5540 #30

PAPER DOCUMENTS

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Introduction

Natural history collections may contain hundreds, if not millions, of documents that can overwhelm storage systems. There may be seemingly countless cubic feet of vertical file cabinets crammed with crumpled newspaper clippings, manuscripts, and photographs; endless linear feet of shelves stuffed with sagging and broken books; and boundless banks of flat file drawers overflowing with damaged drawings and prints. Improved storage techniques can help to preserve these collections. It also is important to develop a comprehensive policy regarding the preservation of existing documents and those that will be generated in the future. The development of such a policy requires a knowledge of the following topics that are outlined in this chapter and Appendices I–VI.

- Preservation planning for document collections, based on assessments of their relative value, use, and risk of loss.
- The component structure of different documents found in natural history collections.
- Deterioration of documents caused by inherent problems in document substrates, media, and formats; environmental problems; and handling and storage problems, such as inappropriate housing techniques, materials, and adhesives.
- Collections maintenance procedures including: establishing work spaces; sorting and stabilizing documents; and selecting appropriate enclosures and storage furniture, data recording, and reformatting options.
- Conservation treatment, research, and training.

Preservation Planning for Documents

Natural history collections are dependent on documents to validate and supplement their specimens. The range of documents can be extremely varied, including field notes, letters, legal records, and scientific drafts and illustrations (Fig. 1). The term "document" refers to any material of informational value, regardless of the document's substrate (*i.e.*, paper or plastic base), medium (*i.e.*, image carrier such as a binder with colorants or magnetic particles), or format (*i.e.*, sheet, bound, rolled, cylinder, or disk). Because each kind of document has specific usage and deterioration problems, the preservation of these materials should begin with an overall assessment, such as a preservation priority survey, that compares the relative value, use, and risk inherent in various document collections.

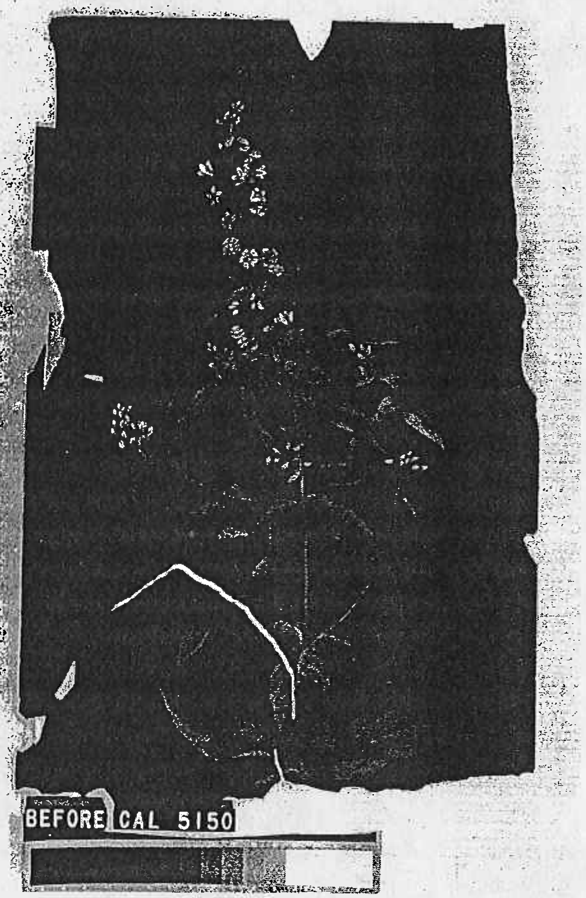

Figure 1. Botanical Illustration of *Lysiamachia* sp. (Loosestrife). Gouache on brittle, colored paper by Adelia Gates, Collection of Lewis Gates. Courtesy of Office of the Smithsonian Institution Archives.

VALUE

This chapter focuses on preservation of original documents on paper. Such original paper-based documents may have diverse media (*e.g.*, graphite, ink, watercolor) and formats (*e.g.*, spread sheets, rolled maps, or record books). These documents may have informational value as well as intrinsic, evidential, and associational value. For instance, a document of an exceptionally rare form, style, or substance could have high intrinsic value. A document that provides legal, historical, or scientific data would have evidential value if the original states of the substrate, media, and format have not been altered radically because of deterioration or modification. Associational value of a document or collection may derive from being created or collected by certain scientists, illustrators, or regional inhabitants.

"Original" documents have greater value than copies, although copies are extremely useful in providing access to collections. If a copy is all that remains, then the copy may function as an "archival original," meaning that along with other original documents, it must be protected by optimum handling and storage practices to prevent further loss of information.

There are many categories of original documents, including vintage originals, archival originals, and original masters. For example, a scientific illustration may be an original drawing (*i.e.*, a vintage original drawing). If it is copied for publication, a photographic process may produce an original negative and multiple contemporaneous photographic prints (*i.e.*, vintage original negative and photographs).

In natural history collections, it is common to find these vintage originals (*i.e.*, the original drawing, an original "master" negative, and one or more original "master" photographs) as well as other reprints or copies. Depending on circumstances, any of these documents, if they are the sole example surviving in the collection, also might be called an archival original. Archival originals should be duplicated to make a preservation master negative and a duplication or print-master negative. Each archival original and master is stored in the most appropriate optimum conditions. The duplication master negative is used to generate use or service copies for general access. Standardization of terms and procedures throughout an institution should be encouraged (Ogden, 1994).

USE

Documents may be integrated within natural history collections in museums and research institutions, or may be housed in ancillary repositories, such as natural history libraries, archives, and private collections. Each of these repositories may use documents in slightly different ways. As a result, preservation planning may vary depending on the nature and mission of the repository, as reflected in preservation literature (see Literature Cited and Suggested Reading). Regardless, documents generally are used for examination, verification, publication, circulation, or display. Frequent, indiscriminate, and careless use can place original documents at high risk for loss of informational, intrinsic, and evidential value.

RISK

Documents are at risk from deterioration, damage, and loss not only because of adverse use, but also because of inherent instability and poor environmental conditions, handling, and storage. Specific risk factors jeopardizing documents and collections are outlined in the following sections of this chapter. Risk assessment, prevention, and management should be incorporated into a comprehensive preservation program. Such a program can reduce the danger of deterioration and loss for all documents within natural history collections.

Any repository can develop a preventive care program for risk reduction functions consisting of preservation planning, reformatting, environmental control, collections maintenance, conservation treatment, research, and training. Appendix I summarizes each of the key responsibilities essential for a systematic approach to the preservation of documents. Preservation planning can start with a simple series of steps, many of which may be initiated quickly and all of which are cost-effective. Appendix II lists examples of preservation action steps that can be implemented immediately, with low cost, and high impact. In particular, preservation planning should be incorporated, from the beginning, into the procedures used to process, arrange, describe, and catalogue document collections.

ASSESSMENT

Preservation planning should include developing a budget for supplies, equipment, personnel, and training. Preservation priority surveys should be conducted to compare various collections and rank each on the basis of its value, use, and risk relative to other collections. Follow-up random sampling surveys of collections (targeted by preservation priority surveys) should be undertaken to estimate the size and number of different document formats, substrates, and media in a collection. Based on the findings, the appropriate enclosures, folders, containers, storage cabinets, data recording, and reformatting materials and procedures can be selected (Fig. 2).

Personnel can be trained to undertake key functions of preservation planning and assessment,

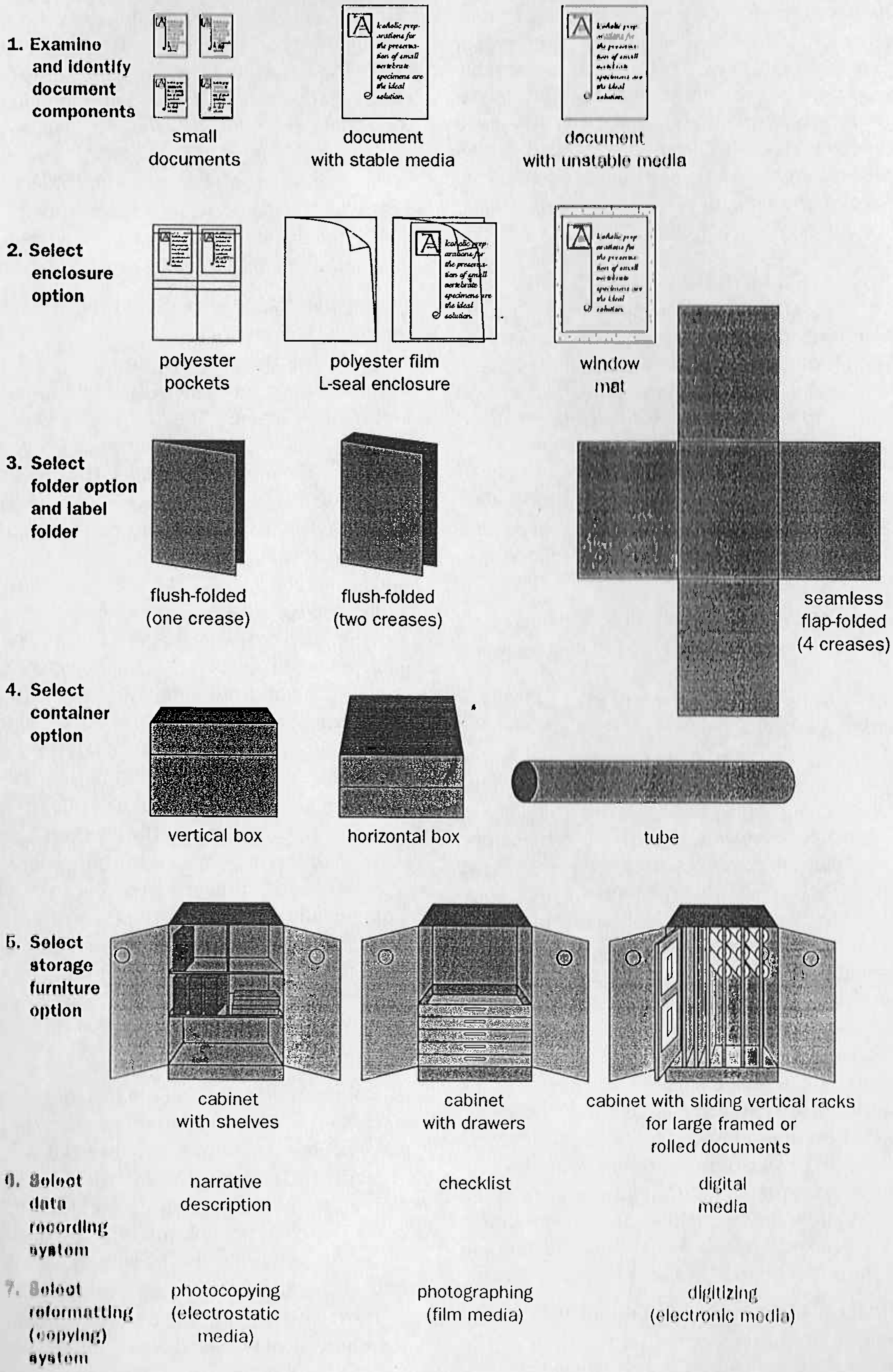

Figure 2. Steps with options for storing document collections.

environmental control and monitoring, and collections maintenance. One of the first steps, however, is to learn how to identify the component structures of documents. This process will enable an assessment of the relative stability of different documents based on inherent chemical and physical properties. These internal (or inherent) factors of deterioration are, in turn, affected by external (or environmental) factors of deterioration, and by handling and storage conditions.

Component Structures of Documents

Paper documents are composite materials. Some general categories of paper documents found in natural history collections include textual documents (*i.e.,* handwritten manuscripts and typed or commercially printed ephemera and bound volumes), or pictorial documents (*i.e.,* drawings, paintings, and prints of scientific illustrations). The following generic descriptions show how different kinds of documents may have similar characteristics that affect their preservation and storage.

OFFPRINTS, NEWSPAPER CLIPPINGS, PAMPHLETS

These documents, generally found in large quantities, are usually thought to be of informational value only and are not normally rare. However, they may have additional value if they are archival originals. They also may be at considerable risk to loss due to high use and unstable components. While such documents generally contain relatively stable media of oil, solvent-based, or thermosetting inks, the substrate on which they are printed may be vulnerable coated or acidic paper. These components, along with the various shapes and sizes of the documents, can make them especially susceptible to damage from inherent, environmental, or handling problems. Such documents should be stored individually or in small numbers in acid-free enclosures or folders within alkaline-buffered flat or vertical file boxes. These documents can be copied for use by researchers, using inexpensive, low resolution photocopy techniques. If the documents are archival originals, they should be protected from frequent handling and photocopied only once, on archival-quality paper, to provide a preservation master copy from which subsequent photocopies can be made.

FIELD NOTES, CORRESPONDENCE, MANUSCRIPTS

These documents are usually original and unique, which increases their intrinsic value. They also may have high evidential value, especially when they contain raw data. Such documents can be at risk because of unstable media, such as pencil or inks that may be friable, acidic, or fugitive. While these documents are frequently of similar sizes (*i.e.,* letter- or legal-size), they may be on thin loose-leaf papers and folded or joined together by fasteners or adhesives that make handling difficult. These documents should be stored in individual acid-free enclosures and folders in flat or vertical alkaline-buffered file boxes. If they are used heavily, then preservation microfilm copies should be made.

SCIENTIFIC ILLUSTRATIONS, SURVEY MAPS, PUBLICATION PROOFS

Many of these documents are original and unique, often with high intrinsic and aesthetic value. They may be at extreme risk to damage for several reasons. They are used heavily, including frequent demands for publication and display. They may have media such as pencil, ink, watercolor, or gouache that may smudge, crack, or fade. Sometimes the media and substrates are potentially incompatible, as in bookplate illustrations affixed with unstable adhesives. The substrates of the documents may be tracing papers or acidic boards that crease, tear, break, and discolor because of inherent instability (inherent vice) and heavy use (Fig. 1). They may range in size from small sketches of microscopic diatoms to full scale renderings of large bones. These original documents should be stored in pH neutral or alkaline-buffered folders or mats in flat, alkaline-buffered file boxes or flat drawer units made of appropriate materials (see von Endt *et al.,* this volume). Because detail and color in illustrations of flora and fauna can be important, documents in this category that have high value, use, and risk should be copied using the high resolution permanent processes available for large format color transparencies.

COPIES

Copies may be found on paper, film, video tape, or disc. These same formats are sometimes original documents themselves (see Calmes; Norris; Nugent; Nishimura, this volume). During collection assessments, the substrate, media, and format of original documents must be distinguished from copies, duplicates, facsimiles, or other reformatted versions.

Preservation planning and subsequent actions, therefore, must be based on a thorough understanding of the inherent nature of original documents in order to determine how they deteriorate and how they should be handled, housed, and stored.

Inherent Deterioration in Documents

Many paper documents are inherently self-destructive because their chemical and physical properties are reactive and unstable. The relative stability of these documents can be anticipated if the structure of their substrates, media, and formats is known.

SUBSTRATES

Papers made before the Industrial Revolution tend to be relatively stable because they were handmade using good formation processes (*i.e.*, manufacturing techniques) and furnish materials (*i.e.*, the ingredients from which paper is manufactured). These papers were formed by casting an even distribution of paper fibers, dispersed in water, on paper molds. Early western papers were typically made from fibers derived from cotton and linen rags that often were sized with gelatin or similar additives to increase strength and to prevent feathering (bleeding) of inks. These papers were strong because of the chemical and physical stability of their materials, enhanced by good interlocking and bonding properties of the fibers.

In the mid-1800s, the quantity of paper increased because of new production techniques, but the quality de-creased because of changes in formation processes and furnish materials. Paper became primarily machine-made on continuously moving belts that caused fibers to align parallel to the direction of the belt, creating a grain or "machine direction." A pronounced grain can decrease fiber interlocking and bonding, reducing tear resistance and dimensional stability of the sheet. Consequently, a pronounced grain can lead to cockling (rippling) or curling, as well as tearing of the paper parallel to the grain direction. In addition, new fiber pulping and beating processes also weakened fiber structure and bonding.

To meet increased demand for paper, manufacturers sought new sources for fibers, such as wood. Mechanically processed "ground" wood pulp was used first, and it is characterized by chopped clumps of short wood fibers, which make a beige to brown colored paper that becomes discolored, acidic, and brittle. Later, "chemical" wood pulp was developed. Chemically processed wood produced less acidic and longer fibers that had better interlocking properties than mechanical or ground wood pulp. Acid-producing ingredients such as lignin in ground wood pulp, alum rosin in sizing, and chlorine bleach in chemical wood pulp can cause papers to become discolored and brittle as they age (Hunter, 1978).

There are various tests to determine acidity, identify fibers and additives, and characterize strength and color (see Burgess, this volume; Van Houten, 1985; van der Reyden, 1992b). Generally, discolored and brittle papers, such as newsprint and illustration boards, have poor permanence and durability. These papers and boards must be supported and handled with extreme care to avoid tearing and splitting of the substrate, particularly along the grain direction or along folds and creases. In addition, acidic papers, including those used to produce poor quality envelopes and folders, can discolor adjacent documents.

MEDIA

Some media on paper documents are unstable. Pencil graphite is friable and can smear. Paints like gouache or tempera can crack and flake. Watercolors have fugitive colorants and dyes that can fade if exposed to light. This also is true for felt-tip or ball-point pen inks. Inks can feather or bleed, transfer or migrate and strike-through the backs of documents, or migrate into and stain adjacent documents. Acidic inks, such as iron gall ink (ink produced by a reaction between tannic acid and an iron salt), can disintegrate a document's substrate.

FORMATS

Different kinds and sizes of documents frequently are grouped into sets attached by fasteners such as paper clips, staples, rivets, rubber bands, tape, or adhesives. These fasteners can tear or stain documents. Bound volume formats include folios, leaflets, pamphlets, booklets, and books. This format generally consists of a text block in a binding of paper, cloth, leather, plastic, or other materials that are joined by adhesive or non-adhesive methods. Glued, sewn, or stapled bindings can tear, sag, and split, eventually leading to detachment and loss of covers. Full-, half-, or quarter-bound leather bindings can react with sulfur in the environment, producing red rot (a powdery disintegration of the leather) that can contaminate and weaken bindings.

Deterioration by Environmental Factors

Environmental factors can initiate severe deterioration and damage, especially in documents that are inherently unstable. Appendix III lists some examples as well as different levels of corrective actions. Problems are exacerbated by the environmental agents of deterioration: light, incorrect temperature, incorrect relative humidity, pollution, and pests.

LIGHT

Light (natural, incandescent, or fluorescent) causes oxidative reactions and chemical changes that may embrittle and darken some acidic papers (*e.g.*, ground wood newspaper clippings or alum rosin-sized notebook papers). It also may fade dyed papers (*e.g.*, blue colored manuscripts) and some media (*e.g.*, inks and watercolors). These changes can happen differentially when documents are covered partially by other materials, as when laid on desk tops or displayed on office walls. Documents with fugitive media, such as felt-tip pen manuscripts or watercolor illustrations, should be exposed only for short durations to low levels of light, filtered to block ultraviolet radiation. This precaution is especially important for documents that are displayed, such as scientific illustrations on acidic ground wood paper (which darkens) and with fugitive media (which fade). In such situations, light levels should be maintained at 3–15 footcandles for no more than three months. Exposure levels and lengths are reciprocal; light damage is cumulative and irreversible. Appendix IV summarizes light damage and control.

INCORRECT TEMPERATURE

An increase in temperature may be caused by heat from light exposure during examination, use, or display of documents, or by malfunctioning heating or cooling systems (see Weintraub and Wolf, this volume). High temperatures can result in decreased relative humidity that may desiccate substrates, media, and adhesives and cause curling, shrinkage, and cracking. Particular care must be taken for documents that are composed of two or more materials that respond to changes in temperature and relative humidity at different rates. Such changes can cause uneven strains, distortions, splits, and tears.

INCORRECT RELATIVE HUMIDITY

An increase in relative humidity from exposure to damp or wet conditions also can cause curling and cockling of paper. Coated papers may block (stick together), resulting in skinning (surface loss) when the stuck sheets are separated. High humidity can accelerate the risk and rate of staining and structural weakening because hydrolysis reactions may lead to acid formation with certain inorganic and organic compounds. These chemical changes can cause localized discoloration from, for example, metallic impurities apparent in small brown spots (foxing), or the growth of mold, which can be both destructive and toxic to workers.

POLLUTION

Volatile acids from atmospheric pollution or wood-base storage cabinets, enclosures, and containers can cause discoloration and embrittlement of paper substrates and media. Particulates circulating through unfiltered ventilation systems may deposit grime, soot, and abrasive dirt on the face of documents and other surfaces.

PESTS

Mold, insects, and rodents can stain and consume organic materials and devastate collections. Evidence of infestation includes grazed surfaces, worm holes, fly specks, or frass. Active infestation requires an immediate response, such as cleaning and isolation of contaminated documents. A paper conservator and a certified pest exterminator, familiar with handling document collections, should be contacted immediately.

PREVENTION

To safeguard against the problems outlined above, areas used for research and storage should be kept clean and free of food and beverages that can cause stains and attract pests. Light, even at low levels (3–15 footcandles) with short exposure times (1–3 months), should be filtered against ultraviolet radiation (UV), although it is important to remember that visible light also can cause damage to collections.

Temperature and relative humidity (RH) should be kept constant. Fluctuations can increase the risk of damage to documents by accelerating the rate of expansion and contraction. This movement may build up strains and distortions within documents. Chemical reactions leading to discoloration and brittleness also are affected by incorrect levels of RH and temperature. Most experts recommend selecting a specific constant point between 16–29°C (60–72°F) and 30–55% RH (Applebaum, 1991; Bachmann, 1992; Ellis, 1992; Hamburg, 1992; Ogden, 1994; Ritzenthaler, 1993). The lower the light, temperature, and RH, the slower the deterioration. Optimum conditions of dark, dry (30–35% RH), and cool or cold storage (16°C to below −18°C [60 to below 0°F]) can increase the life of documents substantially if the documents are not removed from cold storage. Good housing materials and techniques can provide additional buffering against moderate, short-term environmental fluctuations. Appendices III–VI provide appropriate preventive care options for document collections.

Deterioration from Handling and Storage

The most common agent endangering documents is people. Researchers and staff should be encouraged to wash their hands when using documents because body oils can leave irreversible fingerprint stains. Touching documents with bare hands should be avoided as much as possible. Documents should be supported with and turned over by using their folders. Papers may be irreparably marred, weakened, and distorted by scratches and scars caused by poor user habits, such as pressing on documents while taking notes, or affixing inappropriate fasteners that can cause permanent impressions or stains. Documents also can be damaged by using ill-fitting-housing techniques, acidic housing materials, and unstable adhesives.

INAPPROPRIATE HOUSING TECHNIQUES

Planar distortion can occur when documents are placed in folders, boxes, or drawers that are over- or under-filled, or ill-fitting. This distortion can result in structural damage such as folds, creases, and curling. Documents stored vertically can sag to the bottom of a folder or container, and may be crushed. Slack areas must be filled by inserting full-sized support boards or wedges. Forcing individual documents in and out of crowded containers can cause rips and tears.

INAPPROPRIATE HOUSING MATERIALS

Documents can become discolored not only from inherent acidic impurities, but also from acidic housing materials. Poor quality plastic enclosures contain volatile plasticizers that cause documents to stick to the enclosure surface and cause media to bleed (see Baker, this volume). Poor quality paper envelopes and folders contain volatile acids that discolor adjacent documents. Acidic window mats causes discoloration termed "mat burn" around the edges of illustrations. The closed environment of frames can result in slat burns, discoloration from wooden backings or striations from acidic corrugated ground wood backings (see Burgess; Hatchfield, this volume).

INAPPROPRIATE ADHESIVES

Documents often are damaged by attempts to repair them with inappropriate materials such as pressure-sensitive tapes or other adhesives that can cause stains, translucency, distortion, and skinning (surface loss) of the substrate. Pressure sensitive tapes also may cause the media to bleed. Water-activated tapes may cause cockling, surface depressions, or stains. Heat-activated adhesives may cause blocking and discoloration. Adhesive residues may be tacky, cracked, or brittle and can cause sticking, skinning, staining, or contraction and distortion of the document.

INTERVENTION

To ensure appropriate cleaning and repair of documents, a conservator should be contacted. Staff may undertake some basic actions if they are trained under the supervision of a conservator (Appendix III). Appendix V lists good materials and techniques for housing in standard-sized enclosures and containers. Appendix VI lists common practices that can endanger documents and collections, as well as appropriate alternatives that actually enhance preservation. Most agents of deterioration can be controlled or slowed by using good materials and techniques for housing documents, and by practicing appropriate collection maintenance procedures and handling techniques.

Collections Maintenance Procedures

Collections maintenance is an important preservation responsibility that stabilizes documents through good handling and storage practices (Appendix I). Steps for collections maintenance should be developed in accordance with assessment surveys, and formulated into written policies and guidelines (Appendix II). Maintenance should incorporate periodic monitoring of environmental and document conditions (Fig. 1). Procedures should utilize standard storage and preservation options for housing, furniture, data recording, and reformatting (Fig. 2).

To examine documents during maintenance, appropriate workspaces should be designed. To make documents more accessible to users, some stabilizing techniques might be necessary, such as fastener removal, flattening, and cleaning (Fig. 3). In addition, some documents require custom-made housing, such as acid-free wrapper mats or polyester film book jackets and bands (Figs. 4 and 5).

The principles and procedures of collections maintenance should be incorporated into all stages of care and processing for document collections (Appendices III–VI). The exact procedures for collections maintenance should be developed in consultation with appropriate experts, such as historians, archivists, librarians and conservators. For example, resources should be diverted only to documents that clearly meet the mission statement of the repository and are accessioned into its legal custody. The following constitutes good procedures for collections maintenance and use of documents in natural history collections.

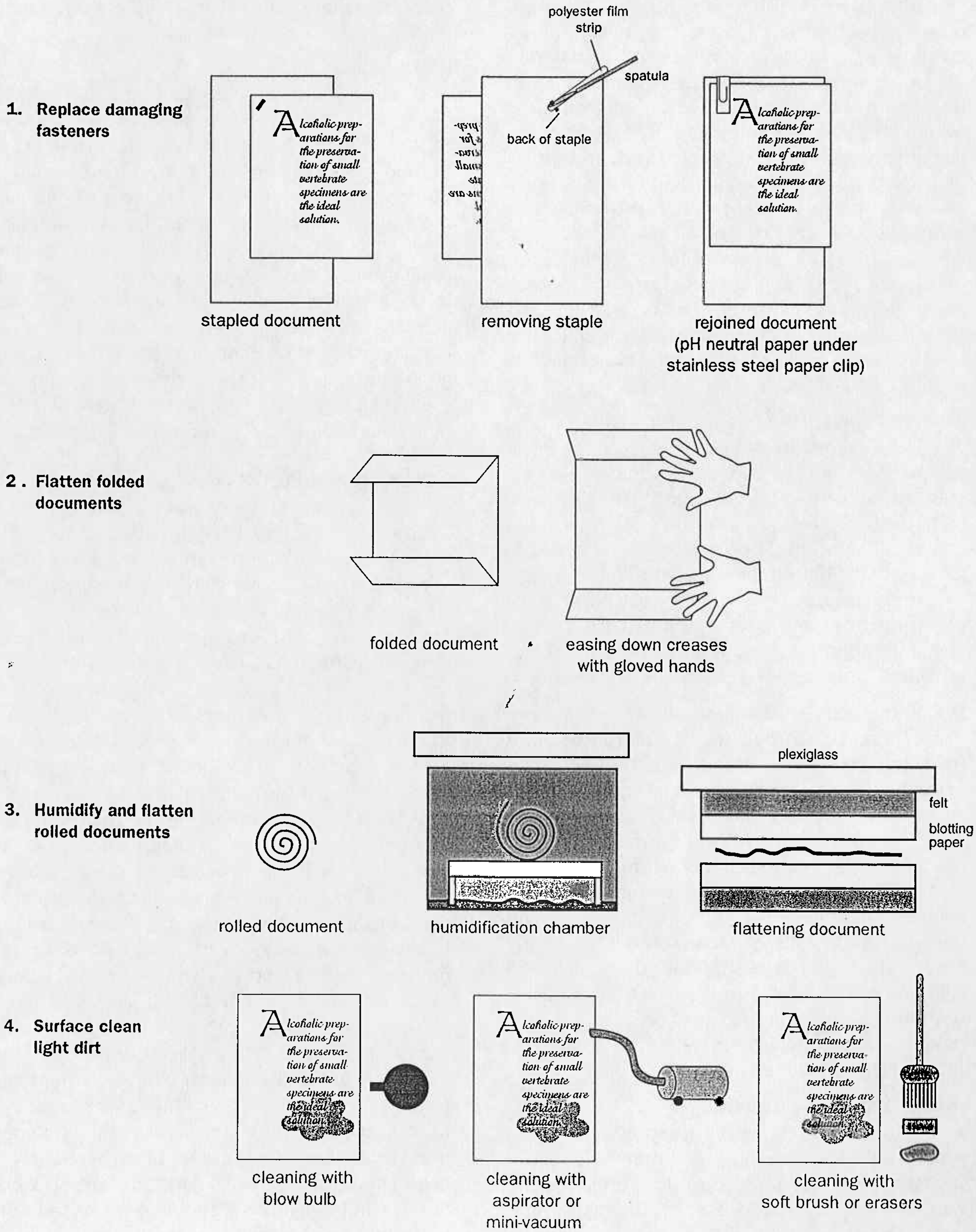

Figure 3. Methods for stabilizing documents.

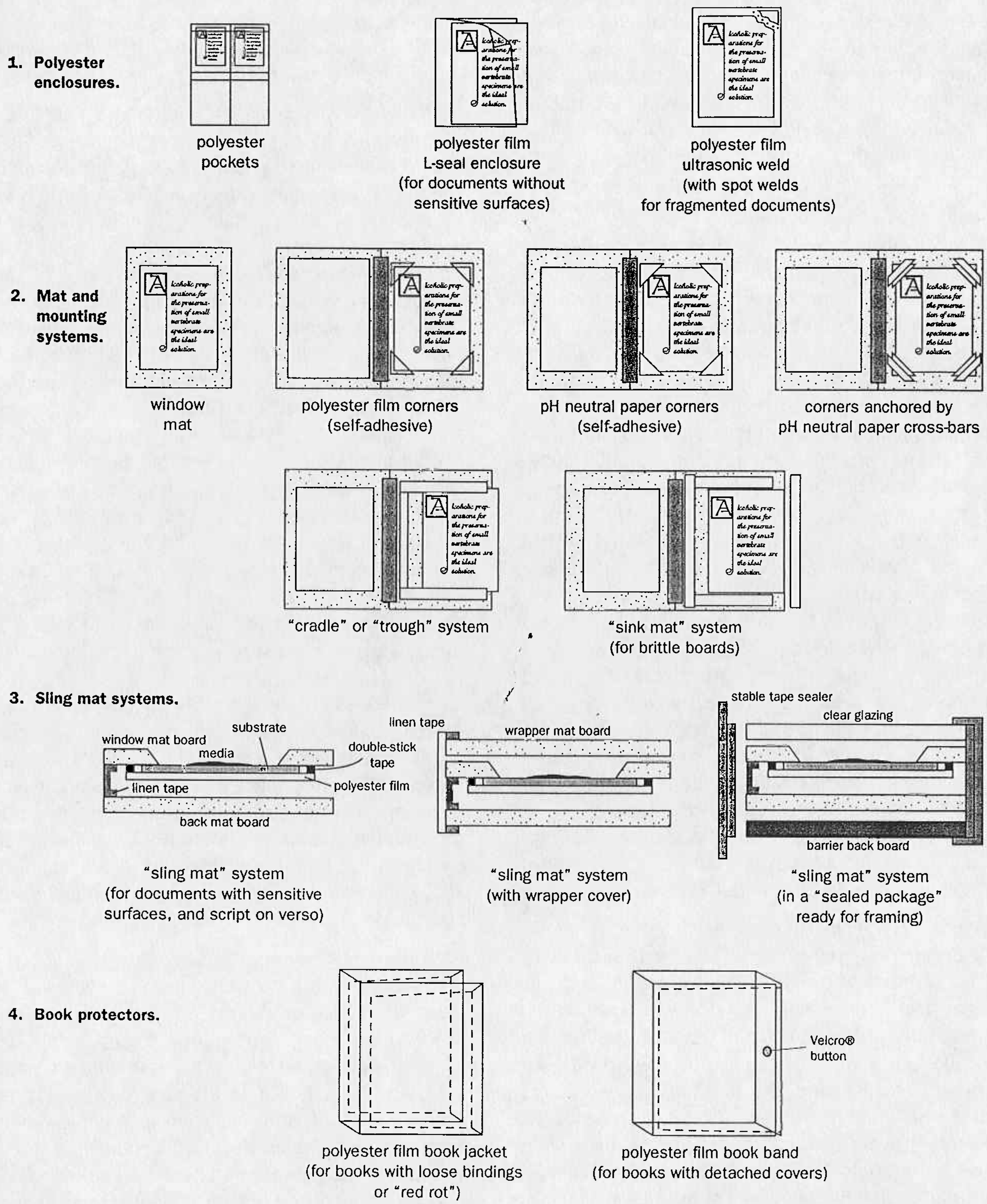

Figure 4. Options for custom-made housing.

SETTING UP A WORK SPACE

A work space should be dedicated to ongoing maintenance projects to ensure continuity and quality. Work space requirements are determined by matching the nature, size, quantity, and use of documents in a collection to the appropriate storage supplies and furniture, as well as techniques for data entry and duplication. A work area should have adequate room for all apparatus necessary for collections maintenance.

Work Surfaces and Supplies

Work surfaces should be at least twice the measure of the largest documents and their enclosures, folders, or containers, to allow room to accommodate these and other materials. Tools and supplies should include computers, cameras, data entry forms, pencils, brushes, spatulas, gloves, stainless steel fasteners, and pH neutral or alkaline-buffered paper, spacers, or support boards and blotters. A selection of appropriate housing supplies should be arranged on the work surface, including polyester film pockets and enclosures, pH neutral or alkaline-buffered folders, and alkaline-buffered boxes. Work surfaces and tools should be kept clean at all times. Surfaces can be covered with blotters or polyester film that can be cleaned or replaced when soiled. Clean white cotton gloves should be used with documents that are exceptionally dirty or highly reactive to body oils. Working with dirty documents may require frequent cleaning of gloves or hands and the use of protective face masks. If documents require substantial cleaning, humidification, flattening, or repair, a conservator should be consulted to train staff in basic procedures, or full conservation treatment should be scheduled elsewhere.

Transporting Documents

Before documents can be transported safely for maintenance or use, the walkways, work and storage spaces to be used should be cleared. Documents should not protrude beyond the edges of shelves, drawers, or table tops. Two hands are required for handling documents and containers, and assistance from other staff may be necessary to move oversized, heavy, fragile, or difficult-to-reach materials. Documents or containers that are unusually fragile or heavy should bear warning labels. Rigid supports and carts that are especially designed to transport boxes, books, or rolled or framed documents should be used for transporting numerous, large, fragile, or heavy items. Heavy containers should be placed on the bottom of carts for maximum stability, and carts should not be overloaded. When removing a book from a shelf, adjacent books should be pushed back gently to expose the spine of the book to be handled, so that the book can be withdrawn by grasping the shoulders rather than the head cap or top.

IDENTIFYING AND SORTING DOCUMENT TYPES

Only one container of documents at a time should be examined and sorted to determine storage and access needs (Fig. 2.1–2.7). In some document collections, such as archival holdings, the original arrangement of documents within a box and folder must be maintained because of the associational value of the collection. The series and sub-series groupings in such a collection illustrate how the collection's creator used and conceptualized the research materials and correspondence. When a folder is removed from a box, its location should be flagged by a pH neutral paper marker. Proper labeling of folders and boxes will prevent misfiling. One folder at a time should be placed flat on the work surface, opened completely, and examined. If a container or folder is overfilled, damaged, or of the wrong size and material for the document, it should be replaced. All information recorded on old housings should be transferred to the replacement housing. In some cases, acidic old housings or extraneous materials may have intrinsic value and should be retained but isolated in protective enclosures. Criteria for retention or disposal of materials should be established in consultation with appropriate experts, such as archivists, historians, curators, and conservators. If a folder is too small, a document should not be altered to fit by trimming or folding. Instead, the document should be transferred to an appropriate standard-sized folder or an oversize storage system.

Examining Documents

During examination and use, care should be taken that pens, briefcases, or notebooks are not placed upon documents. Each document should be evaluated separately to determine its type and size, and whether it is an original, functional archival original, or a master or user copy. Whenever possible, the component structure of documents should be identified because storage needs will be determined by the formats, media, substrates, sizes, and quantity of documents. For instance, acidic documents such as newspaper clippings should be housed separately and isolated from adjacent documents to prevent acid migration. Alternatively, replacement copies can be made by photocopying the original on alkaline-buffered paper. Physical condition also affects the storage materials and handling of documents.

Handling Documents

Documents should be handled as little and as carefully as possible to avoid damage. To prevent transferring body oils or grime, hands and gloves should be cleaned frequently. To turn a document over, a folder containing a single document can be closed, turned over, and reopened to the back of the document. For documents without friable media, a rigid board can be slipped under the back, a second board can be placed on the face, and the whole ensemble can be turned over. Documents with friable media, but with strong substrates, can be lifted temporarily by opposite corners, although it is best to use a support, such as a folder, blotter or matboard, underneath all documents during handling or moving.

STABILIZING DOCUMENTS

Documents may require removal of harmful fasteners and some flattening to avoid damage during use. Likewise, they may require light cleaning to reduce the possibility of abrasion from grime during storage and use, or to prepare them for copying (Alper, 1992; Garlick, 1992; Hamburg, 1992; Hamill, 1993; Ogden, 1994; Ritzenthaler, 1993; and Ruwell, 1985). For routine maintenance of documents with stable substrates and media (*e.g.*, not brittle or friable), staff may be trained in basic procedures by conservators (Fig. 3). Extreme care is required even for routine procedures, because misuse of these procedures could augment damage to documents or cause loss of evidential material.

Replacing Harmful Fasteners

During collections maintenance, fasteners should be removed only from strong and flexible documents, and only if the document is being damaged or needs to be separated for use. Otherwise, removal should be a low priority because some attachments may contribute to the evidential value of materials (*e.g.*, indicating the period when the documents first were assembled and what documents belong together). Fasteners such as rubber bands or rusty staples and paper clips may be candidates for removal. To remove a fastener, a document should be placed flat on a clean surface (staple prongs facing up) with a protective piece of polyester film close to the edge of the fastener (Fig. 3.1). A microspatula can then be worked gently under the fastener. The document can be rejoined, if necessary, by folding a slip of pH neutral paper over the document's point of attachment and applying a stainless steel paper clip or staple. Rubber bands should be removed in a similar manner using polyester film and a microspatula and bulky documents can be held together in folders or boxes to indicate their relationship as a set.

Flattening Folded Documents

Documents may be flattened lightly to improve visual accessibility, safeguard handling, and allow insertion into an enclosure. Folded documents that are strong and flexible may be opened after they are placed on a clean surface, such as blotting paper or polyester film. The peaks of the creases can then be eased down using gloved hands or a polyester film overleaf to disperse the stress on the paper (Fig. 3.2). Creases should not be back-folded because this weakens paper. Routine flattening during collections maintenance should not be done with brittle, stiff, or badly torn documents.

Rolled documents usually can not be unrolled safely without humidification, which requires special testing, apparatus, and space. This process should be done only in consultation with a conservator (Fig. 3.3). Some rolled documents may be eased open, but before this is attempted, it should be determined whether the document will then be too large for the original housing. In addition, unrolling even strong documents can cause paper to crease, crack, and tear later.

Cleaning Lightly Soiled Documents

Cleaning may be undertaken to reduce abrasions from grime and to improve visibility during use or reproduction. Loose dirt on documents without friable media or tears may be removed by carefully using a blow bulb, an aspirator or mini-vacuum, or a soft brush (Fig. 3.4). Brushes should be cleaned and replaced periodically. These cleaning methods will not remove embedded grime or chemical discoloration from light or acidity. Cleaning should not be attempted on unstable or moldy documents except under the supervision of a conservator. Any cleaning should be done in consultation with a conservator, because the process may damage or remove original material. In addition, some types of cleaning agents, such as certain erasers, may leave abrasive or unstable deposits on paper.

SELECTING ENCLOSURES

The selection of enclosure materials and formats depends on the document's components (media, substrate, and format), condition (stable, acidic, or torn), and use. Enclosures should be larger than the document to provide even coverage equal to the size of any folders or containers, to minimize slippage. Materials can be made of permanent and durable plastics or papers (see Baker; Burgess, this volume) produced in different thicknesses (mils or points) depending on size requirements. Polyester film enclosures, polyethylene pockets, and pH neutral or alkaline-buffered window mats protect documents from handling while allowing visibility.

Many enclosures are commercially available in standard sizes and formats. Some documents require custom-made enclosures (Fig. 4). Examples include fragmented documents, which can be encapsulated in polyester film that can be sealed around all the edges of detached fragments (Fig 4.1). Damaged bound volumes may require book jackets or bands for support. Custom-made housings such as polyester film encapsulations or window mats can be constructed easily using common tools (Ogden, 1994; Rose and de Torres, 1992). However, when large collections require custom housings, it may be more efficient to acquire special equipment such as ultrasonic welders for encapsulation, or board-shears and mat-cutters for cutting window mats (Fig. 5).

Polyester Film Pockets and Enclosures for Documents with Stable Media

Polyester film is commercially available in standard sizes or in rolls, and in thicknesses ranging from 1–5 mils. Polyester film is stiffer and provides more support than polyethylene, especially in 4–5 mil thicknesses. Polyester film can be used to make multiple pockets or enclosures sealed on one or more sides (Fig. 4.1). Sealing can be done using ultrasonic-welders, heat, or tape techniques (Odgen, 1994; Ritzenthaler, 1993; Rose and de Torres, 1992; Shelley, 1992). Polyester film should not be used for documents that might be affected by static electricity, such as those with friable media like pencil, chalk, or flaking ink or photographic emulsions. Polyester enclosures can be used for materials with stable media, such as some writing or printer's ink. Documents that are particularly acidic should have an alkaline-buffered paper or board inserted behind the document to absorb acidity. Documents on brittle boards, like scientific illustrations, may also require alkaline-buffered insert boards to provide sufficient support within polyester film enclosures, if the original boards are large and thick. However, the enclosures may provide temporary reinforcement for torn documents.

Polyester film is commercially available as letter or legal-size "L-seals" (*i.e.,* sealed on the left and bottom edges). To insert thin or torn material into an "L-seal" safely, the document first should be placed on a neutral or alkaline-buffered support paper. The polyester film enclosure is laid flat on a table with the open side of the enclosure lifted. The document on the support is then slipped into place, with the sealed edges along the left and bottom edges of the document. If the document is acidic and there is no information on its reverse, the support paper may remain in place. If there is information on the back of the document, the back can be photocopied beforehand onto the support paper, which can then face toward the back of the enclosure.

Some documents, especially those with blue pigments or dyes, may undergo a litmus-like reaction when in direct and prolonged physical contact with alkaline materials. Such documents should be enclosed only with pH neutral paper supports or boards.

Because polyester film traps acidity, it sometimes is recommended that a document be deacidified before being encapsulated. Deacidification is a complex and potentially risky treatment that should only be done by a conservator.

Window Mats for Documents with Sensitive Media or Substrates

Window mats are appropriate for documents or images with friable media or brittle, fragile substrates, such as some scientific illustrations. Matboards (2–6 ply) provide support and protection during handling and storage. The mats should be standard sizes to fit within standard-sized folders and containers. Windows in mats normally are cut to fit the image, platemark, or outer edges of a document. There are numerous ways of holding a document in a mat. The most secure method is to hinge the document in place (Ellis, 1992; Ogden, 1994; Smith, 1992). Non-adhesive methods of attachment include using polyester film or paper photo-corners or "cradles" (Fig. 4.2). Extra support for a large, heavy, distorted or fragile document can be provided by a "sink-mat" (Fig. 4.2). Visibility of text or image on the back of a document can be provided by a "sling-mat" (Fig. 4.3). Additional protection from light, handling, and movement for a document with delicate media or paper surfaces can be provided by a "wrapper-mat" (Smith, 1981) (Fig. 4.3).

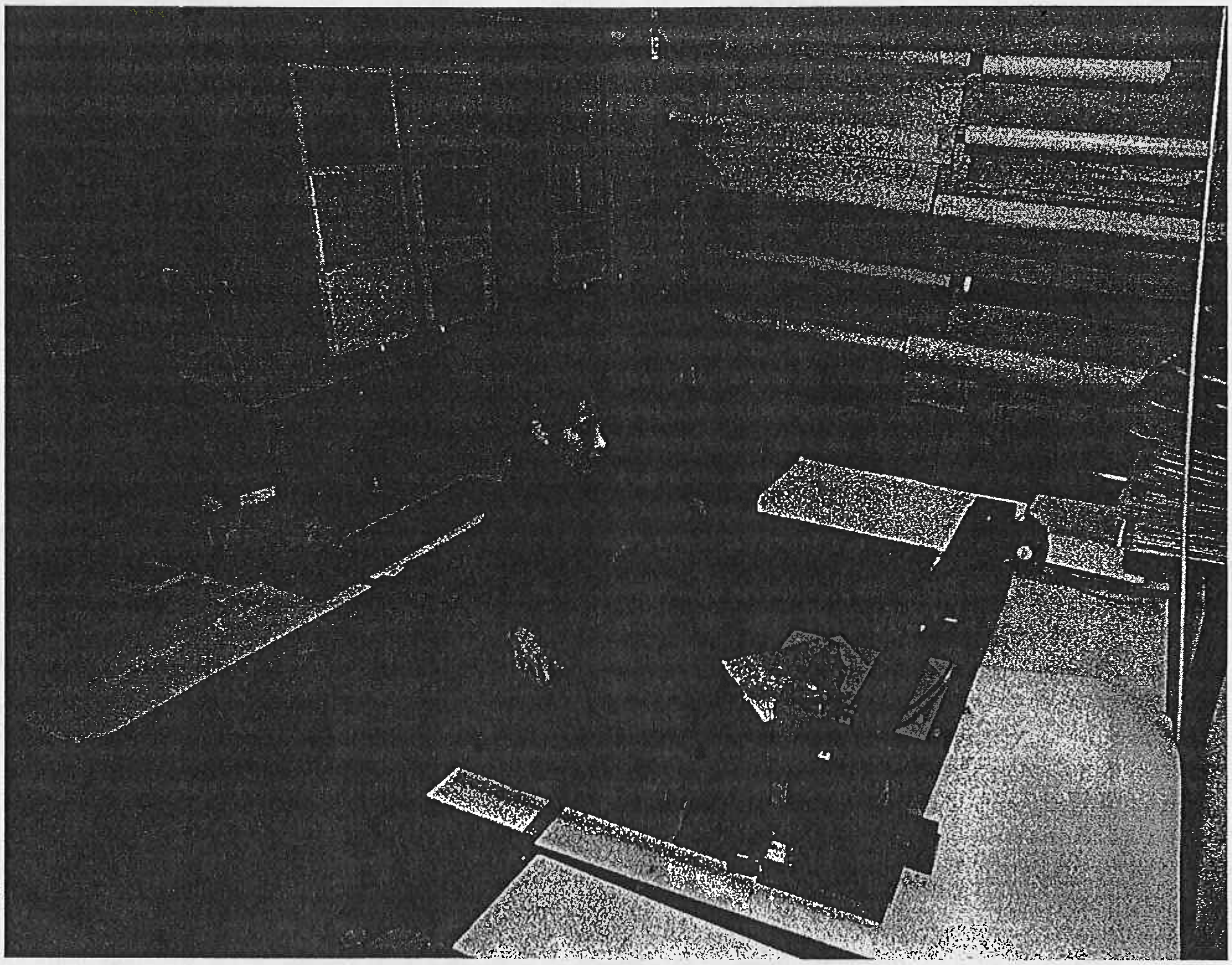

Figure 5. Work space with equipment needed to make custom housing. An ultrasonic-welder in the foreground is used to spot weld a fragment of a document. In the background on the left, is a mat-cutter to cut window mats; on the right, is a board shears for cutting mat board or box board. Stockpiles of supplies include polyester film and folders.

Polyester Film Book Jackets and Bands for Bound Volumes

Polyester film book jackets can protect and temporarily reinforce bound volumes that are damaged by red rot, or that have abraded, torn, or missing headcaps, spines, and cover materials. Severely damaged books with loose or detached cover boards can be held together by a polyester film band around the full height of the book (Fig. 4.4). The plastic band can be held together with a nylon hook and loop fastener (Rose and de Torres, 1992) where the band overlaps on the front. Jackets and bands are made by scoring and creasing polyester to the exact measurements of the bound volume (Ogden, 1994; Ritzenthaler, 1993).

SELECTING FOLDERS

pH neutral and alkaline-buffered folders protect documents from handling and light even if a document is housed in a polyester enclosure or mat. These folders are commercially available in standard weights and sizes, ranging from letter and legal size, to folders large enough to protect posters. Formats can be tabbed, flush-folded, or seamless flap-folded, with one to four creases (Fig. 2.3). One or two dozen documents or encapsulations may be stored within a single acid-free paper folder. Folders should be labeled with a soft (#2) graphite pencil.

Acid-free Paper Folders with Single or Double-Creased Spines for Standard Documents

Single-crease folders are adequate for most documents. Extra bulky documents, pamphlets, and booklets fit best in folders that are flush-folded, with the edges flush to one another and a double-crease. Folders that are tabbed rather than flush-folded traditionally have multiple score lines along their spine and can become shorter in front with each additional crease, exposing documents to damage. Extra large folders can be made by hinging pH neutral or alkaline-buffered two-ply corrugated board (Wagner, 1992).

Acid-free Paper Folders, with Three or Four Flaps, for Documents with Unstable Media or Brittle Substrates

These envelope-like folders protect all edges of a document but do not have adhesive seams that can react with documents. In addition, unlike an envelope, which requires a document to be slid in and out, flap folders can open to expose the document without moving or abrading it. These folders are good for documents with delicate media or surfaces, or for thick, brittle boards. This housing option, while not as safe or versatile as a sink-mat with a wrapper, may be more economical and practical for large collections.

SELECTING CONTAINERS

Enclosures and folders should be placed in strong, alkaline-buffered containers or boxes, with reinforced corners, to keep groups of documents together, as well as to facilitate handling for storage, use, and emergency response. The orientation of the boxes can be horizontal or vertical for letter or legal-sized documents (Fig. 2.4). Large folders should be stored in flat boxes on shelves or in flat file drawers such as map cases. Containers can protect documents from moderate, temporary fluctuations in environmental conditions.

Alkaline-Buffered Flat Boxes

Flat, shallow boxes (5 cm [2–3 in.]) cause the least strain on documents. These boxes are available in standard small, letter, legal, and various medium sizes. They are sold under many names, such as "print boxes" or "clam-shell boxes," that describe what they hold or how they look. Within these boxes, documents can be arranged efficiently in folders by grouping them according to incremental size. The largest size folder (*i.e.*, the same size as the container) should be placed on the bottom, and smaller documents should be housed in half- and quarter-size folders on top, provided this arrangement does not conflict with the original order of the materials in the collection.

Alkaline-Buffered Vertical Boxes for Letter or Legal-Sized Textual Documents

For the convenience of users, letter and legal-sized documents and folders often are stored spine down in vertical file boxes. These boxes are made to fit letter and legal size documents and folders exactly, and they can be 5–15 cm (2–6 in.) deep. Boxes referred to as record center or record-unit boxes usually are "letter-length" wide and "legal-length" deep. These boxes can contain a great number of documents, making them heavy and awkward when full. Rigid acid-free dividers and wedges should be used in vertical boxes to compress space and thereby prevent sagging of documents.

Book Boxes for Bound Volumes

Book boxes usually are custom-made (Rose and de Torres, 1992). They fit books snugly to support weak or damaged bindings and text blocks when placed vertically on shelves. If books are stored with documents in vertical boxes, they should be placed spine-side down. Large books should be stored horizontally on shelves.

Book Cradles for Fragile Bound Volumes

Large or damaged books should be supported evenly during use by book cradles. Book cradles come in various materials and formats. Cradles should be adjustable to allow books to open easily. If necessary, pages can be held down with light and flexible weighted fabric bags.

SELECTING FURNITURE

The type, size, and quantity of document containers, folders, or enclosures dictate the type of storage furniture required. Appropriate furniture configurations include shelves, drawers, panels, and racks (Fig. 2.5). These configurations should be in cabinets with doors to protect documents and containers from light, pollution, and minor fluctuations in temperature and relative humidity. Closed cabinets (*i.e.*, with doors) also may provide short-term protection against fire and water damage. Storage furniture should be free of materials that emit volatile acids that might damage documents (von Endt *et al.*, this volume). The most non-reactive materials currently available are fused powder-coated chromium-plated steel or anodized aluminum (Ogden, 1994; Shelly, 1992).

Fused Powder-Coated Finished Steel Cabinets with Shelves and Drawers

Letter and legal-sized documents can be stored in vertical file boxes on shallow shelves, or in horizontal or flat boxes on shelves that are deep and closely spaced. Only one container should fit in the depth of each shelf so that containers are not hidden from view and access. Documents that are larger than legal size should be stored in flat boxes. Medium-sized flat boxes can be stored on shelves of equal depth to the boxes. Medium- or large-size folders can be stacked in increments in shallow, flat drawers. Documents with friable or flaking media, or torn or brittle substrates, should be stored flat. Flat storage is also necessary for damaged documents in frames. Framed documents may be stacked between alkaline-buffered boards in groups of two or three. Oversize bound volumes should be stored flat.

Anodized Aluminum Panels and Racks for Framed or Extra Large Documents in Polyester Film or on Tubes

Some documents, such as maps and plans, will not fit readily in standard size boxes. If oversized documents cannot be stored flat in individual drawers or extra large folders, they may sometimes be interleaved with neutral pH tissue or polyester film and rolled onto alkaline-buffered, large-diameter tubes (at least 7.5 cm [3 in.] wide, and longer than the document's width). The rolled documents are then wrapped with acid-free paper and polyester or polyethylene film for protection from dust, and stored horizontally on shelves or racks, or in drawers. In other instances, large documents may be encapsulated and hung on racks or panels. Framed documents may be hung on panels or stored vertically or flat in slotted bins, in groups of two or three with each item separated by alkaline-buffered boards.

DATA RECORDING

During maintenance, data bases should be expanded and updated. Record keeping can be done using various formats, ranging from manual to digital (Fig. 2.6). Data collected during maintenance can include identification and condition of documents, or the kind and quantity of housing needed. Information describing documents can be entered into catalog systems designed for texts and images, using data content and value standards that detail names, places, subject index terms, styles, *etc.* (Miller, 1990).

Surveys at the collection or item-level can help flag documents and prioritize problems to be addressed by conservation treatment at a later date (van der Reyden, 1992a). Such periodic monitoring and updating also can enable review and evaluation of the effectiveness of emergency and pest management procedures, as well as damage sustained during collection use.

REFORMATTING

During maintenance or processing, documents can be selected for copying as a preservation and access measure to protect them against damage from handling. Copying is appropriate for documents that are at risk because they are too fragile to handle, are used heavily, or are required for publications or reference.

Fragile documents should be placed in polyester film enclosures before copying. If copying is for publication, the documents first should undergo conservation treatment such as flattening, cleaning, and repair. The initial copy should be considered a master copy, to be protected by optimum storage conditions and to be reproduced for subsequent copies.

Preservation copying requires compliance with specific production standards assuring permanence, durability, and quality of media, substrate, and image (Ogden, 1994; Ritzenthaler, 1993). There are several techniques for copying documents, including photocopying, photography, and digital imaging (Fig. 2.7). No copy, regardless of the resolution, provides the same level of intrinsic or evidential value as the original.

Photocopying

Small monochromatic documents, protected in polyester film enclosures, can be photocopied onto alkaline-buffered paper to make inexpensive, low-resolution copies. Documents must not be fed through automatic feeders. Special copiers are made for color copying and for bound volumes, because pressing books heavily upon the copier may damage the binding.

Photographic Film Copies

Photographic film copies have higher resolution than photocopies. This makes them more appropriate for publications. Making film copies requires more time, money, and training than photocopying. Documents that are legal size or smaller, such as letters and field records, can be copied in various ways, including 35 mm microfilm or microfiche, and color slides. Larger documents may require the resolution achieved from 4 in. x 5 in. or 8 in. x 10 in. black and white negatives and prints or color transparencies (Ogden, 1994).

Digital Imaging

Original documents in good condition, or copies on paper and film, may be scanned into computerized systems. However, regardless of their excellence as access and distribution media, computer formats do not currently meet the requirements of permanence and durability considered necessary for preservation copies.

Conservation Treatment, Research and Training

Any comprehensive preservation program should include conservation treatment, research, and training. These functions are vital to the life of collections but are beyond the scope of this chapter. Because these highly specialized disciplines enhance collections care when integrated into a program of preservation planning, environmental control, and collections maintenance, they are summarized below.

CONSERVATION TREATMENT

Conservation treatment employs chemical and physical intervention to stabilize documents (Ogden, 1994; Ritzenthaler, 1993). Because every treatment, including cleaning, reinforcement, and deacidification, has the potential to change the properties of documents, the current emphasis is on cost-effective preventive care to forestall the need for interventive treatment. Funds may be best spent on rehousing large collections rather than on treating a few items. Criteria for selecting and scheduling documents for treatment should incorporate a triage system to prioritize and coordinate remedial, batched (grouped), and customized treatments. The selection of treatment options should be based on standards and practices developed through conservation research.

CONSERVATION RESEARCH

Conservation research uses materials science to investigate and characterize the technology, composition, and deterioration of documents. Analytical tools used for research in the natural, cultural, and social sciences can be used to test, evaluate, and modify models and theories for new standards and practices. These findings assist in improving preservation administration policies for environmental controls, collections maintenance, duplication, and conservation treatment.

PRESERVATION TRAINING

Preservation training should target each of the responsibilities discussed in this chapter, beginning with preservation planning. Repositories concerned with the preservation of documents should develop a multi-phased training program that focuses on:

- the nature and deterioration of collections having special value, use, and risk factors;
- assessing collections using various survey techniques;
- collections maintenance procedures to stabilize and rehouse collections using approved materials and techniques;
- selection criteria for conservation treatment and development of prototypes and pilot projects to facilitate resource management;
- evaluation of research to develop and test the effect of recommendations on the preservation of documents (van der Reyden, 1986; 1988; 1992a; 1992b; van der Reyden *et al.*, 1993a; 1993b; 1994; Mosier *et al.*, 1992).
- follow up evaluation of the effectiveness and results of various pilot projects, project implementations, *etc.* over time.

Further sources of information can be found in literature on paper conservation (Clapp, 1980), conservation of books (Banks, 1981), conservation research (Kaplan, 1992), training (van der Reyden, 1992a), and treatments. ❋

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Literature Cited

The American Institute for the Conservation of Historic and Artistic Works, Book, and Paper Group (AIC). The Paper Conservation Catalog. 1st–9th ed., Book and Paper Group of the American Institute for Conservation of Historic and Artistic Works, Washington, DC, 1120 pp.

Alper, D. 1992. Making a molehill out of a mountain: the Olmsted plans and drawings processing project, Archives preservation update. American Institute for Conservation of Historic and Artistic Works Book and Paper Group Annual, 11:173–178.

Applebaum, B. 1991. *Guide to Environmental Protection of Collections.* Sound View Press, Madison, WI, 270 pp.

Bachmann, K. 1992. *Conservation Concerns: A Guide for Collectors and Curators.* Smithsonian Institution Press, Washington, DC, 149 pp.

Banks, P. 1981. *A Selective Bibliography on the Conservation of Research Library Materials.* Newberry Library, Chicago, 200 pp.

Clapp, A. 1980. *Reading List for Students in Conservation of Historic and Artistic Works on Paper and Photographs.* American Institute for Conservation of Historic and Artistic Works, Washington, DC, 39 pp.

Ellis, M. 1992. Works of art on paper. Pp.40–51 in *Caring For Your Collections* (H. Whelchel, ed.). Harry N. Abrams, Inc., New York, 216 pp

Garlick, K. 1992. Holdings maintenance: An overview, archives preservation update. American Institute for Conservation of Historic and Artistic Works Book and Paper Group Annual, 11:163–166.

Hamburg, D. 1992. Library and archival collections. Pp.52–63 in Caring For Your Collections (H. Whelchel, ed.). Harry N. Abrams, Inc., New York, 216 pp.

Hamill, M. 1993. Washingtoniana II: Conservation of architectural drawings at the Library of Congress. American Institute for Conservation of Historic and Artistic Works, Book and Paper Group Annual, 12:24–31.

Hunter, D. 1978. *Papermaking: The History and Technique of an Ancient Craft.* 3rd ed. Dover Publications, New York, 611 pp.

Kaplan, H. 1992. Archives preservation outlook: research and education, Archives preservation update. American Institute for Conservation of Historic and Artistic Works, Book and Paper Group Annual, 11:179–185.

Miller, F. 1990. *Arranging and Describing Archives and Manuscripts.* The Society of American Archivists, Chicago, 131 pp.

Ogden, S. (ed.). 1994. *Preservation of Library and Archival Materials.* Northeast Document Conservation Center, Andover, not paginated.

Ritzenthaler, M. 1993. *Preserving Archives and Manuscripts.* The Society of American Archivists, Chicago, 217 pp.

Rose, C., and A. de Torres (eds.). 1992. *Storage of Natural History Collections: Ideas and Practical Solutions.* Society for the Preservation of Natural History Collections, Pittsburgh, 346 pp.

Ruwell, M. 1985. Introduction. Pp.1–6 in *Preserving Field Records: Archival Techniques for Archaeologists and Anthropologists* (M. Kenworthy, E. King, M. Ruwell, and T. van Houten, eds.). The University Museum, University of Pennsylvania, Philadelphia, 102 pp.

Shelley, M. 1992. Storage of works on paper, and warning signs: when works on paper require conservation. Pp. 29–38 in *Conservation Concerns: A Guide for Collectors and Curators.* Smithsonian Institution Press, Washington, DC, 149 pp.

Smith, M. 1981. *Matting and Hinging Works of Art on Paper.* Preservation Office, Research Services, Library of Congress, Washington, DC, 32 pp.

Smith, M. A. 1992. Matting and hinging flat paper objects. Pp. 145–148 in *Storage of Natural History Collections: Ideas and Practical Solutions* (C. L. Rose and A. R. de Torres, eds.). Society for the Preservation of Natural History Collections, Pittsburgh, xvi + 346 pp.

van der Reyden, D. 1986. The technology and treatment of a nineteenth century American time-globe. The Paper Conservator, 12:21–30.

______. 1988. Technology and treatment of a folding screen: comparison of oriental and western techniques. Pp. 64-68 in *The Conservation of Far Eastern Art.* Preprints of The International Institute for Conservation of Historic and Artistic Works Triennial Meeting, 19–23 Sept. 1988, Kyoto, 163 pp.

______. 1992a. Conservation of photographs at the Smithsonian Institution: case studies derived from a condition survey of 15,000 photographs. Pp. 347–360 in *Imperfect Image.* Postprints of Photomaterials Conference. Windemere, 6–10 April, 1992, England, 379 pp.

______. 1992b. Recent scientific research in paper conservation. Journal of the American Institute for Conservation vol. 31(1):117–139.

van der Reyden, D., M. Baker and C. Hoffman. 1993a. Effects of aging and solvent treatments on some properties of contemporary tracing papers. Journal of the American Institute for Conservation, 31:177–206.

van der Reyden, D., M. Baker and E. Mosier. 1993b. Pigment-coated papers I: History and technology and pigment-coated papers II: The effects of solvent treatments on selected examples. Pp. 491–506 in *Preprints of ICOM Committee for Conservation Triennial Meeting Washington DC, 21–27 Aug. 1993.* The Getty Conservation Institute, 911 pp

Van Houten, T. 1985. Preservation of paper records. Pp. 19–40 in *Preserving Field Records: Archival Techniques for Archaeologists and Anthropologists* (M. Kenworthy, E. King, M. Ruwell, T. Van Houten, eds.). The University Museum, University of Pennsylvania, Philadelphia, 102 pp.

Wagner, S. 1992. Storage of large paper objects. Pp. 277–278 in *Storage of Natural History Collections: Ideas and Practical Solutions* (C. L. Rose and A. R. de Torres, eds.). Society for the Preservation of Natural History Collections, Pittsburgh, xvi + 346 pp.

Suggested Reading

NATURAL HISTORY RESEARCH COLLECTIONS

Kenworthy, M. 1985. Storage. Pp.78–90 in *Preserving Field Records: Archival Techniques for Archaeologists and Anthropologists* (M. Kenworthy, E. King, M. Ruwell, and T. Van Houten, eds.). The University Museum, University of Pennsylvania, Philadelphia, 102 pp.

King, E. 1985a. Formats of archaeological and anthropological records. Pp.7–18 in *Preserving Field Records: Archival Techniques for Archaeologists and Anthropologists* (M. Kenworthy, E. King, M. Ruwell, and T. Van Houten, eds.). The University Museum, University of Pennsylvania, Philadelphia, 102 pp.

______. 1985b. Film, tape, and video. Pp.41–59 in *Preserving Field Records: Archival Techniques for Archaeologists and Anthropologists* (M. Kenworthy, E. King, M. Ruwell, and T. van Houten, eds.). The University Museum, University of Pennsylvania, Philadelphia, 102 pp.

______. 1985c. Time line for record preservation. Pp.91–95 in *Preserving Field Records: Archival Techniques for Archaeologists and Anthropologists* (M. Kenworthy, E. King, M. Ruwell, and T. Van Houten, eds.). The University Museum, University of Pennsylvania, Philadelphia, 102 pp.

PROGRAMMATIC APPROACHES TO PRESERVATION IN ARCHIVES

Bellardo, L. and L. Bellardo. 1992. *A Glossary for Archivists, Manuscript Curators, and Records Managers.* The Society of American Archivists, Chicago, 45 pp.

Calmes, A. 1985. *National Archives and Records Services (NARS) Twenty Year Preservation Plan. Publication NBSIR* 85-2999. National Archives and Records Service, Washington, DC, 67 pp.

______. 1992. Practical aspects of plastics found in archives. Restaurator, 13: 23–36.

Commission on Preservation and Access. 1993. *The Report of the Task Force on Archival Selection to the Commission on Preservation and Access, April 1993.* The Commission Preservation and Access, Washington, DC, 7 pp.

Ellis, J. (ed.). 1993. Keeping Archives. D.W. Thorpe, Victoria, Austria, 374 pp.

Ham, F.G. 1993. Selecting and Appraising Archives and Manuscripts. The Society of American Archivists, Chicago, 106 pp.

Holden, M. 1992. A programmatic approach, Archives preservation update. American Institute for Conservation of Historic and Artistic Works, Book and Paper Group Annual, 11:159–162.

Klinger, J. 1992. A Mexican governor's legacy, a conservator's puzzle, Archives preservation update. American Institute for Conservation of Historic and Artistic Works Book and Paper Group Annual, 11:167–172.

Lynn, M. 1990. The relationship between digital and other media conversion processes: a structured glossary of technical terms. The Commission on Preservation and Access Report Preservation and Access Technology, August 1990. The Commission on Preservation and Access, Washington, DC, 49 pp.

O'Toole, J. 1990. *Understanding Archives and Manuscripts.* The Society of American Archivists, Chicago, 79 pp.

Pugh, M. 1992. *Providing Reference Services for Archives and Manuscripts.* The Society of American Archivists, Chicago, 123 pp.

Puglia, S. 1989. Negative duplication: evaluating the reproduction and preservation needs of collections. Pp.123–134 in *Topics in Photograph Conservation*, 3rd ed. (R. Siegel, ed.). American Institute for Conservation Photographic Materials Group, 172 pp.

Ritzenthaler, M. 1992. Historical perspective and current approaches, Archives preservation update. American Institute for Conservation of Historic and Artistic Works Book and Paper Group Annual, 11:156–158.

Vogt-O'Connor, D. 1994. Archival and manuscript materials at the National Park Service. Cultural Resource Management, 17(5):33–35.

Wilsted, T. and W. Nolte. 1991. Managing Archival and Manuscript Repositories. The Society of American Archivists, Chicago, 105 pp.

PREVENTIVE CARE, TREATMENT, AND DISASTER PREPAREDNESS IN LIBRARIES

Blaser, L. 1977. *Display Cradles for Books: Board Construction. Library of Congress Publications on Conservation of Library Materials, Conservation Workshop Notes on Evolving Procedures, Series 600 No. 1,* Library of Congress, Washington, DC, unpaginated.

Boyd, J. 1985. An adjustable book cradle design. American Institute for Conservation of Historic and Artistic Works, Book and Paper Group Annual, 4:1–21.

Buchanan, S. 1980. Disaster prevention and planning, Oklahoma Librarian, 30(9):35–41.

Carlson, L. , J. Bertonaschi, M. Healey, L. Kidder, N. Lev, B. Muens, C. Paulson, and C. Beyer. 1994. *Boxes for the Protection of Books: Their Design and Construction.* Preservation Directorate, Collections Services, Library of Congress, Washington, DC, 151 pp.

Grandinette, M. and R. Silverman. 1992. Who, what and where in book repair: institutional profiles. American Institute for Conservation of Historic and Artistic Works Book and Paper Group Annual, 11:34–84.

Horton, C. 1969. Cleaning and Preserving Bindings and Related Materials. 2nd ed. Library Technology Program, American Library Association, Chicago, 87 pp.

Mohlhenrich, J. 1993. *Preservation of Electronic Formats and Electronic Formats for Preservation.* Highsmith Press, Fort Atkinson, WI, 144 pp.

Morrow, C. 1982. *Conservation Treatment Procedures.* Libraries Unlimited, Littleton, CO, 191 pp.

Myers, J. and D. Bedford. 1981. Disasters, prevention and coping, Proceedings of May 21–22 1980 Conference on Disaster Preparedness, Stanford 177 pp.

Waters, P. 1991. Phased preservation:philosophical concept and practical approach to preservation. Special Libraries, 81(1):35–43.

PRESERVATION OF DOCUMENTS IN MUSEUMS

Bliss, S. 1984. Conserving and cataloguing 150 years of US business ephemera. Pp. 2, 8 in Smithsonian Research Reports, Winter 1984. Smithsonian Institution, Washington, DC, 8 pp.

Fiske, E. 1993. Metropolitan Museum of Art Japanese print collection: Condition survey, computer cataloging and exhibition concerns. American Institute for Conservation of Historic and Artistic Works Book and Paper Group Annual, 12:13–19.

National Park Service. 1994. *Museum Handbook, Part II.* National Park Service Curatorial Services Division, Washington, DC, 150 pp.

Norris, D. 1992. Photographs. Pp.64–75 in *Caring For Your Collections* (H. Whelchel, ed.). Harry N. Abrams, Inc., New York, 216 pp.

Thompson, M. A. 1992. *Manual of Curatorship, 2nd ed.* Butterworth-Heinemann Ltd., Oxford, 756 pp.

Whelchel, H. 1992. Caring for Your Collections. Harry N. Abrams, Inc., New York, 216 pp.

Wilhelm, H. and C. Brower. 1993. The Permanence and Care of Color Photographs: Traditional and Digital Color Prints, Color Negatives, Slides, and Motion Pictures. Preservation Publishing Company, Grinnell, IA, 744 pp.

CUSTOMIZED HOUSING, TREATMENT, AND CONSERVATION RESEARCH

Maxson, H. 1986. Design and construction of a support for a folding fan. American Institute for Conservation of Historic and Artistic Works Book and Paper Group Annual, 5:33–38.

Mosier, E., D. van der Reyden, and M. Baker. 1992. The technology and treatment of an embossed, chromolithographic 'mechanical' victorian valentine card. American Institute for Conservation of Historic and Artistic Works Book and Paper Group Annual, 11:100–125

Stanley, T. 1992. The treatment of early Russian manuscript scrolls. American Institute for Conservation of Historic and Artistic Works Book and Paper Group Annual, 11:186–196.

van der Reyden, D., 1980. *Guidelines for the Care of Paper Artifacts.* Manuscript on-file in the Office of the Registrar, National Museum of American History, Smithsonian Institution, 40 pp.

_____. 1994. Material care and material science: preservation of paper-based research collections. The Grapevine, News from the Smithsonian Forum on Material Culture, 14:1–2.

_____. 1995. Preservation responsibilities. Pp. 63–71 in *Materials Issues in Art and Archaeology IV.* Materials Research Society Symposium Proceedings. Cancun: Materials Research Society, Pittsburgh, 1995, vol. 352. 918 pp.

_____. 1995. Genuine vegetable parchment paper: Effects of accelerated aging on some physical and chemical properties. Pp. 271–284 in *Materials Issues in Art and Archaeology IV.* Materials Research Society Symposium Proceedings. Cancun: Materials Research Society, Pittsburgh, 1995, vol. 352. 918 pp.

van der Reyden, D. and D. Williams. 1992. A load to bear: Papier maché furniture, its conservation and care. Antiques Show Magazine, 0:29–34.

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APPENDIX I

Preservation Responsibilities

Preservation planning is an administrative function required for the implementation of policies that are based on established standards and practices (such as risk management, cost-benefit analysis, handling guidelines, supply specifications). Effective planning should be done in conjunction with assessment surveys of institutional environment and security; collection priorities based on value, use, and risk; and item-level condition and housing needs to ensure responsible levels of accessibility and care that is appropriate to the needs of collections. A consideration of the budget, staff, supplies, space, and time resources of the repository is mandatory. Preservation planning facilitates reformatting, environmental control, collections maintenance, treatment, research, and training.

Reformatting to make preservation copies can protect original documents from handling while increasing accessibility for general use. The original formats of collections must be assessed using objective selection criteria (value, use, and risk). These selection criteria determine the most appropriate reformatting options based on permanence, cost, time, personnel, quality, *etc.* to produce and distribute new formats (*e.g.*, photocopies for low value, use, and risk originals; color transparencies and digitization for high value, use, and risk collections) following current published criteria and cost-benefit analysis. Various formats (original, archival original, preservation master copy, duplication master copy, and user copies) are then stored according to individual optimum environmental criteria.

Environmental control preserves collections by controlling critical factors (light, temperature, relative humidity, pollution, and pests) throughout a facility to meet the needs of various formats (*e.g.*, cold storage for originals and masters, cool for duplication copies, and ambient for user copies). Effective environmental control depends on the use of appropriate furniture (closed shelves or shallow drawers), containers (horizontal or vertical file, print or document boxes), and housing (paper or polyester enclosures). Appropriate procedures incorporate integrated pest management and emergency preparedness into building and collections maintenance (see Wilcox; Roberts, this volume).

Collections maintenance preserves by preventing loss of informational, evidential and intrinsic value by controlling environment and handling to ensure accessibility of collections. To aid accessibility and protect the collections, some documents might receive limited on-site physical stabilization (flattening and reinforcement), while rare documents might be selected for more comprehensive professional conservation treatment.

Conservation treatment can chemically and physically stabilize selected individual or batches of deteriorating documents (*e.g.*, illustrations having brittle mounts or sticky tapes) to facilitate accessibility. Selection criteria and scheduling might follow a triage protocol for remedial, batched, or customized treatments, based on standards and practices developed through conservation research.

Conservation research utilizes materials science to characterize the technology, nature, and deterioration of collections to augment their use for research in the cultural and natural sciences. Conservation research also helps enhance preventive and interventive care protocols for collections and develop, test, evaluate, and modify models and theories for new standards and practices to improve preservation administration policies.

Preservation training ensures that all the responsibilities noted above are implemented to the highest standards. It encompasses inhouse and outreach education for all levels of internal and allied staff, as well as the public. Training incorporates introductory orientations, midcareer updates, career enhancement, and advanced scholarly programs. Training and educational curricula should target each of the responsibilities outlined above, starting with preservation administration and assessment.

APPENDIX II

Preventive Care Action Steps
That Can Be Implemented Immediately With Low Cost and High Impact

Conduct assessment surveys to determine collection needs and resource allocations. These surveys include:

- Environmental surveys of a facility's HVAC systems, light levels, emergency preparedness, *etc.*, to establish or modify policies; to identify resources and budgets for short-, mid-, and long-term protection and accessibility of materials, and to develop a schedule for allocation of time and resources.
- Preservation priority surveys to prioritize groups of collections based on relative value, use, and risks.
- Random sampling surveys to assess and quantify the resource needs of individual collections (targeted by preservation priority surveys) by evaluating the size, condition, storage housing, and nature of the collections to determine whether new storage, *etc.* is needed and, if so, the type and quantity.
- Item-by-item surveys to prioritize groups of collection material for treatment.

Write policies, guidelines, and budgets to develop:

- Handling procedures for staff and users. Depending on available expertise, such guidelines can be basic or complex, *i.e.*, they may incorporate information on the environment and the nature and deterioration of materials.
- Appropriate materials and techniques to be used for storage or for exhibition.
- Framing and packing procedures, and other housing procedures.
- Disaster prevention, preparedness, and response procedures.

Initiate collections maintenance procedures including:

- Improving accessibility of collections through preventive care storage, or by duplicating or reformatting fragile or damaged material through photocopying, microfilming, color transparencies, facsimiles, models or replicas.
- Cleaning collections lightly where appropriate.
- Reinforcing or supporting damaged materials.
- Removing and replacing harmful materials (such as inappropriate fasteners on paper documents).
- Removing and replacing harmful housings (such as acidic envelopes), and rehousing documents with stable materials and appropriate techniques to protect the collections from improper handling and the environment.

Develop and raise funds for short-, mid- and long-range preservation projects including:

- Stabilization and treatment
- Research and development
- Training

APPENDIX III

Deterioration Problems Encountered in Document Collections, and Possible Solutions

	PROBLEMS			SOLUTIONS (phased approach)		
TYPE	APPEARANCE	CAUSE	EFFECT	1. Should only be done by a technician, trainee, or conservator.	2. Should only be done by a trainee or conservator.	3. Should only be done by a conservator.
MOLD	Localized; black, white or colorful; may have fluffy surface growth	relative humidity ≥ 65%; water damage; poor ventilation	staining; loss of sizing resulting in decreased strength and increased water sensitivity; contamination of other collection items	remove from collection; place in buffered folder or box; contact fumigation expert; control environment to reduce relative humidity and increase ventilation	remove from collection; locally remove mold using a fine brush; wear mask and gloves	remove from collection; locally remove mold using a fine brush, HEPA vacuum; wear mask and gloves; decolorize if possible and appropriate; reinforce, mend, fill, and/or line weakened or lost substrate
FRASS	small fragments of collection material; insect parts; feces	insect or rodent infestation	loss of support (substrate) material; contamination of collection	remove from collection; place in buffered folder or box; contact pest control expert familiar with collections	remove from collection; locally remove frass using a fine brush; wear mask and gloves	reinforce, mend, fill and/or line weakened or lost substrate
EMBRITTLEMENT	fractured, shattered, cracked or broken paper or mount; may be yellowed	inherent acidity from groundwood pulp, residual processing chemicals, alum rosin sizing; oxidation from light and heat; hydrolysis from moisture	no fold endurance; yellowed; could lead to loss of substrate	support paper, or mount, with insert and polyester film enclosure (if media not friable), or box of acid-absorbing (alkaline buffered) material	support paper, or mount, with sink mat	line paper or treat mount, if appropriate
FRAGILITY	extensively torn and/or creased	folding; mishandling; thin paper; acidic ink	tearing could extend with handling, could lead to losses	support paper in folder or polyester film (if media not friable)	if clean, heat-act mend if appropriate	clean, mend, fill, and line
ROLLED OR FOLDED	deformed; creased; cracked; or rippled	non-uniform compression, contraction, or expansion of paper	non-uniform size; cockling	protect in box of adequate size	humidify and flatten; place in oversized storage if necessary	humdify; flatten, mend, line; store in oversized storage
TACKY ADHESIVE	glossy; translucent; oozing	adhesive residue; tape residue	saturates color; yellows or stains; causes media to bleed or strike through; causes substrate to appear transparent	place in box	cover with non-stick material	remove tape and reduce adhesive with solvents
STAINS	overall or localized yellowing or darkening	hydrolysis and oxidation (by high humidity, light, and volatile acids from housing and pollution); formation of light absorbing double bonds in cellulose chain	yellowing edges from oxidation; darkening from acid materials	control environment to reduce humidity, light and pollution; protect items from acidity by rehousing in non-acid materials; remove loose deposits with brush	remove loose surface grime by drycleaning with fine brush and eraser crumbs	decolorize with solvents and chemicals to increase legibility
	localized brown or other discoloration, often having a contour line	acid impurities physically and/or chemically embedded within paper fiber	mat burn, slat burn, water stains, tape stains, adhesive stains	protect from acid materials by rehousing; document tape stains to target conservation	document tape stains to target conservation	remove tape and stains by chemical and physical means; decolorize stains to increase legibility
FRIABLE MEDIA	loose or smudged media	media has low binder content only loosely adhered to paper surface	loss of information and detail; blurring of image	test for friability with a fine brush; place horizontally in box so that nothing touches the surface	custom house in a fitted box or wrapper and sink mat	consolidate if appropriate
CRACKING OR FLAKING MEDIA	losses; cleaving or lifting of media	desiccation of binder; abrasion; differential expansion and contraction of media and substrate; acidity of media	loss of information	place horizontally in box and reduce movement; contact a conservator	place horizontally in box and reduce movement; contact a conservator	consolidate
FUGITIVE MEDIA	fading; other color change; change in contrast	decolorization of pigment or dye by light; inappropriate pH of storage materials	loss of information	protect from light; store in pH neutral enclosure	if pH sensitive, rehouse accordingly	no appropriate conservation treatment possible

APPENDIX IV

Summary of Light Damage to Documents and Recommendations for Control

Light damage to paper documents is caused primarily by ultraviolet radiation (UV) and visible light. Little damage is caused by infrared radiation (IR).

UV radiation damages by initiating photochemical reactions, including photolysis, which leads to:

- embrittlement resulting from chain scission and crosslinking of organic polymers in paper (fibers, size, additives);
- discoloration of chromophores from metallic or organic impurities, such as lignin, resin, starch, glue, *etc.*, from light absorbing double-bonds (leading to yellowing or darkening); and
- decolorization or color shift of pigments and dyes as bonds are broken.

UV radiation can be controlled by the following actions:

- reduce UV 95–98% by filtration with UF 3 Plexiglas®;
- reduce the light intensity level;
- reduce the duration of exposure to the UV source.

Visible radiation damages by photochemically induced oxidation, causing:

- discoloration, as above,
- decolorization or color shift.

Visible radiation is controlled only by reduction in light intensity level and time of exposure to the light source. Visible radiation damage is not controlled substantially by filtration with UF 3 Plexiglas®.

Infrared radiation causes damage when it is absorbed because it is converted to heat. IR radiation is controlled by controlling light intensity, distance, and increasing ventilation.

Recommendations for light levels and time of exposure vary according to the susceptibility of materials and are computed as lux/hours.

The susceptibility of the material can be categorized as follows:

- sensitive—fugitive media;
- unstable—media and substrate that contain light sensitive-impurities such as lignin, or are colored; and
- stable—high quality, noncolored media and support.

Intensity and length of exposure recommendations for various materials (assuming 1 footcandle = 10 lux, and 1 day = 10 hours).

- Sensitive:
  5 footcandles/3 months = 45,000 lux-hours
- Unstable:
  10 footcandles/5 months = 150,000 lux-hours
- Stable:
  15 footcandles/12 months = 540,000 lux-hours

The lux-hour computations are reciprocal, *i.e.*, an unstable paper document can be exposed at 500 lux for 1 hour or 50 lux for 10 hours and the effects are the same. The effect is also cumulative, *i.e.*, "rest periods" do not rejuvenate a paper document; the damage is permanent and additive.

APPENDIX V

Housing Options for Paper Documents

SUPPLIES		TYPE OF ITEM: pencil, chalk, charcoal, crayon, graphite, pastel media	ink media— not friable (ball point, bister, felt-tip, India, iron gall, sepia)	relief (letterpress print, wood block) or intaglio print (drypoint, engraving, etching)	planographic print (lithograph, photomechanicals, silk screen, stencil)	watercolor, acrylic, casein, gouache,oil tempera media	photographic media	newsprint	bound volume
POLYESTER	POCKETS		X		X		X	X	
	L-WELD		X		X		X	X	
	MATCH-BOOK WRAP		X		X		X		
	BOOK JACKET								X
	BOOK BAND								X
	POLYETHYLENE SRIPS								X
pH NEUTRAL OR ALKALINE BUFFERED PAPER	FOLDER	X	X	X	X	X	X	X	
	FLUSH FOLDER	X	X	X	X	X	X	X	
	FOUR-FLAP FOLDER	X	X	X	X	X	X		
pH NEUTRAL OR ALKALINE BUFFERED MAT BOARD	WINDOW MAT	X	X	X	X	X	X		
	WINDOW MAT WITH WRAPPER	X	X	X	X	X	X		
	SLING MAT	X	X	X	X	X	X		
	SINK MAT	X	X	X	X	X	X		
	INSERT MAT	X	X	X	X	X	X		
	PHOTO-CORNERS	X	X	X	X	X	X		
	JAPANESE TISSUE HINGE	X	X	X	X	X	X		
HORINZONTAL PRINT BOX		X	X	X	X	X	X		

APPENDIX VI

Basic Handling: Some Preservation Guidelines for Paper Documents

Don't	Do
• do not eat, drink or smoke where collections are stored, used, or displayed; these activities will attract insects and lead to structural loss and staining	• keep areas clean to avoid attracting insects and rodents; keep liquids away to prevent spills and stains; keep hands clean to avoid stains
• do not transport rolled documents under arms or without support	• support documents in folders, mats, boxes, etc. on carts, if necessary
• do not carry more than you can manage safely; avoid accidents, strain on the documents or on yourself	• request help if more than one person is required to move oversized or heavy material
• do not work in cramped spaces	• dedicate surface space on which to work that is at least two times the size of the largest item, to allow the item to be turned over
• do not handle documents more than necessary; this can tear and stain them	• use duplicates for sorting and selecting, and use originals for evidential value and materials science research, etc.
• do not slide documents around on top of one another	• slide a rigid support or folder under documents to move or turn them over
• do not grasp documents tightly by their edges	• move unsupported documents by holding them at opposite corner
• do not handle photographic materials with ungloved hands because finger oils can mar and degrade their surface	• wear gloves when handling photographic materials
• do not store photos or alkaline-sensitive materials in buffered paper because they may cause color change	• use pH neutral paper for photographs
• do not expose documents to unnecessary light because it can cause fading and/or darkening; don't allow light sources near documents because they can cause heat and curling	• control light intensity, proximity, and duration; keep documents in the dark, or in folders, closed boxes or closed drawers
• do not place elbows or extraneous materials on top of documents	• arrange adequate space to use, examine, and rehouse documents
• do not use pens in collections	• use graphite pencils while working in collections; require researchers to use pencils
• do not affix adhesive labels to documents	• use a #2 pencil if documents must be marked for identification; mark in a lower corner or on the reverse
• do not trim documents or dispose of fragmented pieces	• keep pieces together; they can be aligned in approximate place if encapsulated using ultrasonic welding to spot weld polyester film

Don't	Do
• do not use any tape to repair tears and loses; even "archival quality" tape may have reversibility problems	• provide adequate support for brittle or fragile documents; reduce access to them and schedule them for repair using stable materials
• do not fold documents to fit into folders or boxes	• store documents in appropriately sized containers
• do not use inappropriate interleaving materials or techniques; interleaving can cause swelling of bookbindings; Glassine is dimensionally unstable and looses strength upon aging; buffered tissues may cause color change in some blue pigments, cyanotypes, and albumen photographs	• use pH neutral tissue slip sheets or inert or uncoated polyester film under window mats for non-friable materials; use alkaline buffered insert paper behind encapsulated acidic documents
• do not pressure mount documents for display, or use improper glazing materials such as plexiglass for friable media	• use spacers in framing and ultraviolet filtering glazing
• do not use anti-static sprays on glazing that will come into contact with documents	• clean glazing with deionized or distilled water and small amount of alcohol, if necessary, and wait 15 minutes until the surface is thoroughly dry before installing document
• do not over or under pack containers because this jeopardizes the documents	• insert pH neutral or alkaline buffered board supports or wedges (the full size of the documents) to take up excess space in boxes
• do not use acidic enclosures or acidic containers such as kraft paper envelopes or wooden core solander boxes	• use high alpha-cellulose enclosures and boxes, either pH neutral or alkaline buffered
• do not allow friable materials (e.g., pastels) to travel, or flaking or fugitive media to be displayed	• make facsimiles of sensitive materials and use the facsimiles for display
• do not allow documents to be exposed to volatile acids from wooden or freshly painted furniture, or other pollutants	• keep documents from contact with volatile materials using only stable materials for adhesives, cleaners, and furniture
• do not laminate documents: the heat or solvent used can cause irreparable damage to them	• encapsulate appropriate documents in inert, uncoated polyester film using ultrasonic or heat-sealing techniques
• do not line fragile documents with fabric: fabric expands and contracts in the opposite manner of documents causing delamination and tenting or surface distortion	• schedule conservation treatment for documents that require lining
• do not remove documents from cold storage environments more than once per year; each removal counters a gain made by cold storage	• keep documents designated for cold storage in cold storage and use reformatted copies for general access
• do not pull books from shelves by headcaps	• remove books from shelves by pressing books on either side in or by pushing out from behind

Don't	Do
• do not rest books on their foredges	• rest books that must lay horizontally on their spines
• do not photocopy damaged books on regular copy machines	• copy damaged books, if necessary, on customized copy machines; reduce access to the books until treated by a conservator
• do not apply leather dressings to books	• protect leather covers with polyester film book jackets or book bands

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Volume I

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