The Conservation Laboratory

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There are two aspects of museum conservation: the first centers around the work done in the laboratory, cleaning and treating archeological materials in need of attention, for example, corroding metals that must be stabilized, fragmenting limestone reliefs and pottery contaminated by salts that must be soaked out, or embrittled and fragile wood and leather objects that are crumbling and need to be strengthened. The second aspect, equally important, involves climate control—maintaining a stable and suitably controlled atmosphere—within the exhibition and storage areas of the museum.

Aging of all organic (wood, leather, ivory, textile) and inorganic (metal, stone, pottery, glass) material occurs naturally through the years in the presence of light, oxygen, and moisture, which initiate the chemical changes causing deterioration. With objects buried for thousands of years, the severity of decay depends on the material of the artifact and its interaction with the burial environment. In conditions favorable to survival, chemical reactions in the ground will be minimal; the object will react with and exhaust the chemicals in its immediate area and soon achieve a state of equilibrium with its environment, and will be excavated in reasonably good condition. In adverse conditions where agents of deterioration such as salts, oxygen, moisture, and biological activity fluctuate or are constantly renewed, equilibrium between object and environment is never achieved; these excavated objects will be poorly preserved.

In either case, once an object is brought out of the ground, it is subjected to different environmental conditions with which an equilibrium again must be established, and these conditions are not necessarily more favorable to survival than those in the ground. In a museum atmosphere an artifact may be subjected to fluctuations of temperature and relative humidity, to corrosive air pollutants, and to excessive levels of light, all of which continue the chemical and physical deterioration begun during burial.

Temperature and relative humidity are interdependent factors, and the constant fluctuation of one or both presents a serious danger to museum objects, since each material has a range best suited to it. For most materials, a temperature of 70° Fahrenheit is satisfactory; too high a temperature accelerates chemical reactions while prolonged high temperature, combined with the presence of oxygen, breaks apart the long-chain carbon molecules that make up organic materials and causes embrittlement and loss of strength. In addition, inorganic and organic materials expand as temperature becomes higher and contract as it becomes lower; this dimensional change places fragile objects under a physical stress that continues to weaken them.

Metals are best kept at the low humidity of 30 per cent to prevent excessive atmospheric moisture from initiating corrosion. But organic materials, which naturally hold a certain amount of water in their cellular structure, must not be allowed to become too dry—too low a humidity shrinks and warps wood, cracks ivory, and embrittles leather—and a humidity of 50 to 55 per cent is generally satisfactory. Many organic materials are hygroscopic and are able to absorb moisture from the air during days of high humidity, expanding as they do so; as the humidity falls, the moisture is given up, causing the object to contract. Here again, the object is subjected to dimensional changes that not only weaken it but also loosen a paint or gesso layer if one is present.

The range of temperature and relative humidity within the Oriental Institute Museum is great both daily (the humidity on a summer day can go from 47 to 76 per cent) and seasonally (a low of 11 per cent recorded in the winter with a high of 76 per cent recorded in the summer). To some extent the enclosed exhibition cases serve as a buffer against the sudden drastic daily changes, but they are not sufficiently airtight to protect against seasonal variations. Objects in the basement stored in cardboard boxes are especially vulnerable to such changes. In museum cases containing sensitive material, small instruments showing temperature and humidity can be seen. Very often the readings are not ideal, but without a climate control system within the Museum, little can be done to create proper exhibit and storage conditions.

Another great danger to museum objects exists in the gaseous air pollutants—sulfur dioxide, hydrogen sulfide, nitrogen oxides, and ozone—that result from industrial wastes in incomplete combustion of fuels. Under certain conditions sulfur dioxide will react with atmospheric moisture to form sulfuric acid, which chemically attacks all types of materials; for example, bronze and copper objects develop sulfate corrosion products; leather and cellulose (wood, papyrus, linen, cotton) products become embrittled and powdery; and the surface of limestone and marble, stones composed mainly of calcium carbonate, is converted to calcium sulfate, a compound that occupies a larger volume than the carbonate and thus causes the stone surface to powder or flake.

Nitrogen oxides from auto exhausts are acted upon by sunlight to produce ozone, familiar to Chicagoans from the frequently announced ozone alerts. Ozone is particularly damaging to those objects composed of cellulose, breaking the double bond that occurs between carbon atoms.

Hydrogen sulfide attacks metal, especially silver, which it tarnishes.

In addition to gases, small solid particles—soot, grit, and dust—are carried through the air and come into the Museum on visitors' clothes, through the ventilation system, and through cracks around windows. Many of these particles are tarry and difficult to remove once they adhere to objects. Some contain pollutants such as sulfur dioxide, and others will attract moisture to hasten deterioration.

Light also plays an important role in the degradation of materials. A beam of sunlight falling on an object causes a localized increase of temperature which may be great enough to crack the object. Besides heat generation, it is the invisible ultraviolet portion of light that does the most damage, acting with oxygen to break the molecular bonds in objects of organic origin: it causes dyes to fade, and ivory, textiles, leather, wood, and papyrus to discolor and become brittle.

To protect objects, the level of illumination in the Museum is kept low. Curtains exclude strong daylight, and the fluorescent tubes—which also emit a high level of ultraviolet radiation—used to light the exhibit cases are covered with a plastic filter to absorb the harmful portion of the light.

Thus, the work done in the laboratory is only half of the job of preserving artifacts. Climate control within the Museum is critical if objects are to remain in satisfactory condition. Such a system would maintain temperature and humidity at constant levels, eliminating the damage that such fluctuations cause, and air pollutants would be filtered out. The Institute has plans for such a system, but the cost is high, over $3,000,000, and it may be many years before the plans are realized.

As a partial solution to one aspect of the problem, the Museum is planning the construction of a basement storage room for metal objects which would keep temperature and relative humidity at a low enough level, 70° F. and 30 per cent, to prevent corrosion, a great problem in the present storage area. The estimated cost for such a project is $13,000. This includes:

$4,500	for dehumidification and air conditioning
2,000	for room construction and lighting
6,500	for four metal storage cabinets

We hope to be able to raise money for this special room within the next year, since it is greatly needed.

I would like to take this opportunity to thank Mr. William Boyd of Lake Wales, Florida, who responded to our appeal in last year's Annual Report for a microscope. Because of his generosity, we have been able to purchase a Nikon high-power polarizing microscope with a special attachment for photographic work. Among its many uses will be the identification of fibers and pigments and metallographic analysis.