THE ENVIRONMENT

2.1 Temperature, Relative Humidity, Light, and Air Quality: Basic Guidelines for Preservation

Control of temperature and relative humidity[1] is critical in the preservation of library and archival collections because unacceptable levels of these contribute significantly to the breakdown of materials. Heat accelerates deterioration: the rate of most chemical reactions, including deterioration, is approximately doubled with each increase in temperature of 18°F (10°C). High relative humidity provides the moisture necessary to promote harmful chemical reactions in materials and, in combination with high temperature, encourages mold growth and insect activity. Extremely low relative humidity, which can occur in winter in centrally heated buildings, may lead to desiccation and embrittlement of some materials.

Fluctuations in temperature and relative humidity are also damaging. Library and archival materials are hygroscopic, readily absorbing and releasing moisture. They respond to diurnal and seasonal changes in temperature and relative humidity by expanding and contracting. Dimensional changes accelerate deterioration and lead to such visible damage a cockling paper, flaking ink, warped covers on books, and cracked emulsion on photographs. In some situations, however materials may be protected from moderate fluctuations. Mild changes appear to be buffered by certain types of storage enclosures and by books being packed closely together.

Installation of adequate climate controls and operation of them to maintain preservation standards will retard the deterioration of materials considerably. Climate control equipment ranges in complexity from a simple room air conditioner, humidifier, and/or dehumidifier to a central, building-wide system that filters, cools, heats, humidifies, and dehumidifies the air. It is always advisable to seek the guidance of an experienced climate control engineer prior to selection and installation of equipment. Additional measures can be taken to control temperature and relative humidity. Buildings should be kept well maintained. Cracks should be sealed as soon as they occur. External doors and windows should have weatherstripping and should be kept closed to prevent exchange of unconditioned outside air. In areas of this country that experience cold winter weather, windows can be sealed on the inside with plastic sheets and tape. In storage areas windows can be sealed using both wallboard and plastic.

Authorities disagree on the ideal temperature and relative humidity for library and archival materials. A frequent recommendation is a stable temperature no higher than 70°F and a stable relative humidity between a minimum of 30% and a maximum of 50%. Research indicates that relative humidities at the lower end of this range are preferable since deterioration then progresses at a slower rate. In general, the lower the temperature the better. The temperature recommendations for areas used exclusively for storage are much lower than those for combination user and storage areas. Cold storage with controlled humidity is sometimes advisable for remote storage or little-used materials. When materials are taken out of cold storage, however, the radical, rapid temperature changes they experience may cause condensation on them. In such cases, gradual acclimatization may be required.

Maintaining stable conditions is crucial. An institution should choose a temperature and relative humidity within the recommended ranges that can be maintained twenty-four hours a day, 365 days a year. The climate-control system should never be turned off, and settings should not be lowered at night, on weekends, or at other times when the library or archives is closed. Additional costs incurred by keeping the system in constant operation will be far less than the cost of future conservation treatment to repair damage caused by poor climate.

While these recommendations may be expensive or even impossible to achieve in many libraries and archives, experience and scientific testing indicate that the useful life of materials is significantly extended by maintenance of moderate, stable levels of temperature and relative humidity. Where economics or inadequate mechanical systems make it impossible to maintain ideal conditions year round, less stringent standards may be chosen for summer and winter with gradual changes in temperature and relative humidity permitted between the two seasons. The seasonal standards should be as close to the ideal as possible. It is important to note that temperature and relative humidity requirements of non-paper-based materials in the collections may differ from those of paper-based materials. Also, maintaining the ideal level of temperature and relative humidity may damage the fabric of the building that houses the collections. Difficult choices and compromises may be unavoidable.

Temperature and relative humidity should be systematically measured and recorded. This is important since the data produced 1) documents existing environmental conditions; 2) supports requests to install environmental controls; and 3)

indicates whether available climate-control equipment is operating properly and producing the desired conditions. Remember that changing one factor may alter others. If measures are taken without considering the environment as a whole, conditions may worsen rather than improve. It is essential to know (from recorded measurements) what conditions actually are and to seek the advice of an experienced climate-control engineer before making major changes.

The importance of continued monitoring after the institution of a change cannot be stressed too much.

LIGHT

Light accelerates deterioration of library and archival materials. It leads to weakening and embrittlement of cellulose fibers and can cause paper to bleach, yellow, or darken. It also causes media and dyes to fade or change color, altering the legibility and/or appearance of documents, photographs, art works, and bindings. Any exposure to light, even for a brief time, is damaging, and the damage is cumulative and irreversible.

Visible light levels are measured in lux (lumens per square meter) or footcandles. One footcandle equals about 11 lux. Fo many years generally accepted recommendations limited visible light levels for light-sensitive materials, including paper, to 55 lux (5 footcandles), and for less sensitive materials to a maximum of 165 lux (15 footcandles). In recent years these recommendations have been debated, with aesthetic concerns and varying rates of light fading for different media being considered.

Although all wave lengths of light are damaging, ultraviolet (UV) radiation is especially harmful to library and archival materials because of its high level of energy. The standard limit for UV is 75 µW/l . The sun and tungsten-halogen or quartz lamps, mercury or metal halide high intensity discharge lamps, and fluorescent lamps are some of the most damaging sources of light because of the high amounts of UV energy they emit.

Because total damage is a function of both intensity and duration of exposure, illumination should be kept as low as possible (consistent with user comfort) for the briefest amount of time feasible. Ideally materials should be exposed to light only while in use. When not in use, they should be stored in a light-tight container or in a windowless room illuminated only when materials are being retrieved. Illumination should be by incandescent bulbs. When materials are being used, light should be from an incandescent source. It is important to note that incandescent bulbs generate heat and should be kept at a distance from materials. Light levels should be as low as possible, and exposure should be for th shortest time that is feasible.

Windows should be covered by drapes, shades, blinds, or shutters that completely block the sun. This will also aid in temperature control by minimizing heat loss and limiting generation of heat by sunlight during the day. Skylights that allow direct sunlight to shine on collections should be covered to block the sun or painted with titanium dioxide or zinc white pigments, which reflect light and absorb UV radiation. Filters made of special plastics also help control UV radiatior Ultraviolet-filtering plastic films or UV-filtering Plexiglas can be used for windows to lower the amount of UV radiation passing through them. These filters, however, do not provide 100% protection against light damage. Drapes, shades, blinds, or shutters that completely block the light are preferable. Fluorescent tubes should be covered with ultraviolet-filtering sleeves in areas where collections are exposed to light. An alternative is the use of special low-UV fluorescent tubes. Timed switches should be used for lights in storage areas to help limit duration of exposure of materials.

Permanent exhibition of materials should be avoided. Since even slight exposure to light is damaging, permanent exposure is deadly. If materials must be displayed, it should be for the briefest time and at the lowest light levels, with light coming from an incandescent source. Materials should never be displayed where the sun shines directly on them, even if for only a short time and even if the windows are covered with an ultraviolet-filtering plastic.

AIR QUALITY

Pollutants contribute heavily to the deterioration of library and archival materials. The two major types of pollutants are gases and particulates. Gaseous contaminants — especially sulfur dioxide, nitrogen oxides, peroxides, and ozone — catalyze harmful chemical reactions that lead to the formation of acid in materials. This is a serious problem for paper anc leather, which are particularly vulnerable to damage caused by acid. Paper becomes discolored and brittle, and leather becomes weak and powdery. Particulates — especially soot — abrade, soil, and disfigure materials.

Controlling air quality is difficult and complex and depends upon several inter-related factors. Various standards for air quality have been suggested. However, until more experience is gained, the most reasonable recommendation is that th

amount of pollutants in the air be reduced as much as practicable.

Gaseous contaminants can be removed by chemical filters, wet scrubbers, or a combination of both. Particulate matter can be mechanically filtered. Electrostatic precipitators should not be used because they produce ozone. Equipment varies in size and complexity from individual filters attached to vents, furnaces, or air conditioners to building-wide systems.

Equipment also varies greatly in effectiveness. It is important that the equipment chosen be suited to the institution's needs and the level of pollution in the area where the institution is located. A regular schedule of maintenance and filter replacement should be followed. An experienced environmental engineer should be consulted for recommendations.

There are several additional ways to control air quality. One is the provision of good air exchange in areas where collections are stored or used, with replacement air being as clean as possible. Care should be taken to insure that air intake vents are not located near sources of heavy pollution such as a loading dock where trucks idle. Another measure is keeping exterior windows closed. Yet another measure is storage of library and archival materials in archival-quality enclosures, which may help decrease the effects of pollutants on materials. Newly available enclosures made with molecular traps such as activated carbon or zeolites, which will capture pollutants, appear to be particularly effective in this regard. Finally, origins of pollution should be eliminated as much as possible. Automobiles and industry, major sources of pollution, will probably be beyond control. Other sources, however, may be reduced. These include cigarettes photocopying machines, certain types of construction materials, paints, sealants, wooden storage/display materials, cleaning compounds, furniture, and carpets.

Temperature, relative humidity, light, and air quality all affect the longevity of library and archival collections. By following the guidelines provided above, one can significantly extend the life of these collections.

SUGGESTED FURTHER READING

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Written by Sherelyn Ogden

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