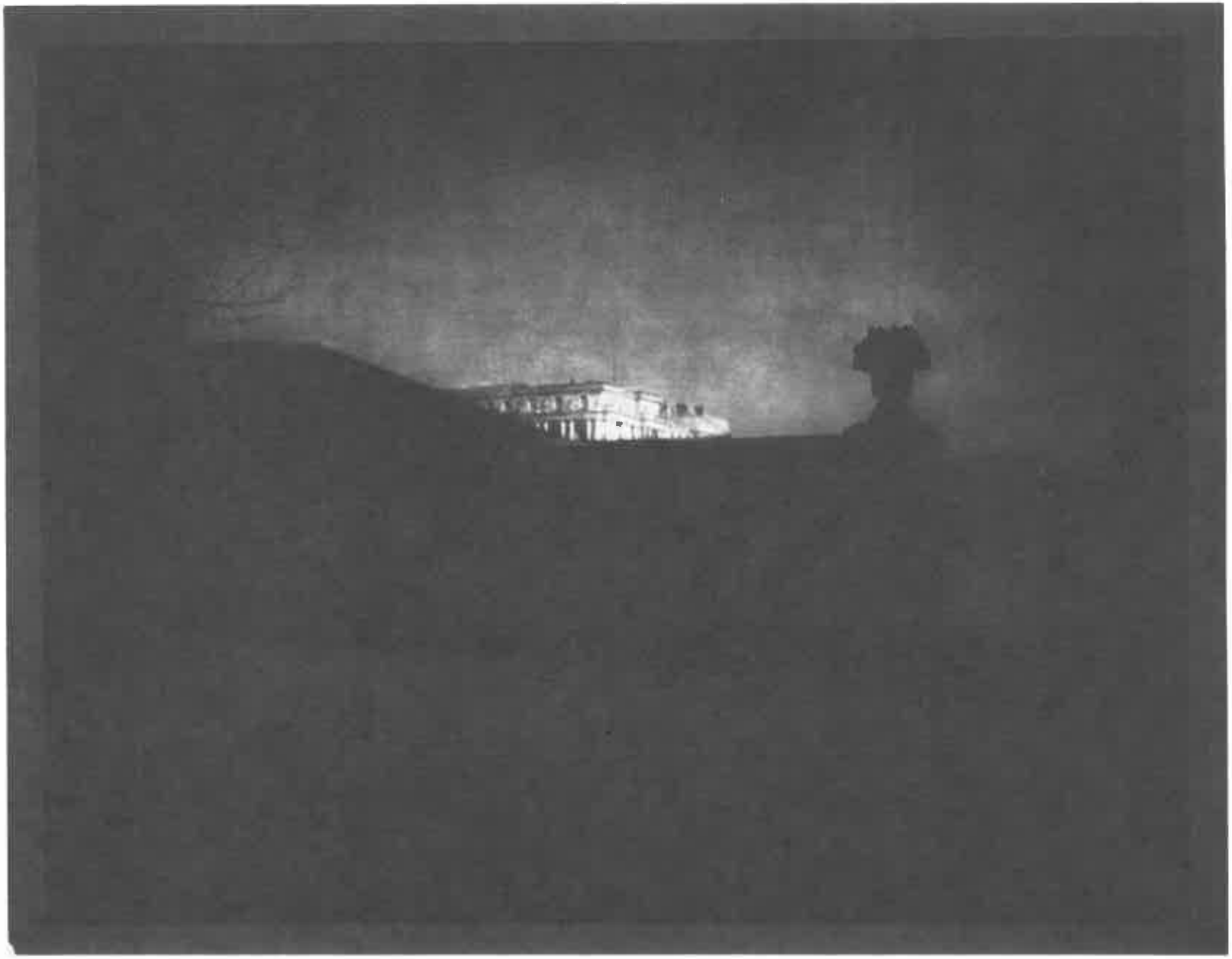

Figure 67: *These photographic prints have an image character which could be mistaken for fine art prints (such as etchings or lithographs).*

Right:
Black-and-white photograph by Edward Steichen, "Nocturne — Orangerie Staircase, Versailles. Courtesy of the National Gallery of Canada, Ottawa.

Below:
Oil print photograph by Siegfried Rempel.

(b)

6. Preparation for Storage

6.1 Storage Enclosures

The commercially-available storage enclosures include envelopes and sleeves for individual items, boxes and filing containers for bulk storage. Envelopes and sleeves are composed of paper or plastic; envelopes are available in quality-fibre finishes, both in buffered and unbuffered forms.

6.1.1 *Paper Enclosures*

Alkaline-buffered enclosures should be used for the following:

- Nitrate negatives
- Brittle prints
- Mounted prints
- Artifacts with collodion emulsions
- Photographic collections in industrialized areas

The use of alkaline-buffered papers in intimate contact with photographic artifacts is presently under examination. Buffered envelopes are suggested if acidic components are likely to be present.

One advantage of paper envelopes over transparent plastic sleeves is the porosity of the paper. This is particularly important for nitrate materials, from which the decomposition gases must be allowed to escape.

6.1.2 *Plastic Enclosures*

Transparent plastic sleeves have the advantage of allowing the artifact to be viewed directly without handling. Their disadvantage is that they may trap moisture and thus cause ferrotyping (see Figure 68). (Ferrotyping results when the smooth gelatin surface, after absorbing moisture, contacts another smooth surface — such as the transparent plastic sleeve.)

The selection of plastic enclosures available, with their characteristics, follows:

- Polyester — Used as a base for contemporary films and as a storage material. It has the disadvantage of generating static electricity (when handled) and attracting dust and fine particulate dirt. If the artifact is slid into and out of the sleeve, mechanical abrasion may result.
- Tri-acetate — A film base which is still in use. It tends to scratch, and abrasion of the sleeve may prevent adequate viewing of the contents. It is available as a sleeve open at both ends and, therefore, may allow an artifact to fall out. It does not prevent dust and dirt entering.
- Polyethylene — Available as a transparent sleeve or an opaque enclosure. The transparent sleeve becomes scratched and may eventually interfere with viewing the artifact, if extensively handled. The sleeve may also have a very snug fit, which may cause stress, buckling plastic supports. The opaque material is known by its trade name, "Tyvek". It is a random spun, heat-set polyethylene.

All of these plastic sleeves, except for Tyvek, are inappropriate for use with glass supports because they do not allow for the thickness of a glass support. Either paper or the Tyvek polyethylene enclosures are recommended for all photographic artifacts.

6.2 Storage Enclosure Construction

6.2.1 *The Seamless Enclosure*

The construction should be seamless, as illustrated in Figure 69. For unusual sizes, this enclosure can be constructed by hand from rolls of quality paper or from Tyvek. These seamless enclosures are commercially available in both paper and polyethylene Tyvek.

H. Bohem's enclosure* has been modified to a four flap construction to eliminate scratching the artifact during its insertion and withdrawal.

Artifacts should be placed onto the flat centre-flap in the following orientation: glass and plastic supports, emulsion-side down; paper and metal supports, emulsion-side up. Paper and metal artifacts oriented emulsion-side up should have a sheet of interleafing tissue, cut to size, placed over them prior to closing the enclosure.

The seamless enclosure can be used for any black-and-white photographic artifact. If the item is thick, this thickness can be accommodated by additional dimensions in the enclosure.

The enclosure layout is shown in Figures 70 and 71.

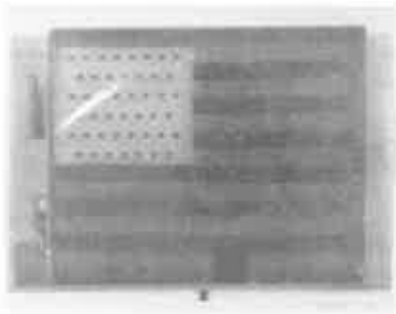

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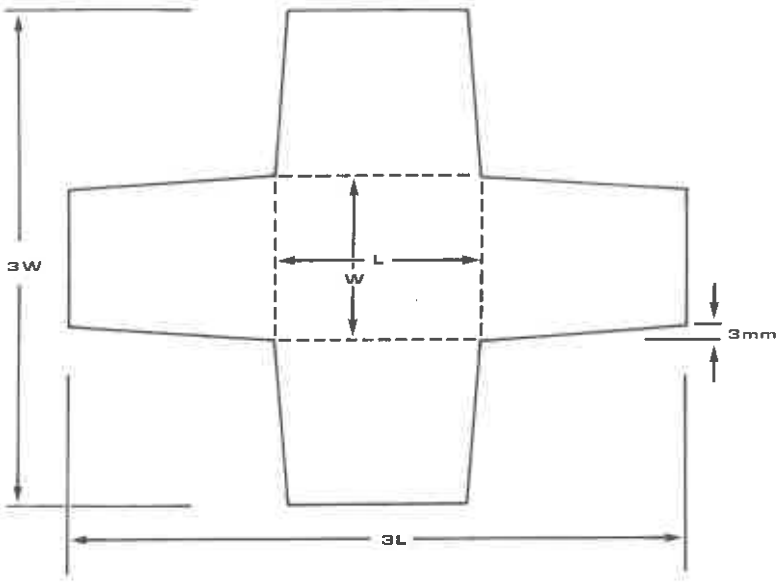
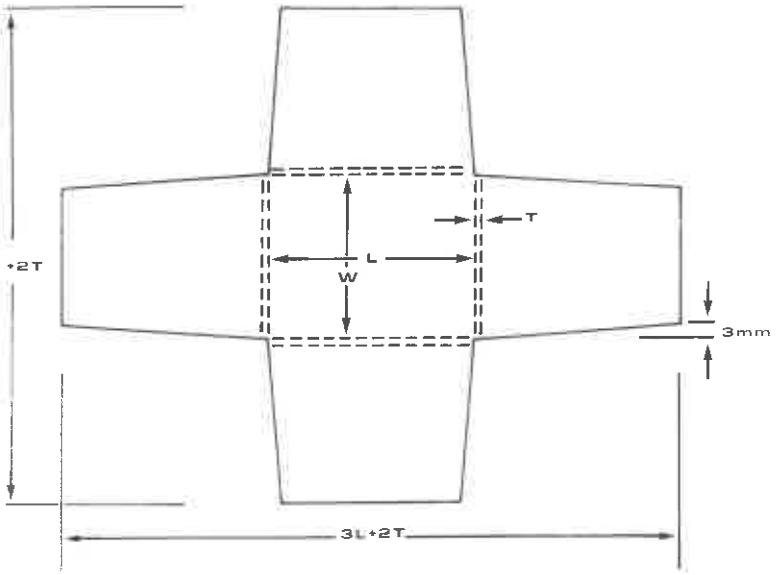
Figure 68: *Moisture trapped between smooth plastic and gelatin emulsion will result in them sticking together.*

Figure 69: *This enclosure allows the artifact to be viewed without direct handling.*

*This enclosure is described in Collection, Use and Care of Historical Photographs, Robert A. Weinstein and Larry Booth (see Bibliography).





71.

Figure 70: *This is the construction pattern for thin artifacts such as loose prints and sheet film.*

Figure 71: *This is the construction pattern for thicker artifacts, such as mounted prints. Their measurements are given as "L" for length, "W" for width and "T" for thickness.*

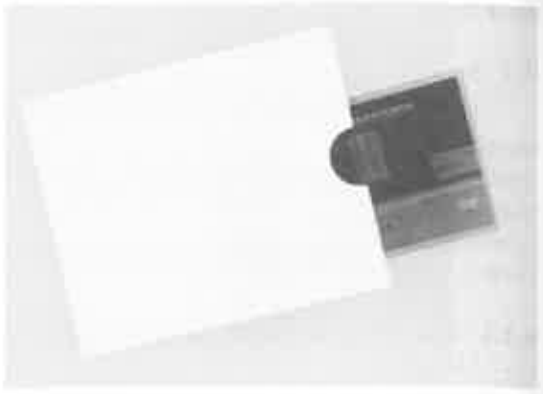
Figure 72: *This envelope requires the item to be slid in and out during handling and viewing.*

Figure 73: *This box opens flat, will hold a number of items and can be placed on open shelf storage.*

Figure 74: *By using a large number of small boxes to store materials, the risk of damaging the contents is reduced.*

Figure 75: *The nitrates, once interleafed, should be put into foil packages and sealed for cold storage.*

Figure 76: *Once sealed and boxed, material can be stored in a regular refrigerator.*



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6.2.2 *The Traditional Enclosure*

The traditional paper-envelope construction is not recommended (see Figure 72). The need for sliding artifacts in-and-out results in scratching or other damaging effects.

Should the traditional seamed envelope be used, the following points must be observed:

- The adhesive seams must lie along the edges of the envelope and extend into the envelope only as far as is absolutely necessary to provide an adhesive bond. The seam must also be on the outside of the envelope.
- The adhesive must not become acidic with time, nor should it be hygroscopic.
- The artifact must be oriented emulsion-side away from the seams.

6.2.3 *Storage Boxes*

Storage boxes and files should meet the following criteria:

- Boxes should be custom-made with a slight space left to be filled with acid-free paper (see Figure 73).
- Keep the same type of support and the format material together. For example, do not mix 4 x 5-inch glass plates with 5 x 7-inch plastic supports within the same storage box.
- Smaller boxes, which may contain a variable number of items, should then be placed in file boxes for open-shelf storage or into metal filing enclosures of baked enamel (see Figure 74).
- Boxes should be constructed of buffered paper stock.

6.3 Preparation of Nitrates for Storage (Excluding Motion Picture Film)

Nitrate materials must be isolated from the collection. Larger collections should be stored in isolated vaults. Smaller collections of nitrates can be stored conventionally — if the following conditions are maintained.

1. Identification and removal to an isolated storage area.*
2. Duplucation at the first possible opportunity.
3. Regular examination (at 3- to 12-month intervals) of the nitrates stored in room temperature conditions.
4. Cold storage (refrigerate after sealing in the appropriate enclosures).

6.3.1 *Storage at Normal Conditions*

Nitrate materials deteriorate continuously and their decomposition products are a threat to the security of any photographic collection. If refrigeration is not possible, keep at room temperature, under the following conditions:

- Store in a room whose atmosphere is exhausted directly to the *outside.*
- Remove deteriorated nitrates from the collection (see Table II).
- Do not seal artifacts into containers or enclosures which inhibit venting of the nitrate's decomposition products.
- Keep the temperature at the lowest normal value possible, with a corresponding relative humidity maintained at between 30% and 40%.

*The presence of nitrate materials on the premises may negate fire insurance policies.

6.3.2 *Cold Storage*

Sealing and storing in a standard domestic refrigerator (not frost-free refrigerator) is the best approach with nitrate collections. In this sealed condition, artifacts experience a dark, low temperature and low relative humidity environment that minimizes their rate of deterioration.

The steps for sealing stable nitrates in vapour-proof enclosures are as follows:

1. The nitrates (see Table II) should be interleafed with buffered paper, cut to the size of the artifact. The first and last layers of the assembly should be 2-ply buffered mattboard. About 30 to 40 nitrates can be placed into each enclosure (see Figure 75).
2. This assemblage is pre-conditioned at 20°C and 25-to-30% relative humidity for several hours, and while still in this environment, is sealed into vapour-proof enclosures. All the remaining air in the enclosure should be squeezed out, and the envelope heat sealed. Use an electric iron at the cotton setting — 125-to-150°C.
3. Store envelopes so that pressure is not applied to the sides of the enclosures.
4. Before an envelope is re-opened, a conditioning time of three-to-four hours will be necessary in order to condition it to room temperature conditions.
5. This is a passive storage system (see Figure 76). The nitrates should be copied prior to storage, to ensure that the originals do not need to be handled.
6. Monitor the enclosed nitrates at intervals for indications of deterioration (see Table II).

6.3.3 *Monitoring Nitrate Deterioration*

See Table II for detailed description.

6.4 Preparation of Acetates for Storage (Excluding Motion Picture Film)

Acetate materials are not as unstable as nitrate materials. The base of early diacetates deforms, due to a loss of volatile components. This results in a distortion of the image. Also, acetic acid is given off, but this is not as damaging to the image as the nitric acid given off by the nitrate materials (see Table III).

The schedule for treatment is similar to that for nitrates:

1. Identify and isolate.
2. Duplicate at the earliest opportunity.
3. Store in cold storage to minimize deterioration.

If normal conditions of storage are used, attempt to keep all of the acetate material in the same area and, if possible, store in an area separated from the collection. If cold storage is used, prepare the acetates as outlined for nitrates. Because the items are sealed into foil envelopes, the same refrigerator can be used for both acetates and nitrates. However, if it is possible, keep the nitrate and acetate materials separate.

TABLE II — THE DETERIORATION OF NITRATE MATERIALS

Condition	Description	Action Required
Stable Nitrates	— the base support is still colourless or at most only slightly yellow	— prepare a copy and store
	— the emulsion is not water soluble	— monitor every 12 months
Semi-stable Nitrates	— base support is yellow or yellow-brown in colour	— as above
	— the emulsion dissolves with a water spot-test	— monitor every 3 months
Unstable Nitrates	— the emulsion is water soluble and dissolves when tested in water	— prepare a copy, if possible, and dispose
	— a yellow-brown or orange-coloured base support	— once a nitrate reaches this stage, it cannot be kept.
	— the image is bleached or stained	
	— the base is very brittle and cracks when handled or the base is sticky and tacky	

TABLE III — THE DETERIORATION OF ACETATE MATERIALS

Condition	Description	Action Required
Stable Acetates	— These will be primarily tri-acetates	— sort and store in buffered paper enclosures
	— the dimensions of the base will be exactly the full dimension when manufactured; for example, 4" x 5"	— store in normal conditions
Unstable Acetates	— These will be di-acetates	— prepare a copy, if possible
	— the base will have shrunk and will no longer have the exact dimensions it had when manufactured; for example, 3 7/8" x 4 7/8"	— isolate in cold storage until conservation can be undertaken.
	— Extensive shrinkage will cause a buckling of the base and emulsion, and the emulsion may separate from the base.	

Appendix: Spot-Testing

Spot-tests are required whenever a solvent is to be applied to an artifact: it establishes whether there is compatibility between the artifact and the solvent. This procedure was introduced in Technical Bulletin #6* where it was discussed in detail, using distilled water and ethyl alcohol (ethanol). In this bulletin, two new solvents — Kodak Film Cleaner and Trichloroethylene — are introduced**. Their application will be exactly the same:

1. Prior to applying any liquid to an artifact, a spot-test is used to determine if a compatibility exists.
2. Identify the emulsion side, then apply one drop of solvent to a non-significant, non-image edge area. This application is best undertaken with an absorbent point of a micro swab dipped into the solvent and lightly touched to the edge of the bottle, leaving just one drop on the tip, before placing it onto the chosen point of the artifact.
3. The drop of solvent should be observed for a few minutes *or* until a physical change is noted. Once this observation is completed, the surplus solvent should be carefully blotted with an absorbent blotting paper. Press it down over the spot, but do not rub the surface with it.
4. After blotting, the area of the spot-test should again be observed. An oblique viewing angle may show a swelling, a relief between the wet and dry areas or an area of dissolution.

Again, the artifact will require tilting back and forth during examination to ensure proper observation. The blotter should be examined, as well, to check the solubility of the emulsion. The transfer of the image and emulsion to the blotter paper would be an indication of a soluble emulsion.

These tests depend upon the swelling action by the absorption of solvent or the solvent action by dissolution of the emulsion.

Sensitive emulsions — such as collodion — will require extreme care during testing, lest the image be destroyed. The dissolution of the image can be recognized by the formation of a solvent front in which the emulsion, when wet with solvent, appears to "swim"; the image loses its pictorial quality. However, it may be possible to observe a solvent front in which the image is not altered, and this indicates that the emulsion has been varnished.

Glass plates, particularly those with collodion emulsions, were normally varnished in the course of processing and finishing. The removal or smearing of this layer when using solvents may be damaging to an artifact; and in a positive spot test with the film cleaner, the formation of a de-varnished area means that it cannot be cleaned with that solvent.

*Op. cit.; Rempel, Siegfried.
**Both of these solvents require well-ventilated areas.

The cleaning solution is, in general, safe with black-and-white photographs. It should, however, be tested each time prior to use, as some artifacts may have been treated with materials not compatible with the cleaner.

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Supplies

1. Auxiliary and Stabilizing Supports

Glass sheets: various sizes, 3 mm. (⅛-in.) thick — hardware or glass store

Matt Board: cream, white and black; buffered and unbuffered, 2-and 4-ply — Conservation Resources, Light Impressions, Process Materials or University Products

Unprinted newsprint — art store

2. Chemicals

Film cleaner (Kodak) *not* movie film cleaner — photographic store, Kodak Canada

Trichloroethylene — pharmacy, Anachemia, B.D.H. or Fisher Scientific

3. Enclosure and Storage Materials

Blotting paper — Light Impressions, Process Materials
Cold storage enclosures — Conservation Resources, Kodak Canada
Cotton tape, unbleached — sewing store
Document envelopes — Conservation Resources, Hollinger Corp.
Filmoplast-P tape — Light Impressions, Filmolux International Inc.
Interleafing paper (acid-free) — Process Materials, Light Impressions
Mailing tube (acid-free) — Process Materials
Paper enclosures (buffered & unbuffered) — Conservation Resources, Light Impressions
Storage Boxes — Pohlig Bros., Conservation Resources, Process Materials
Tyvek Enclosures — Conservation Resources

4. Equipment

Dropper Bottles — Fisher Scientific, Canlab
Solvent disposal can — Fisher Scientific, Canlab
Ultra-violet lamp — Fisher Scientific, Canlab

5. Cleaning and Handling Materials (Including spot-testing materials)

Absorbant Points — L. D. Caulk Co.
Cotton batting — drug store
Cotton gloves (disposable) — photographic store, Kodak Canada
Dusting brush (oriental) — art store
Dusting brush (shaving) — department store
Eraser (soft vinyl) — art store
Eraser powder (Scum-X) — art store
Filter paper — grocery store (coffee filters)
Glass container (resealable) — hardware or grocery store
Q-Tips — grocery store
Razor blade (one sided) — sewing store
Scalpel and blades — Safety Supply Co.
Other suppliers are listed in *Museum and Archival Supplies Handbook*, The Ontario Museum Association, 1978, 126 pgs.

Suppliers' Addresses

Anachemia Chemicals
C.P. 147
Lachine, Québec
H8S 4A7 (514) 489-5711

B.D.H. Chemicals
350 Evans Avenue
Toronto, Ontario
M8Z 1K5 (416) 255-8521

Canlab (Canadian Laboratory Supplies)
2710 Lancaster Road
Ottawa, Ontario
K1B 4T7 (613) 523-7440

Conservation Resources International
1111 N Royal Street
Alexandria, VA 22314
(703) 549-6610

Filmolux International
U12-690 Progress Avenue
Scarborough, Ontario
M1H 3A6 (416) 439-9311

Fisher Scientific Co.
184 Railside Road
Don Mills, Ontario
M3A 1A9 (416) 445-2121

The Hollinger Corp.
Box 6185
Arlington, VA 22206
(703) 671-6600

Kodak Canada Ltd.
3500 Eglinton Avenue W
Toronto, Ontario
M6M 1V3 (416) 766-8233

L. D. Caulk Co.
172 John Street
Toronto, Ontario
M5T 1X5 (416) 598-3121

Light Impressions Corp.
Box 3012
Rochester, NY 14614
(716) 271-8960

Pohlig Bros. Inc.
Box 8069
Richmond, VA 23223
(804) 644-7824

Process Materials Corp.
301 Veterans Blvd.
Rutherford, NJ 07070
(201) 935-2900

Safety Supply Canada
214 King Street E
Toronto, Ontario
M5A 1J8 (416) 364-3234

University Products Inc.
Box 101, S Canal Street
Holyoke, MA 10141
(413) 532-9431