

Introduction: Recognizing Problems

The following English text is from the script of a [video](#) available from the Smithsonian Center for Materials Research and Education, entitled:



Rescuing Records - Recognizing the Problems of Preserving Documents in Research Collections

Use:



Paper documents are such a common and integral part of our world, that we take them for granted. Until, that is, we are reminded of their vital importance to our lives, when faced by their potential destruction. For instance, as the earth's natural resources are consumed and some species of plants and animals vanish into extinction, we must rely more and more on paper documents to know the impact of our actions on our world. Such documents are found throughout



- *museums,*
- *research institutions,*
- *archives,*
- *libraries, and*
- *other collections.*

Value:



One reason that documents are so valuable is that they are often the primary or only record of our most profound enterprises. Documents preserve information on everything, from our first small steps into space to our earliest air craft in the sky (even though many of the actual aircraft themselves have long since been destroyed). Other documents preserve information about more earthbound structures that are endangered or have vanished. Some architectural drawings are the only record we have of the appearance and scale of threatened or lost structures. If such images become distorted from poor storage or handling, perceptions of our diverse cultures can also become distorted.



Collections documenting diverse plants and animals are especially fundamental to our understanding of the world. Scientific illustrations, for instance, may help gauge subtle changes that species might have undergone because of changes in their environments. These changes can threaten the existence of some species that could in turn threaten our very lives. For example, to find out whether mutation, evolution or extinction has occurred for a species, scientists may closely examine specimen found in research collections. Such research collections include illustrations that record the actual color of the specimen used in the original species description. However, comparison between the early original type specimen and a modern example can be complicated, especially if the colors of the original illustrations have changed because of storage in acidic envelopes or other poor conditions.



Risk:

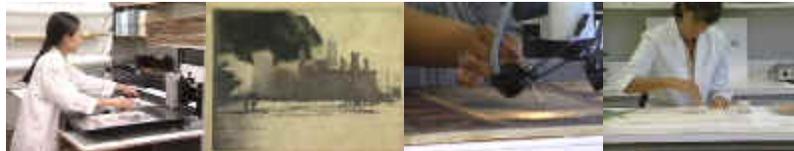
Preservation policies must be written to protect these unique and irreplaceable documents. Careful preservation planning can reduce the need for expensive conservation treatment or restoration in the future. Cost effective preventive care procedures must be integrated into preservation programs including



- *conservation treatment,*
- *collections maintenance,*
- *research,*
- *environmental control,*
- *training, and*
- *duplication.*



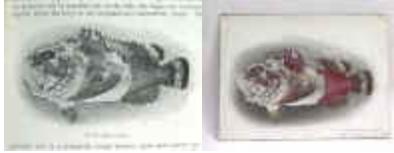
Sound preservation policies should require periodic surveys to assess a facility's environment and identify problems like poor display and storage conditions. Preservation surveys should also prioritize collections by comparing their relative *values, uses, and deterioration*, in order to target resources and funding for preservation efforts. *Handling guidelines* should be written to inform staff and users about which materials and methods are appropriate, or not, for storage, as well as for the display or exhibition of documents. Procedures for collections maintenance can include the replacement of harmful materials, as well as some light flattening and cleaning of documents.



Appropriate preventive care can preserve both the longevity of the collection and the budget of the repository. From a point of cost efficiency, preventive care is *far less expensive* than the conservation treatment that is necessary once the deterioration is allowed to progress too far. Even minimal resources can be utilized with maximal results if administrators, collections managers, conservators, scientists and users of the collections all work together to slow down rather than accelerate deterioration. Preventive care is particularly important since documents may, besides evidential and research value, also carry intrinsic information, which may be destroyed by deterioration or even the then needed conservation treatment.



Analysis of the techniques and materials involved in the production of the document, and of subsequent changes to it, may provide us with information well beyond that contained in the image or text itself. Moreover, we can deduce from these analyses how, and how quickly, the document may be expected to deteriorate. However, the quality of the information extracted from documents by material science is only as good as *the quality of material care* undertaken to protect documents from change.



Paper-based materials are found in different types of collections, but they dominate the holdings of archives and libraries. In libraries, individuals trained in library science must care for circulating collections of bound volumes. In archival holdings, archivists who are usually trained historians, maintain the order and context of paper based records of specific individuals or institutions. In both libraries and archives, paper materials are important for their *informational* value, in archives also for their *evidential* value, and in both, occasionally, their *intrinsic* value.



In museums, paper materials may be collected along with paintings, sculpture, textiles and other artifacts. Paper based materials can be important to curators and exhibit designers not only for their high *aesthetic* or *market value*, but also for their *research* value in illuminating history.

In research collections, paper based materials have been considered of ancillary value by researchers, scientists, or collections managers who in the past were concerned more with artifact or specimen collections. But in fact, such documents are often the primary sources validating artifact or specimen collections.



Documents can be defined as anything that records information, so there are a bewildering array of documents, although there are some clues to their identification. Documents come in many types of formats or *forms* and have various substrates or *supports*, as well as media, or the *material that forms the image*.



- A document's substrate might be *cellulose* as in newspapers, *cellulose acetate* or *nitrate* as in slides or negatives.



- Media include *colorants in binders* found in ink manuscripts; *silver in the emulsions* of some photographs; or *magnetic particles* on audio and video tapes.



- Formats include single or sets of sheets, or bound volumes like pamphlets and books whose pages are joined by adhesives, staples or sewing threads.

Substrates:



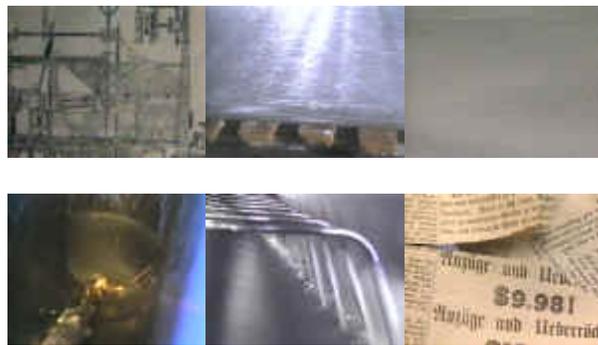
Each of these various components of documents have inherent *chemical and physical properties* that change as a document ages and deteriorates. The strength of the substrate may be *weakened*, or the color of the media can *shift*. Such deterioration can be caused by chemical reactions involving *acid materials, oxygen and water vapor*. Many documents are self-destructive from the moment they are made, since their chemical and physical components are reactive and unstable. This instability, inherent in some documents, is sometimes referred to as '*inherent vice*'.



Paper made prior to the 19th century was relatively *stable*. For most of history, paper was *hand-made*. Paper is made from a pulp of fibers originally derived from *plants*. The fibers are dispersed *in water*. Once they have been evenly distributed, they are randomly deposited on a *paper mould*. When the mould is *shaken*, the fibers become *interlocked* and *physically bonded* to form a *felt-like web* that becomes *chemically bonded* after it is *pressed and dried*. This early process of hand making paper from *cotton, linen or bast fibers* resulted in inherently strong paper.



During the Industrial revolution, *machines* were developed to mass produce paper by casting pulp on continually *moving belts*. Fibers in machine-made papers tend to line up *parallel* to the length of the belt, *weakening* fiber bonding and creating a *grain* in paper that can cause the paper to *curl, crease, or tear* in this direction. In addition, increased demand for paper resulted in the need for new sources of fiber, some of which are unstable, like *ground wood pulp*. Acidic materials like *lignin*, found naturally in ground wood pulp, along with unstable additives and procedures, like acidic *bleaching* and *sizing*, cause many modern papers to *discolor* and *weaken* as they age. Ground wood and acid-sized papers are not very *permanent or durable*, and can crease, split, and tear, particularly along the direction of the *grain*.



Media:



The media found on paper documents can also be extremely reactive or unstable. For instance, *friable graphite* from pencils can smudge when rubbed by handling or by adjacent materials or paint can crack and flake off. *Fugitive colors* can fade if exposed to light.



Soluble media can dissolve and run, or bleed and feather, even penetrating into the paper to cause strike through, seen on the reverse of the document. *Oily or acidic media* can cause discoloration by off-setting onto other documents or striking through their own paper substrates. Some acidic media, like iron gall ink, can even destroy the paper on which it used.



Documents composed of acidic materials must be *separated* to prevent contamination of their neighbors. Materials such as cellulose nitrate and acetate photographic negatives can give off gases as they age. When they are in closed containers or humid environments they may rapidly decay beyond recognition. If they have begun to deteriorate, photographic materials should be copied to preserve their information for scholars. Duplication methods include making surrogate negatives or prints. These can then be scanned onto computers and the images distributed world-wide. The duplicate negatives, like the originals themselves, should be placed in controlled environments, such as cool or cold storage, in order to slow down deterioration. Duplication, which replicates only the *superficial appearance* of the original, not the *physical or chemical make-up* that authenticates a document, can none-the-less protect an original from *unnecessary handling*.



External Factors of Deterioration:



Deterioration is accelerated by detrimental environmental agents such as

- *light,*
- *temperature,*
- *relative humidity,*
- *pollution, and*
- *pests.*



Light:

Light can cause oxidation, which leads to chemical changes that can *fade or darken* some types of paper and media, and make paper very brittle. Document deterioration caused by inherent vice, such as sensitivity to light, can be accelerated by incorrect use, storage, and display. Only part of a document might be affected by the light if the document is partially covered by items laid on top of it. This is especially obvious in documents that have been matted. Display or exhibition of paper materials result in most of the excessive exposure to light that documents receive. Sensitive items should only be exposed to light that is *filtered* to block harmful *ultra-violet radiation*. Even then, light levels should be low and the documents exposed for only short periods of time. The relationship between the light levels and duration is reciprocal. The lower the level, the slower the damage. The brighter the light, the greater the damage. Damage caused by light is *irreversible!*



Temperature and Relative Humidity:

Documents are also at risk of damage from lights when they are being used, examined, or photographed by researchers. This is because the *heat* produced by some lights can cause a rapid rise in temperature. This can cause the paper to *curl* as humidity levels change.



Changes in relative humidity may alter the chemical and physical stability of paper materials. Special attention should be paid to documents having multiple layers of substrate and media. Each layer may respond to changes in temperature and humidity in different ways. This will result in uneven strains, cracking, and distortions of the image.



An increase in humidity can cause *cockling*, or a series of parallel ripples that distort the paper. Increased humidity and moisture can also cause *blocking*, when papers with surface coatings stick together. When someone tries to separate the sheets, *skinning*, or the random tearing of the thin surface coating that carries the image, occurs. Both blocking and skinning are particularly a problem in books that have been damaged by water. Clay-coated papers are particularly susceptible.

Paper manuscripts can be discolored and damaged by mold. Mold can grow on paper when the relative humidity exceeds 65%. *Foxing* can be caused by mold that attacks portions of a document containing metallic impurities left in the paper from manufacturing processes.



Acids and Pollution:

Acidic materials in mats can cause *mat-burn*, and wooden frame backs can cause *slat-burns*. Acids in storage boxes with ground wood cores or wooden storage cabinets can volatilize and cause acidic discoloration in paper. Atmospheric pollution and dirt particles can circulate through unfiltered ventilation systems, contributing to *discoloration and abrasion* in documents.



Pests:

Insects, rodents and other pests can cause various types of *surface stains and losses*. Immediate action must be taken to prevent loss of entire collections from active infestation caused by mold or pests. Infested materials should be isolated, and a fumigation expert experienced in collections should be contacted at once.



In short:

- Research, display, and storage areas should have light sources filtered against ultra-violet radiation to minimize light damage.
- The temperature and the relative humidity should be kept as constant as possible, for example around 70oF. and 50% relative humidity. The lower the light, temperature, and RH, the slower the damage.
- Food and beverages should be kept away from collections since they can cause stains and attract pests.



Handling:

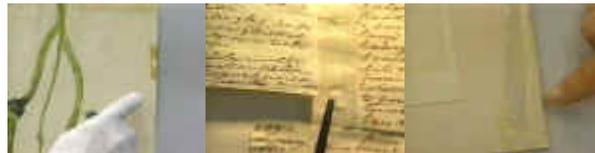
The most difficult pests to safeguard against are people. Documents can be irreparably marred, weakened, and distorted by indentations made from note-taking. The dirt and oil from our hands can cause fingerprint stains that are permanent, so touching any type document with bare hands should be *avoided*. Clean white cotton gloves can protect materials that are especially sensitive, such as photographs or video and audio tapes, from damage caused by hand oils.



Using fasteners, like some paper-clips and staples, can weaken paper by causing *holes, indentations and rust stains*. Trying to replace or remove documents stored in crowded containers can cause *tears, folds and creases*. Force should never be used to remove or replace a folder or document.



Rolling paper documents for storage can sometimes result in a series of parallel creases. Well-meaning, but misguided attempts to clean or repair documents often cause damage. Some cleaners are not only abrasive, but are difficult to remove.



Most tapes can cause *stains* in paper and are difficult or even impossible to remove safely. Water-activated tapes, like paper- or cloth-backed adhesive tapes, can cause *impressions* and other distortions. Adhesive residues can *permeate paper, becoming tacky, brittle, or cracked*. Adhesives sometimes cause paper to stick together or become stained. Tapes and adhesives should only be removed by *conservators* trained in the chemical, physical, and historical properties of paper documents.



Conservators are experienced in the safe use of solvents and specialized equipment. Individuals responsible for collections should seek assistance from conservators, or conservation educators and scientists, in order to [solve](#) many of the preservation problems facing documents. But anyone can protect paper from most agents of

deterioration. Research records can be rescued by appropriate *storage, handling and display*.



Conclusion:

We know that we face the potential loss of some of our natural resources if we expose them to hostile external environments. But now we have learned that we also face the potential loss of the records that document both our natural and cultural resources. These records will be *lost* if we misuse them or store or display them in hostile interior environments. If we are to preserve our natural heritage, we must also conserve our cultural heritage. To do this, we must rescue our records not only from disastrous emergencies, but also from disastrous *neglect*.

Credits: Script by Dianne van der Reyden (Senior Paper Conservator, Smithsonian Center for Materials Research and Education(SCMRE), formerly known as the Conservation Analytical Laboratory (CAL), Smithsonian Institution) and Diane Vogt-O'Connor (Senior Archivist, Curatorial Services, National Park Service). Production by Cinemasound, 1995.

This tape is the first in a series by the Smithsonian Center for Materials Research and Education (SCMRE) on the preservation of documents. For more information about the series, or for additional information on preservation, contact the Smithsonian Center for Materials Research and Education (SCMRE); The American Institute for Conservation of Art and Historic Artifacts (AIC); The American Library Association (ALA); The Canadian Conservation Institute (CCI); The National Institute for Conservation (NIC); The Society of American Archivists (SAA); or similar organizations.

Reference: [See following for solutions](#) to the problems noted in this text, and for a complete list of references: van der Reyden, D. 1995. "Paper Documents," for *Storage of Natural History Collections: A Preventive Conservation Approach*. (C.L. Rose, C.A. Hawks, and H.H. Genoways, eds.). Pittsburgh, PA: [Society for the Preservation of Natural History Collections](#), pp. 327-354.

To take the quiz...