



PREVENTIVE CARE OF BOOK COLLECTIONS

With proper care, books can last for centuries—but they are also fragile. In *The Inheritance of Loss*, novelist Kiran Desai (2006) provides a vivid reminder of what can happen to books in an uncontrolled environment:

The Gymkhana library was a dim morguelike room suffused with the musk, almost too sweet and potent to bear, of aging books. The books had titles long faded into the buckled covers; some of them had not been touched in fifty years and they broke apart in one's hands, shedding glue like chitinous bits of insect. Their pages were stenciled with the shapes of long disintegrated fern collections and bored by termites into what looked like maps of plumbing. The yellowed paper imparted a faint acidic tingle and fell easily into mosaic pieces, barely perceptible between the fingers—moth wings at the brink of eternity and dust. (217)

Light, heat, humidity, insects, dust, and careless handling all take their toll on book collections, which can contain a wide variety of organic and inorganic components: wooden boards, paper or parchment leaves, cloth or leather coverings, metal bosses, and many different inks and pigments. Each of these materials responds differently to environmental conditions, and the most sensitive components ideally determine how the books are handled, stored, housed, and exhibited. Although damaged books can often be rescued through conservation treatment, it is far more economical and effective to prevent their deterioration by following some basic preservation guidelines.

LIGHT LEVELS AND ULTRAVIOLET RADIATION

Light can permanently fade carpets and drapes. It can also fade book spines, change the color of paints or inks, and bleach or darken paper. Too much light exposure eventually weakens and decays paper, cloth, and leather, particularly if high-energy ultraviolet (UV) waves are not filtered out. These waves not only give people sunburns, they also damage a wide variety of organic materials—and glass alone does little or nothing to block UV radiation.

To protect books from light and UV damage, store and exhibit them away from windows and skylights. If this is not possible, use curtains or blinds to block the light. In addition, consider installing UV filters on all local light sources. Both sunlight and artificial light from fluorescent tubes or tungsten-halogen bulbs contain UV, although sunlight contains far more. UV films can be adhered to window glass. UV filters are also available for artificial light sources, including plastic sleeves that slip over fluorescent tubes and lens filters for tungsten-halogen bulbs. Exhibition cases can also be made with UV-filtering glazing. However, all such UV filters have limited life spans and must be checked regularly for damage and functionality.

Light and UV meters can be used to check the performance of filters and to determine how much visible light and UV radiation are reaching a given storage or exhibition space. The readings are expressed in footcandles or lux for visible light—units that express the amount of light energy illuminating a square foot or square meter, respectively—and in microwatts (W) per lumen, or the ratio of UV energy to visible light energy, for UV radiation. Ideally, all UV will be blocked, and light levels will be as low as is commensurate with successful reading or viewing of books. Conservators recommend keeping visible light and UV levels

below the limits listed in Table 1. These limits are especially important for long-term book exhibition, since light damage is cumulative and irreversible. Although 50 lux may seem like very low light for reading, good exhibition designers will provide conditions that allow visitors' eyes to adjust to dim lighting. Even in these conditions, books with sensitive media should not be exhibited for more than six weeks, and the pages on display should be changed frequently to prevent overexposure of any given book opening. If books contain particularly light-sensitive materials, including certain fugitive dyes and pigments, consider draping their display cases with heavy fabric that can be removed for viewing, or place the room's lighting on a motion-sensitive switch.

Table 1: Recommended light levels for books and paper-based collections

Storage	1-5 footcandles, 10-50 lux
Work Areas	30-60 footcandles, 330-660 lux
Exhibition (six months or less)	5-15 footcandles, 50-150 lux
Ultraviolet Content	Less than 0-10 μ W/lumen

HEAT AND HUMIDITY

Books are also sensitive to heat, moisture, and fluctuations in temperature and relative humidity. High temperatures speed up the rate of deterioration of all book materials, and low temperatures lead to drying and embrittlement of once-flexible cloth, leather, and paper. High humidity levels can actually speed up the rate of photodegradation, making light even more damaging. They also foster mold growth and accelerate the deterioration of acidic paper, inks, and leather. Fluctuations in humidity can cause book boards to warp and parchment or vellum to shrink and deform. Whenever possible, both the temperature and the relative humidity in collections storage and exhibition spaces should be kept within a range that stabilizes the organic materials of which books are made.

Relative humidity (RH) is a ratio that relates the amount of water actually present in air to the amount of water the air could hold if it were fully saturated. Since air can hold more moisture at higher temperatures, RH is dependent on temperature. For long-term book care, understanding existing RH and temperature conditions is crucial. Measurements may range drastically within a given building or even a given room, influenced by factors such as windows, air vents, leaks, and whether a space is above or below grade. Traditionally, institutions have used expensive hygrothermographs to track the temperature and RH in given areas. Today, digital dataloggers are available that use integrated thermometers and electrolyte solutions to monitor ambient conditions; the data they gather can be downloaded directly to a computer for tracking and analysis.

Although many conservators believe that books and archives would survive longest at 45°F and 30%RH—temperature and humidity levels more like those in a refrigerator than those found in most libraries and museums—making even small changes to existing temperature and RH patterns can have a tremendous impact on the longevity of book collections. Reducing the temperature in which acidic books are stored by 9°F may increase their lifespan 100-fold; cutting the RH in half may double their lifespan. Ideally, books should be stored in their own climate-controlled space at temperature and RH levels that are rather low for human comfort (see Table 2).

Table 2: Recommended temperature and RH levels for paper-based collections.

	Recommended Goal	Recommended Range
Temperature	65°F	\pm 2-3°F daily; +10°F/-20°F seasonally
Relative Humidity	45%	\pm 3-5% daily; \pm 10% seasonally

Where these standards are impossible to maintain—due to historic building structures, HVAC system construction, or budgetary constraints—it is important to limit the amount of RH and temperature fluctuation to the extent possible. Store book collections in cooler, drier areas of the building, away from exterior walls, basements, attics, and sources of water leaks. (RH should never rise above 75% because of the risk of mold growth.) Use fans and dehumidifiers as necessary to provide even ventilation and reduce moisture. Place particularly sensitive books, like those covered in parchment or vellum, in alkaline storage boxes that buffer any changes in RH and temperature. Whenever possible, use separate storage areas, exhibition cases, or individual boxes to create microclimates that foster the long-term chemical stability of book materials.

PEST MANAGEMENT

Bookworms are real, and they love to eat the glue that holds book spines together—but conservators are far more likely to see damage related to silverfish, cockroaches, or mice. Many insect and rodent pests produce specific types of book damage, from the lacy surface grazing of bookcloth and starch-sized paper (silverfish) to the gnawing of entire volumes (mice). Cockroaches and other insects leave frass and droppings everywhere.

To prevent such damage from occurring, private collectors and institutions alike should create integrated pest management plans for preventing, monitoring, and eradicating pest infestations. Private pest management firms that specialize in libraries and museums can provide comprehensive monitoring and treatment services. In addition, staff members should be alert to signs of infestation, and they should quarantine all donations and new accessions until they have been examined for pests and mold. Corrugated cardboard boxes, which often harbor colonies of silverfish, should never be allowed into storage or exhibition areas—at least without careful inspection for insects. Fresh flowers, food, and food waste should be kept out of collections areas or removed daily. Floor drains and other entrance points should be screened to keep rodents and insects out of the building.

One of the best ways to monitor for insect infestation within a collection is to use sticky traps. Simple sticky traps—placed face-up on the floor for most insects or face-down on pennies for silverfish—trap a wide variety of pests (Parker 2009). The traps should be checked and changed on a regular basis, and designated staff members, volunteers, or pest-management contractors should record the number and type of insects trapped. The relative amounts of insects on traps in different areas may help to triangulate sources of infestation.

If a book or building is found to be infested and treatment is required, pesticides and tracking powders should be avoided, as they can contain chemicals that are toxic to humans. For rodent infestations, traps are the preferred method of removing the pests. Baits should never be used, as they can contain carpet-beetle eggs that will produce a new infestation. For insect-infested books, the simplest and most cost-effective method of treatment is freezing. Place each book in a polyethylene (Ziploc) bag and freeze it at -20°F for at least 72 hours. Anoxic treatments—which remove all the oxygen from the book and replace it with a gas such as carbon dioxide—are also available, but they take at least two weeks to complete and require extensive technical expertise.

HOUSEKEEPING

Dirt, dust, and other contaminants accelerate the chemical deterioration of books. Dirt and dust trap moisture next to the objects they land on, and they can stain or abrade book materials. Certain cleaning products can also pose problems for book collections. Ammonia attacks metals, and peroxides catalyze the oxidation of organic materials. Airborne

pollutants—including sulfur dioxide, nitrogen oxides, ozone, and many acids—can corrode metals and damage paper and leather.

To protect books from the effects of dirt and other contaminants, dust books and bookshelves regularly with a soft brush, or vacuum them using a brush attachment. Train the housekeeping staff and volunteers to handle books and bookends safely. Evaluate the cleaning solutions and dust cloths currently in use to see whether less harmful ones should be substituted. Install particle filters in the HVAC system and ensure that they are changed on schedule. Store books away from sources of gaseous pollutants, including copying machines, open windows in urban environments, and new wood or particleboard furniture.

STORAGE AND HANDLING

Because books are mechanical objects that must be manipulated to be read, they are often damaged through improper usage. Books can also suffer during storage or when transported between library stacks and reading rooms. For the greatest impact on the long-term condition of a book collection, ensure that museum or library staff, volunteers, and visitors follow basic book-handling and book-storage guidelines.

Overcrowded bookshelves are a common problem because they can cause books to be crushed, warped, or even lost. Small books can get shoved to the backs of shelves when larger books are placed next to them. Whenever feasible, group books by size so they can support one another on the shelf. Use bookends to keep books from slumping or leaning, but be aware that slim, flat metal bookends can slide between leaves during shelving and cut or crush the paper. If books are too large to be shelved upright, place them spine-down on the shelf rather than spine up. Although this makes the book harder to identify, it prevents gravity from pulling the text block out of its binding. Heavy, oversized books such as atlases should be stored flat with their spines facing out. Shift books between shelves as necessary to prevent overcrowding.

If books are already damaged, or if they contain parchment or vellum leaves or covers, fitting them with alkaline storage boxes can prevent further damage and stop fluctuating environmental conditions from warping the parchment. Boxing a book makes sure that loose leaves or detached covers are not lost, and it also protects books from light and dust. Although boxed books take up more shelf space, the fragmentary or fragile books inside can be moved, stored, and used more safely. In many cases, the enclosures can be made quickly and inexpensively from 10-point alkaline cardstock. Custom-fit alkaline book boxes are also available from online vendors (see Resource List).

When retrieving a book from the shelf, be careful not to put unnecessary stress on the binding. Pulling a book from the shelf by inserting a finger at the top of the spine can tear the spine away from the cover. Instead, push in the books on either side of the desired volume and grasp the body of the book firmly before pulling it out. If the books are shelved too tightly to allow this, reach over the desired book and push back on the top edge of the text block to move it out of the shelf. Once books have been retrieved from the shelf, don't carry too many at a time. A tall stack of books can easily topple or block your vision and cause you to fall. If many books have to be moved, use a cart or make multiple trips.

Readers should also follow certain guidelines. Pens and greasy food crumbs leave permanent stains on book pages. Only use pencils in reading rooms, and never eat, drink, or smoke in collections areas. Although sticky notes are marketed as removable, they leave adhesive residues behind and become more and more difficult to remove over time. Rubber bands also degrade and leave sulfurous residues. Paper clips and staples bend pages and create rust stains in humid environments. Even acidic paper bookmarks can turn adjacent

book leaves brown if left in a book. Whenever possible, use only alkaline or buffered paper bookmarks.

Opening a book too far can cause the glue and sewing thread holding the leaves together to fail. Books should never be opened past the point at which they begin to resist. To maintain this opening, place valuable books on cushions or book cradles to support the binding and prevent the spine from breaking. Book cradles should be made of non-reactive, conservation-grade materials such as polyethylene foam or alkaline mat board. For exhibition, they should be custom-fitted to the desired book opening, and the book should be strapped in place with narrow polyethylene straps.

When creating photocopies or scans of book leaves, it is also important not to stress the spine of the book by flattening it against the bed of the copier or scanner. Although it uses more paper and necessitates more copies, it is usually safer to capture only one page at a time, allowing the spine to lie on the lip of the platen. In this era of widespread digital photography, it may be safest to capture images of the text on camera and then to print them.

In the past, many people who cared for books treated their old leather bindings with leather dressings, which were thought to nourish and rehydrate the leather. Today, most conservators agree that such dressings—which often contained neatsfoot oil or other lubricants—were more likely to promote drying and cracking of the leather over the long term. Although leather bindings may become dry, dusty, and cracked with age, it is better to place them in Mylar or Melinex jackets or to wrap them in acid-free paper than to apply leather dressings. Plastic-based leather-repair products should also be avoided.

If a book is already damaged and conservation treatment is not an option, providing it with an alkaline storage box is often the best solution. Torn leaves and covers should never be repaired with pressure-sensitive tapes such as masking tape, packing tape, or transparent office tape. Over time, these tapes become rigid and place additional stresses on the paper and bindings. They also become more sticky, stain the original book materials, and require toxic chemicals to remove. Make fragile or fragmentary books a priority for future conservation treatment.

Caring for books is a great privilege, as well as a great responsibility. From illuminated manuscripts to today's bestselling novels, books capture period technologies and permit intellectual access to other times, places, and cultures. By providing books with the proper environmental conditions and handling them with care, we let future generations share these treasures.

RESOURCE LIST: ONLINE SOURCES FOR ARCHIVAL STORAGE BOXES

Whenever possible, measure your books and buy archival boxes custom-fit to those measurements. Boxes in standard sizes can also be padded to fit with polyethylene foam or acid-free paper. For printed books or manuscripts, look for boxes that are acid-free, lignin-free, and buffered (alkaline). For scrapbooks or items that contain photographs, make sure the boxes have passed the photographic activity test (PAT).

Gaylord, www.gaylord.com
Hollinger Metal Edge, www.hollingermetaledge.com
MicroClimates, www.archivalboxes.com
Talas, www.talasonline.com
University Products, www.universityproducts.com

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