An Evolution in Environmental Control

It is important to understand how the last several decades of preservation research (at the Image Permanence Institute (IPI) and in many other institutions) have fundamentally altered basic approaches to analysis of temperature and humidity conditions for collections. In the past, the paradigms for environment control were based on target ranges of temperature and RH, and analysis consisted mostly of determining whether specific conditions were being met. Deviations from 'ideal' ranges were by definition undesirable. 'Flat lining' (absolutely unchanging T and RH) was seen to be the best for all collections, and had the added advantage that it was easy to look at a graph and tell if the lines on the graph were flat or not.

Consensus recommendations for 'ideal' conditions developed in the 1940s to 1980s, and came to be defined as 68°F (20°C) and 50% RH, with little permissible variation. Because historically the focus of concern was the effects of RH on fine art materials, the importance of temperature was diminished, and it did not seem to matter too much if the 'ideal' conditions were crafted to be at temperatures comfortable for humans.

Although even the early conservators recognized the gross oversimplification that articulating an 'ideal' represented, a number of circumstances helped to shape the popular acceptance of these concepts. Monitoring of conditions (if done at all) was with weekly pen-and-ink charts made by hygrothermographs and without the power of computers to do extensive calculations or condense a whole year of data onto one graph. As a result, seasonal variations were hard to notice. Monitoring with weekly charts enforced a short-term perspective that worked against perceiving longer-term, more significant trends. Without computer analysis, no derived statistics or metrics were possible without extremely laborious hand calculations. Whether lines were flat or targets were achieved was about all one could learn from monitoring in this way.

Preservation research over the last twenty years has shown that the simple notion of one-size-fits-all environments does not fit the scientific facts of collection deterioration. Research that closely studied how materials deteriorate showed that no single environmental condition could ever be ideal—not for the different components of a composite object, let alone for a collection that contains many different kinds of materials. Ideal conditions for minimizing metal corrosion should be quite dry, while the same level of dryness will shrink wood and leather, threatening cracks and tears. Organic materials decompose at a rate that depends heavily on temperature, so the cooler the better for them. Some moisture is necessary to make parchment flexible, though too much moisture allows mold to grow and can cause permanent deformation. In practice, every environment is a compromise that considers the capabilities of the mechanical system and the vulnerabilities of collection materials.

A more nuanced view, in which individual mechanisms of deterioration are considered separately, leads to much more effective environmental management. IPI's research has focused on developing ways to quantitatively estimate the effect of environmental conditions on specific mechanisms (pathways) of deterioration. Based on its research, IPI has proposed a set of environmental metrics that can be used to assess and manage collection storage environments.

Using Metrics for Analysis of Environmental Data

IPI's Preservation Metrics are quantitative numerical estimates of the rate of environmentally induced decay in collections, broken down into specific numbers for the natural aging in organic materials, risk of mold growth, and the potential for mechanical damage and metal corrosion. Each metric integrates spans of time into a single value representing how the environment is likely to affect one particular form of deterioration, taking into account all the ups and downs of temperature and RH. This ability to integrate all the fluctuations in temperature and humidity into a single overall estimate of decay rate is a powerful feature for analyzing data.

With T and RH targets, you are in or you are out. If you are out, there is little guidance on what that means or what to do about it. It is difficult (if not impossible) to study the lines on graphs, weigh the significance of deviations, and balance the magnitude of their impact on specific collection materials in your head. Add to this the fact that both temperature and RH play a role, and that the relative importance of each element is different for various forms of collection decay. The notion that you can scan all these graphs and analyze the preservation quality of your storage space for your collections without the help of an automated process is unlikely.

Preservation metrics are very useful for flagging potential problems from a quick screening of the data and for comparing one space with others. Although the metrics may be unfamiliar at first, after a little time working with them, their value becomes apparent, especially when there are many datasets to analyze.