

THE ENEMIES OF PAPER **AND HOW TO** **MINIMIZE THEM**

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Paper is a fascinating material. A favorite substrate of artists, it can endure for centuries if properly made, handled and preserved, or it can be quickly destroyed by accident or carelessness.

The process of making paper today is remarkably similar to methods used seven hundred years ago. Of course, modern machinery has increased manufacturing capacity, and technology allows us to control quality, cost, longevity and other characteristics. Consistency and variety are our modern advantages, but paper is still much the same as it has been all along.

Relatively few custom picture framers have the special education & training to properly preserve, as well as present, valuable paper items. Framers who are not truly qualified in matters of preservation may unknowingly cause damage or destruction. Concerned owners should learn enough to judge the skill, knowledge, and integrity of framers and others who handle their paper treasures. Qualified framers answer questions thoroughly, and offer their credentials and references to informed clients.

If a valuable paper item is already damaged, perhaps it can be repaired. A qualified paper conservator (a specialized scientist who knows the chemistry of papers, inks, and other related substances) should be consulted. Most museums are acquainted with professional conservators and use them regularly.

Everyone handles paper every day, but most of us know relatively little about its care and preservation. Paper has more “enemies” now than at any time in history. This brief overview is intended to help your awareness of potential hazards and help you prevent their harmful effects. Deterioration of valuable papers can thus be slowed, so that they can be preserved and enjoyed by future generations.

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INHERENT FAULTS

- * Stray pieces of fiber or metal in the paper.
- * Marks from hasty drying, curing.
- * Alum content (sizing) which will eventually destroy the paper from within.

Newsprint, for example, will be in durable condition for no more than a couple of decades, perhaps less. That is its nature by design. It is not intended to endure, and contains many inherent faults.

Note that even the best papers may have imperfections, but if these will not affect the longevity of the sheet or its suitability for the intended use, they are generally acceptable.

Choose good quality paper. Paper made of 100% alphacellulose (purified paper fibers, processed to remove all lignins) is intended for permanence and is recommended for artworks.

Avoid most copier papers, Kraft papers, newsprint, construction papers, recycled papers, and others of questionable content and longevity. Generally, inherent faults cannot be corrected, although the effects of acid can be slowed by addition of chemical buffers during manufacture, or later by a qualified conservator.

ACID

Acids are inherent to the manufacturing process of many papers. Lignin, a component of wood (and its pulp) makes acid as it degrades. Alum, a popular sizing, destroys paper in a few years, from within. Many of the books in our libraries, printed this century, will be lost to acid destruction within fifty years.

Acid can migrate from its "host" material (wood, wood pulp paper) into paper that was originally acid free, causing the tell-tale acid burn we often see in framed pieces. Some of the worst common offenders are corrugated cardboard, Kraft papers (brown or colored), inexpensive matboards, wood frame mouldings.

Store in lignin free, acid free packaging that provides a barrier against acid migration.

Frame with non-acidic materials. NOTE: Standard matboard available today is called "acid-free" by virtue of calcium carbonate or other chemical buffers. It is still wood pulp paper, which still contains lignins, and it will eventually turn acidic when the buffer is exhausted.

If acidic materials must be used for framing or storage, provide a gas-impermeable barrier (glass or metal), to isolate the art from the acid-bearing materials. Or, if that is not practical, then provide at least a long-term "filter" of clear polyester film, acrylic, or alpha-cellulose 4-ply board.

The acid content of many papers can be neutralized even after manufacture by addition of chemical buffers (usually applied by soaking) by a qualified conservator.

Acid damage is irreversible.

HUMIDITY

High humidity causes expansion of paper's fibers, making it more susceptible to surface abrasion and shredding. Also, the higher moisture content encourages insects, mildew and mold.

Low humidity causes contraction of paper's fibers, making it more brittle and susceptible to tearing.

Frequent or rapid changes in humidity stress the fibers. If the paper is mounted, it can actually tear itself from its mounts, due to radical expansion and contraction.

See also: *Temperature*

Generally, 50% relative humidity is considered ideal, regardless of temperature, but most papers can adapt to higher or lower humidity, so long as it is constant. Paper is hygroscopic - that is, it absorbs moisture like a sponge. When humidity changes, it tries to maintain its equilibrium moisture content (EMC). The slower the rate of change, the better.

Slow down the rate-of-change of humidity by insulating the paper in proper framing or other packaging.

Keep in an area of constant humidity, if possible.

Keep in a closed container with an inert desiccant material that can be conditioned to maintain a certain range of relative humidity (RH).

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TEMPERATURE

High temperatures increase molecular activity and organic reactions, which accelerate aging.

Temperature and relative humidity changes are directly related. Warm air can hold more moisture than cool air. In winter, for example, RH levels are much lower than in summer. High temperatures and high humidity often go together, which compounds the effects of each. Above all, the condition of high temperature and high humidity encourages mold and insect growth.

Low temperatures are generally not a problem.

See also: *Humidity, Mold, Pests*

Cold storage is best (with 50% RH), because organic reactions are slower, and insects are less likely to invade. For practical purposes, ambient temperatures under 75 degrees F are generally acceptable.

Temperature changes cause expansion (during warming) and contraction (during cooling). Keep temperatures stable; avoid rapid changes, such as might occur during transport in seasonal extremes. Rapid or frequent cycles of expansion/contraction are destructive to paper.

“Insulate” with proper framing or packaging, to slow the rate of change, especially during transportation or storage.

LIGHT

All light is damaging, according to intensity and time of exposure. Sunlight is most harmful because it is the most intense, and contains the full spectrum of frequencies.

Ultraviolet (UV) light, on the high-frequency end of the light spectrum, causes fading. Harmful UV levels are common to sunlight, fluorescent and some other artificial light sources.

Infrared (IR) light is the low-frequency end of the light spectrum. It is responsible for generating heat (increasing molecular activity), accelerated aging, brittleness, weakening of fibers, and discoloration. Most artificial light sources emit IR, but it is considered relatively low-intensity and slow to cause damage. Ordinary glass removes some IR light.

Note that damage from light is cumulative and irreversible.

Store or display in dark or low-light conditions. Avoid sunlight, fluorescent light, and other artificial light of high intensity. Usually, five foot-candles is enough for viewing or reading comfortably.

UV damage (fading) can be slowed or nearly stopped by the use of UV-filtering glass or acrylic in framing, window coverings, and light fixture lenses.

Note that even minimal light levels are harmful over long periods of time. The only way to completely stop light damage is to keep your paper in the dark – but darkness also is the preference of insects.

See also: *Pests*

PESTS

Mice, carpet beetles, clothes moths, powder post beetles, furniture beetles, flies, silverfish, cockroaches, book lice all feed on paper's components; mainly starch and cellulose.

Damage can be done by the pests themselves, their larvae, eggs, excrement, and carcasses.

Prevention is best, since damage is usually well underway before the pests are discovered.

Keep the paper and its surrounding area clean and dry (50% RH is ideal), with good air circulation. Storage for any period of time should be in tight packaging. Inspect often.

Avoid dark, damp, warm areas. Also avoid areas near food, food waste, or other pest attractions.

Note that most pests prefer the dark, but light is harmful, too. Caution and vigilance are the best defenses against pests. There is no perfect answer.

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AIRBORNE POLLUTANTS

Chemicals and particles in the air we breathe can destroy paper. They are usually unseen, and difficult to identify until damage shows. Here are some common ones, and typical sources:

- * Sulfur - From combustion of fossil fuels such as coal, natural gas, and oil.
- * Chlorides - "Salt air" - can come from evaporation of sea water, perspiration or steam of cooking.
- * Nitrogen Oxides - From traffic exhausts and deterioration of photographic films.
- * Formaldehyde - From insulation, wood fiber products, fabric finishes, foam rubber.
- * Acids - From reaction of above with moisture.
- * Ozone - From electrical devices.
- * Alkaline aerosols - From new concrete.
- * Particulates - Smoke, oils, greases, soot, dust.

Minimize exposure to possible pollutants:

- * Keep out of garage, furnace room and other areas where combustion and its by-products exist.
- * Keep in a properly closed picture frame.
- * Keep in tight packaging of acid free material.
- * Encapsulate.
- * Use filtered air.

Airborne pollutants go where the air goes, generally. Filtering is an obvious advantage, but equipment must be maintained. Also, some pollutants will probably get through.

Display or storage in a closed room with filtered, conditioned air is better than exposure to outdoor air of unknown quality.

Damage from pollutants can continue after exposure is stopped. Conservators can clean away most of these, halting damage. However, damage done is usually irreversible.

MOLD

Mold (fungus) spores are ever-present in airborne particles. They settle and germinate into tiny plants where conditions are favorable.

Germination is common where there is poor air circulation, RH over 70%, and temperatures over 70 degrees F. However, once germinated, growth can continue in less favorable conditions.

Avoid by keeping temperature and relative humidity under control, and keep air circulating.

Avoid dust and dirty areas.

If mold occurs, it can usually be killed and residue removed by a qualified paper conservator. However, some discoloration may remain.

UV light and alcohol are effective mold killers.

PHYSICAL DAMAGE

Creases, folds, wrinkles, rips, cockling, marks, punctures, cuts are nearly always preventable, but usually irreversible.

- * Prevent. Prevent. Prevent.
- * Handle as little as possible.
- * When you must handle paper, use both hands, and use supports over and under the sheet.
- * Rolling is somewhat harmful, but may be better than poor attempts to transport flat and unsupported.
- * Frame it or properly store it as soon as possible.

Most physical damage is permanent. However, some harm can be repaired and /or cosmetic treatment can help and can prevent further damage. Consult a qualified paper conservator.

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- Ann Ferguson, Ph.D.

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