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Environmental Monitoring: A Library Case Study

by Kazuko Hioki

MOST LIBRARIANS UNDERSTAND the effects of environmental conditions on collections. However, do you know how much the daily and seasonal temperature and relative humidity (RH) fluctuate in your facilities? Is the existing climate level acceptable? Is the mechanical system performing as it was designed? How can we quantify the effect of environment on the natural aging rate of organic materials? The University of Kentucky (UK) Libraries Preservation Department launched environmental monitoring projects in several library buildings over a year ago.

Storage Facilities and Environmental Concerns

The UK Libraries consist of 15 branch and associate libraries with holdings of over 3.4 million volumes, 6.4 million microfilms, and 32,000 current periodical subscription titles. Six facilities were selected for this project because of environmental concerns and the impact on materials housed there.

HOBO data logger

Because mold-infested items are never sent to the storage according to Library policy, the mold had likely grown while in storage.

Three of the six are closed stacks environments and are outlined below.

1. Underground Storage: "The Cave"

Since the 1990s, the UK Libraries have contracted with a commercial underground storage facility that consists of a one-acre stack area within a 32-acre limestone cavern.

A couple of years ago, the interlibrary loan department noticed evidence of mold on materials housed in this storage facility. The Libraries consulted with a university mycologist who took samples from the site. His examination found detritus of an inactive, non-toxic mold species. Because mold-infested items are never sent to the storage according to Library policy, the mold had likely grown while in storage. Since we had no data to verify temperature and RH levels, the Libraries began to investigate the infestation.

Fig. 1

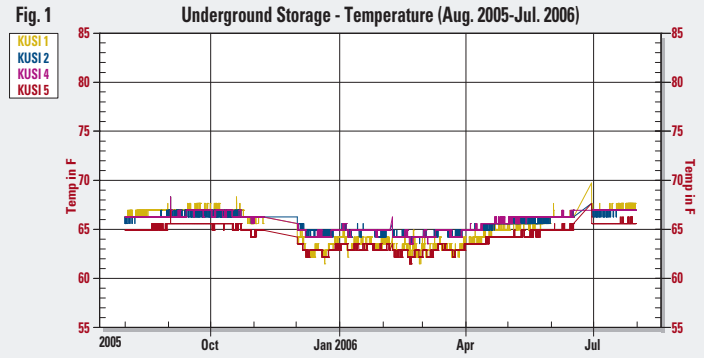
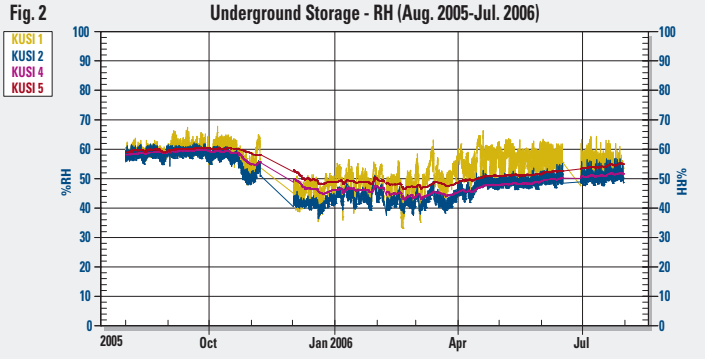


Fig. 2



2. King Library Special Collections Closed Stacks: "The Core Stacks"
Built in early 1930s, the King Library houses Special Collections and Archives which includes rare books, manuscripts, photographic materials, acetate films and other artifacts. A "core" of closed stacks, including a basement and five floors, form the middle of the building. The stacks environment has been controlled by two independent Liebert units, which run 24 hours/day, 365 days/year. According to spot checks, the desirable environment was inconsistently achieved in the Core Stacks. The rest of the King building that surrounds the Core Stacks is controlled by a central HVAC system, which is shut down at night, on weekends and holidays.

3. Basement Storage Room: "The Vault"
Some of the most vulnerable materials in Special Collections and Archives such as nitrate and acetate films, videos, broadcast archives and photographic materials are kept in a closed stack in the Fine Arts Library basement. This space is a large, L-shaped room with compact shelving units. One independent Liebert unit runs 24 hours/day and 365 days/year but the humidification function was disabled in the past. The staff has expressed concern about the room's uneven temperature distribution, poor air circulation and warmer temperature settings. The deteriorating acetate films are already exhibiting the irreversible deterioration known as "vinegar syndrome."

Monitoring Method

Data loggers are used to record temperature and RH. A data logger with electronic sensors and a computer chip inside a matchbook-sized container continuously records temperature and RH with reasonable accuracy. We placed 17 HOBO data loggers at six library facilities and uploaded the data to a computer every 2-3 months. A software program, *Box Car® Pro*, is used to extract the data from the loggers and then *Climate Notebook®*[1] is used for graphs production and data analysis. The UK Libraries were chosen to participate in the Image Permanence Institute's (IPI) grant project, entitled "Training and Implementation for Effective use of Environment in Collection Preservation." This project provided four highly accurate data loggers called Preservation Environment Monitors and data analysis services.

Data Analysis

We used *Climate Notebook*® for data analysis which has more features than basic graphing. For instance, with this software we can compare various storage environments and quantify collection storage environments by using preservation metrics such as the Time-Weighted Preservation Index (TWPI) and the Mold Risk Factor (MRF). Below are examples of an analysis using *Climate Notebook*®.

The Cave

In order to identify areas with less stable environmental conditions, four data loggers were placed throughout the underground storage. The temperature and RH of those locations were compared (Fig. 1 and Fig. 2).

A comparison shows no significant differences in temperature and RH among those locations. These graphs also show the temperature and RH level was never high enough to encourage mold outbreaks. (In general, mold growth is inevitable in an RH of 70% or higher for a sustained period.) We also analyzed the risk of mold growth by using the *Climate Notebook*® metric, Mold Risk Factor (MRF[2]). Based on a number derived from temperature and RH data over a period of time, MRF expresses the likelihood and severity of mold growth on organic materials such as paper, textile and plastics. During the period of monitoring, MRF was zero, which means mold was probably not a problem at that time. However, the current RH level at the Underground Storage is very close to the threshold for mold growth. One logger recorded RH 68-69% for a sustained period. It is likely that an extended hot, humid summer or fall, a prolonged rainy season and/or a dysfunction of the dehumidifier in the past prompted the mold growth. Similar conditions could prompt another outbreak.

The Core Stacks

Two data loggers were placed in the basement and on the 5th floor of the Core Stacks. The temperature and RH were compared (Fig. 3 and Fig. 4). The temperatures ranged from 61°F to 74°F with the higher temperature occurring in the winter and lower temperature occurring in the summer. The high temperature in winter is possibly the influence of the ambient environment of the King Library Building which surrounds the Core Stacks. The RH of the stacks fluctuates drastically with a range from 19% in winter months to 73% in August and September in the basement. The *Climate Notebook*® metric,

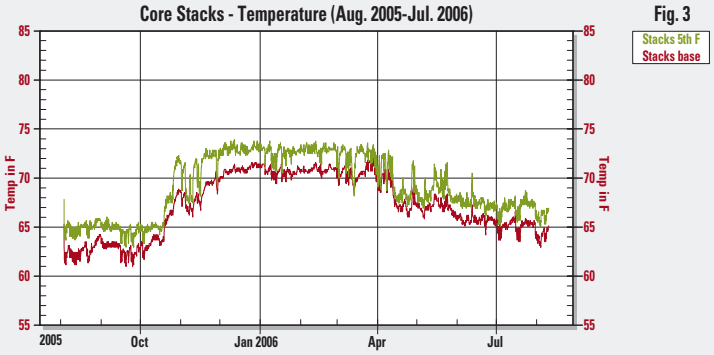


Fig. 3

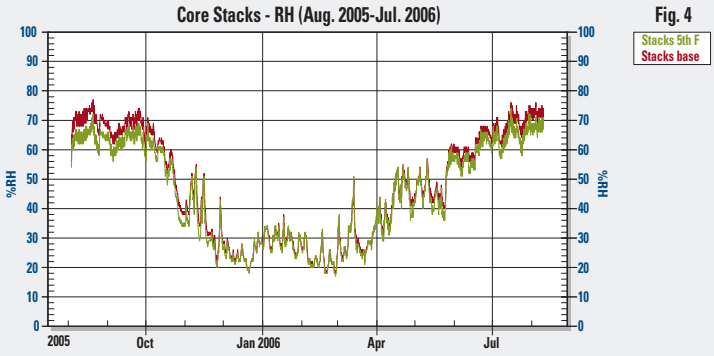


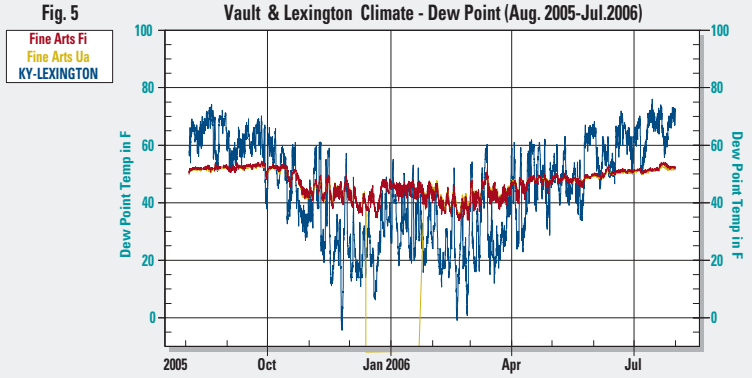
Fig. 4

Dimensional Change Max (DC Max),[3] measures the potential for physical change in organic material caused by gain or loss of moisture. During the period of monitoring, DC Max numbers for stacks were close to 2.5%, which represents a risk of a dangerous dimensional change in objects. Laminate and composite materials such as illuminated manuscripts and photographs are particularly

vulnerable to mechanical deterioration caused by that level of fluctuation.

In addition to mechanical deterioration, chemical deterioration (natural aging) is among our chief concerns for preservation. How fast is the collection aging? Time-Weighted Preservation Index (TWPI)[4] is a metric to measure how temperature and RH affect the rate of natural aging in organic collection materials. The higher the TWPI value, the better the storage environment. Both the basement and 5th floor have a TWPI below 50. Is that a problem? Although TWPI is not a precise predictor of the useful life of materials and TWPI 50 does not mean that the photographs, for instance, will decay in 50 years, it is a convenient comparative measure. According to IPI, purpose-built controlled storage environments (e.g., Library of Congress's remote storage) often have a TWPI value of 200 or more. Therefore, we can project that some of Kentucky's collections will have a four times shorter lifespan than those in the Library of Congress.

Fig. 5



The Vault

Since uneven temperature distribution was reported, two data loggers were placed in the Fine Arts Basement Storage to examine this problem. Two monitored spaces showed some degree of variation within the room (an average of 5°F difference in the summer and 2-3°F in the winter), but it is not clear why the difference exists.

The other concern is if the Liebert's humidification function is working. A comparison between indoor and outdoor[5] dew point graphs answers this question. Dew point[6] is a measure of the absolute amount of water in the air. Unless the mechanical systems add or remove water from the air, the outdoor dew point and the indoor dew point are the same. In other words, any variation between the outdoor and indoor dew point is the result of the mechanical system. The graph (Fig. 5) shows the outdoor (blue) and the indoor (red and yellow) dew point. Lexington's outdoor dew point was downloaded from IPI's website and incorporated to the Vault data by using *Climate Notebook*®. The red and yellow trends indicate that the Vault is dehumidified during the summer because the room's dew point is lower than the outside dew point (blue), and in the winter, the red and yellow trends show humidification.

The RH drifted, but stayed between 30% and 50% most of the year. The temperatures remained relatively steady between 65°F and 73°F through the year; however, even with an average of temperature 69°F, the Vault is too warm for the nitrate and acetate films and photographs[7].

Taking Action

First, we analyzed the collected data. Now we are in the process of defining the optimal environment, finding options to correct problems, and developing action plans for improvement. These steps are not easy or simple. They require some understanding of highly technical architectural and mechanical engineering concepts. They also require broad collaboration among preservation, collections and facility experts. Our achievements to date have been modest, but they have been cumulative which bodes well for future improvement. For instance, at the Underground Storage facility, we shared the findings with the company's management. Immediately they began to continuously

monitor temperature and RH. While not yet implemented, our proposal to achieve an RH lower than 50% by increasing the dehumidification potential of the current and/or additional equipment was well-received.

In the near future, we will present our findings to the Libraries. Following that, we want to work strategically with our facilities personnel to achieve more optimal and consistent environments in all storage areas. Monitoring will continue in these sites, and other diagnostic surveys may commence.

What We Learned

A systematic monitoring has provided data to understand the existing climate, and *Climate Notebook*® has helped to evaluate the performance of current mechanical systems and to define the optimal environment. Effective environmental management requires an understanding of technical issues such as the relationship of temperature and RH and the engineering of environmental systems. This knowledge also helps to develop better communication with facilities management staff. Developing a successful collaboration with facility staff is a key to the effective management of the environment, however, it takes time and some effort to build trust and good team work. I have frequently stopped by the Libraries' physical maintenance office to ask questions, share my findings and just to chat. There may be limited options for correcting the existing mechanical or architectural problems, but the information we've accumulated helps us move beyond adjusting the thermostats or applying for grants to install new HVAC systems. We are starting a new conversation with our facilities management and we are better prepared to state our case. Hopefully as more institutions carry out monitoring projects, information is shared with us.

1. *Climate Notebook®* is a software application developed by IPI with funding from the Mellon Foundation. Information is available at http://www.imagepermanenceinstitute.org/shtml_sub/cat_hardsoft_cnb.shtml.

2. MRF: the higher the mold risk factor, the worse a mold problem is likely to be. MRF 0 to 1: Progress toward mold spore germination has been made. MRF above 1 : Mold has most likely germinated. When the MRF is greater than 1, the number represents how bad the problem is likely to be.

3. DC Max: 1 % DC Max indicates a controlled environment, and 2.5% or more represents a risk of dangerous dimensional change in objects.

4. TWPI: tells how good or bad an environment is on average over a long period of time. TWPI values below 50 may signal inappropriate conditions for vulnerable materials such as paper and photos.

5. Outdoor climate: outdoor climate greatly influences indoor climate. *Climate Notebook®* can incorporate outdoor temperature and RH collected from National Oceanic and Atmospheric Administration (NOAA) weather stations in more than 1000 cities including Lexington, KY.

6. Dew point: helpful information on dew point, temperature and RH is available at "Step-by-Step Workbook" p.11-15, http://www.imagepermanenceinstitute.org/shtml_sub/cnbworkbook.pdf.

7. Film storage: ISO recommends storage conditions for nitrate based film at a Max. temp of 36°F and RH of 20-30%. For acetate based film at a Max. temp. of 45°F and RH of 30%.

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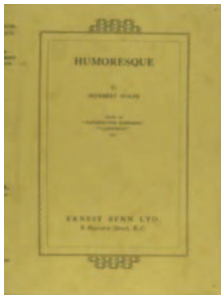
Djs in the Library – Dust Jackets that is, Not the Music Makers

by Margit Smith



Dust jacket for *Humoresque* by Humbert Wolfe, 1927.

Dust jacket for *Skanes Historia*, by Ingvar Andersson, 1947.

Dust jacket for *Polish Music Since Szymanowksi*, by Adrian Thomas, 2005.

TODAY THE DUST JACKET'S ORIGINAL purpose has become secondary shown by this entry in *ODLIS, the Online dictionary of Library and Information Science*: "The removable paper wrapper on the outside of a hardcover book usually printed in color and given a glossy finish to market the work to retail customers and protect it from wear and tear".[1]

A Very Short History

How did dust jackets (dust wrappers, book jackets, cover jackets and dust covers) develop and how long have they been used?

Increased book production during the 19th century and the advent of book cloth that could be decorated easily led to the development of book jackets which protected books during shipment.

The earliest European dust jacket was used in London in 1832 on *The Keepsake*, published by Longman. Buff-colored, with a decorative red border around the title, it enclosed the whole book. German dust jacket design mirrored the rise of a strong graphic design movement around the turn of the century. French publishers discovered the marketing power of Toulouse-Lautrec's posters; fortunately, many of his dust jackets are preserved in the Ludwig Charell collection.[2]

The earliest dust jacket in the United States is probably on *The Bryant Festival at "The Century,"* published by Appleton in 1896.[3]

Dust Jacket Design

Used mainly as a marketing tool, the dust jacket is expensive to design and produce. Coordination between designer, author, illustrator, editor, the writer of the copy and the 'blurb,' the marketing team, and finally the printer, who may not be the publisher, is a long and circuitous route to a powerful product that is often separated from the book and carelessly discarded. Dust jackets are big-ticket items and the most direct advertisement medium for distribution and sale of books; bookstores and vendors frequently base their orders on the examination of advance jackets.

The NYPL Digital *Gallery of Dust Jackets from American and European Books 1926-1947,*[4] shows over two thousand examples tracing changes of style and design. A very plain example from 1927 with simple frame covers *Humoresque*, by Humbert Wolfe (see ill. 1).

In stark contrast is the very content-related design on Ingvar Andersson's *Skanes Historia* (see ill. 2), published just 20 years later, leaving no doubt about the topic.

After the war, design transitioned from the sentimentality reminiscent of magazine covers during the '50s, through the eclectic '60s, to the mini-poster-like designs in the '70's and '80s. Today all styles are found, including the integration of minimal, often ambiguous pictorial content (see ill. 3) with intentionally artless typography.

The dj in the Library

To keep or discard? Public and school libraries tend to keep dust jackets to enhance circulation, especially in children's collections. In a year-long study of the browsing collection at University of South Carolina Libraries, Tinker Massey found that jacketed books transferred to the stacks circulated more than non-jacketed books.[5]

Money, staff, time and space constraints cause many libraries to eliminate dust jackets. Considered breeding grounds for mold and harborers of insects by preservation staff, they are frowned upon for the additional handling and space requirements they need. Henry Petroski in *The Book on the Bookshelf*[6] states that dust jackets take up approximately

2.5% of shelf space and more if protective sleeves are used.

Dust jackets are important because the flaps and back cover often carry obscure facts about the book's creation, helpful to students of art/art history of the publishing industry, as well as to bibliographers, researchers and catalogers.

In the case of minor writers, they often provide access points to biographical facts not covered elsewhere, the author's photograph, past or future works, dates and series details. Dust jackets carry identification of illustrations, the illustrator, the designer of the jacket and the translator, often omitted from the book itself. The intended audience or suggested reading level, explanatory comments, a brief summary or abstract—all provide additional clues.

Brian and Mary K. O'Connor's evaluative article "*Book jacket as access mechanism: An attribute rich resource for functional access to academic books"* details the number of dust jackets with access attributes as a percentage of the total. The most numerous attribute is "Subject indicators" with 96.1%; the lowest is "User description" with 46.9%, showing that informational elements on dust jackets aid in determining the book's 'aboutness' and contribute to decisions about its suitability for use.[7]

Jackets are retained with the books, as at the Florida History Collection and the Baldwin Library at the George A. Smathers Libraries at the University of Florida, or kept in a separate file, indexed, cataloged and accessible to researchers, as at Boise State University.[8] Occasionally museums and libraries mount thematic dust jacket displays.[9]

Dust jackets are of major importance to rare book collectors. Antiquarian and out-of-print dealers routinely state presence and condition of dust jackets in their lists. Alan Bamberger says that "Rare dust jackets mean big bucks in the antiquarian book business. For example, a first edition of *The Great Gatsby* or *The Maltese Falcon* in good condition without a dust jacket (also spelled dustjacket) sells for about $2000; with dust jacket in fine condition, about $100,000."[10] (For an interesting discussion on the topic see the exchange between members of the Rare Book Society[11] and Tom Congalton's article in the Spring 2006 issue of the *ABAA Newsletter.*[12]) The high value of dust jackets has lead to the unscrupulous manufacture of fake jackets, which, according to Bamberger, are easy to identify.

Money, staff, time and space constraints force most academic libraries to eliminate dust jackets.

Maintenance and Preservation

Retention of dust jackets means a maintenance commitment. Additional protective plastic sleeves add expense and handling, but serve several important purposes. Protective sleeves keep a collection neat and clean, and reduce the need for expensive headcap repairs. Nancy Schrock quotes Gregor Trinkaus-Randall's figure of 15% hinge damage (an easier repair) compared to 5.6% spine damage on dust-jacketed volumes.[13] Damaged protective sleeves are replaced—severely damaged dust jackets are usually discarded. Many types of dust jacket protectors are on the market; Archival Products now offers a newly developed product, the Non-glare Polypropylene Book Cover, which is scuff resistant and suitable for covering books or dust jackets. Dust jacket repair on circulating collections calls for the same materials and procedures as the repair of books. Scant literature exists about dust jacket repairs, but Arthur Johnson's includes instructions for backing the damaged dust jacket with a suitable piece of paper in his manual on repair of cloth bindings.[14]

Maintenance recommendations for book jackets in circulating collections:

- Avoid taping any part of the dust jacket or its protective sleeve to the book.
- Remove dust jackets from the book and turn inside-out for cleaning and repair.
- Remove accumulated dirt with a soft natural bristle brush.
- Reinforce frayed edges with invisible archival mending tape or a strip of suitable acid-free Japanese tissue paper.
- Replace torn off pieces with a small piece of tape or, if there is enough shear, apply a dab of PVA.

- Clean dust jackets on shiny paper and protective sleeves with diluted rubbing alcohol, rinse and wipe dry thoroughly with a soft cloth.
- Mount badly damaged dust jackets on suitable acid-free paper using wheat starch or methyl cellulose and eliminate all air pockets with a brayer before placing under weights.
- Store dust jackets for research separately in flat drawers, without protective covers.
- Interleaf with buffered acid-free paper.
- Schedule regular inspection to prevent mold and silverfish infestations.
- Dust jackets kept for their intrinsic value need the same care as valuable and rare items in special collections.

Library supply vendors' pamphlets and on-line information help in choosing the most suitable dust jacket protectors. Northeast Document Conservation Center has a short leaflet online[15] with instructions to make a polyester book jacket for books with or without dust jackets.

Conclusion

Libraries make considered decisions about the materials they collect, including the humble dust jacket. Cost, handling, space needs, repair and need for protective covers, argue against keeping them. Additional access points, biographical information, publication information and graphic design elements argue for their retention. Considered indispensable items by collectors of fine and rare books, forgers capitalize on this by producing fakes and facsimiles. Children delight in their visual promise of what's in the book, readers remove them because they are slippery and unwieldy. They are tossed aside and disposed of or treasured. They are simple, yet complex objects and form integral parts of books—now being preserved mainly in our public libraries and by discerning private book collectors.

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