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Special Issue on Preventive Conservation

Framework for Preservation of Museum Collections

by Charlie Costain

A chart entitled "Framework for Preservation of Museum Collections" has been developed by the Environment and Deterioration Research Division of CCI. It is intended to assist conservators, collection managers, and other museum professionals in assessing the threats to their collections.

The chart was initially developed by Stefan Michalski to help individuals assess the dangers to their collections objectively. Since the 1960s, conservators have been concerned about the museum environment, in particular about relative humidity, light levels, pollution, and temperature. Pests are also a concern, but often are considered separately from environmental factors. However, none of these factors had traditionally been grouped with other serious threats to a collection, such as breakage, theft, fire, or water damage. This incongruity became apparent when CCI staff were carrying out "environmental surveys" of museums; there were some museums that had purchased hygrothermographs when they had no smoke or fire detectors, or that were concerned about ultraviolet light when they had inadequate locks on the museum doors.

The "Framework for Preservation of Museum Collections" consists of a 9 row by 7 column matrix. Along the left-hand side of the chart, various threats to

Figure 1. Facility survey of a museum collection area.

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museum collections are grouped into nine agents of deterioration: direct physical forces; thieves, vandals, and displacers; fire; water; pests; contaminants; radiation; incorrect temperature; and incorrect relative humidity. The type of museum object that is vulnerable to each agent is identified, along with the type of damage that can occur. The columns outline methods of control that can be carried out at each of three different levels or scales: the building (architectural or engineering elements), portable fittings (items or modifications that are generally purchased on an operating budget), and procedures (actions that can be carried out by museum staff). Control at the building or portable fittings level is further broken down into actions that are suitable for storage, display, or transit situations. Each cell of the matrix lists stages for controlling an agent of deterioration under five general headings: avoid, block, detect, respond, and recover/treat.

In this article, I will restrict my discussion to the principal agents of deterioration that are outlined in the Framework, and will discuss some examples of how the Framework might be used. For an illustration of how the control strategies in the Framework might be applied, please see the article by Tom Strang elsewhere in this Newsletter. Stefan Michalski's article in this Newsletter also serves to further illustrate the use of the Framework.

Agents of Deterioration

The nine agents of deterioration group together various active agents that threaten museum collections. The relative order of importance of these agents was generally determined by the severity of damage that each inflicts on an object and by the overall likelihood of this damage occurring. The actual order of importance of the agents may differ for a given institution or for a particular situation.

Direct physical forces can be either sudden and catastrophic or long-term and gradual. Sudden damage usually results from a shock to the artifact while it is being handled or moved, during collapse of shelving or supports, or as a result of earthquakes or war. Long-term exposure to some force may result in the deformation of an object, and may be due to inadequate support in display or storage or to artifacts having been stacked. Vibration can also cause damage to artifacts in the short term or the long term, depending on the circumstances. The most common damages in this category result from improper handling procedures, and the type of damage varies from complete loss of the artifact to minor damage that can be repaired. Most museum artifacts are vulnerable to this type of direct physical force.

Most of the risks in the category of **thieves, vandals, and displacers** are traditionally covered by museum security services in large institutions. Thieves obviously are a great concern because museum objects have a high value, their location and existence are well known, and if an object is stolen the loss is total. Vandals tend to attack high-profile or noticeable items, and often inflict severe damage. The agent "displacers" addresses the problem of artifacts that are misplaced within the museum; this is usually done inadvertently by staff members in storage areas. If an artifact or specimen has been misplaced and cannot be found, the effect is the same as a theft.

Fire obviously poses a threat to all museum collections, although organic artifacts are particularly vulnerable. In addition, smoke from fires poses a particular threat, especially to porous specimens. Although fires are infrequent, they result in massive loss and extensive damage.

Water is a major threat to museum collections because of leaking roofs, skylights, or water pipes. Flooding or fire suppression equipment may also cause water damage. Porous organic materials, metals, and composite materials (i.e., materials that are layered or joined) are particularly susceptible to water damage. In addition, many artifacts have some component that is wholly or partially soluble in water.

There is an obvious relationship between the risks from the threat of fire and the risks of water damage from having a sprinkler fire suppression system. Although the risk of a sprinkler malfunction may be greater than that of a fire, the damage caused by a fire is much more extensive and devastating to the collection than that caused by water. The Fire Protection Advisor at Heritage Services, Department of Canadian Heritage, who has inspected hundreds of museums and has seen the results of a number of museum fires, strongly recommends installing sprinkler systems.

The agent of **pests** includes attack by insects, vermin, or mould. The threat here is primarily to organic materials, which can be damaged either because they are a food source to the pest or because they represent a barrier that the pest wants to cross. Damage can be extensive if pests become established (i.e., begin to live, eat, excrete, and die) in the museum collection. Problems with mould and microbes are related to problems with relative humidity.

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Contaminants is the term used to describe chemical agents from the museum environment that can cause some alteration of museum objects. Contaminants can be in the form of gases, liquids, or solids. Gaseous contaminants are frequently considered to be pollutants, although the source of the gas may be external industrial and vehicle emissions (e.g., sulphur dioxide or nitrogen dioxide), gases emitted by materials within the museum (e.g., vapours given off by wood, coatings, or other artifacts), or oxygen present in the atmosphere. Liquids that might contaminate museum objects include plasticizers migrating from plastics, and grease deposited by improper handling. The most common solid contaminants are salt (either airborne or from handling) and dust. Contaminants can result in complete destruction of an artifact over a prolonged period of time, but more often result in some disfigurement of the artifact.

Radiation includes ultraviolet and visible light. Ultraviolet radiation can cause disintegration and discolouration of the outer layers of organic objects, and visible light can cause fading (or, less often, darkening) of the outer layers of coloured components in artifacts. Ultraviolet light is not necessary for humans to view museum objects, and so should be avoided or eliminated in museum display and storage areas. Some visible light is necessary to allow visitors to see objects on display, but this must be balanced against the stability of the colorants in the objects. Fugitive colorants will change noticeably after just a few years of display, even if they are displayed at low light levels (50 lux). Light damage will not cause complete physical destruction of an artifact, but can affect the relevance of or the interest in an object and can reduce its value considerably. Discolouration caused by light damage cannot be repaired or reversed.

Temperature is a measure of a physical property and by itself cannot directly cause damage to museum objects. However, damage to museum collections does result from **incorrect temperatures**, which can be broken down into three different types: temperatures that are too high, too low, or fluctuating. High temperature can result in accelerated degradation rates of chemically unstable components, low temperature can cause embrittlement of some materials, and fluctuating temperatures can cause materials to fracture or delaminate. Although temperature levels within museums are usually dictated by human comfort levels, low-temperature storage areas are used for certain unstable artifacts such as colour photographs. Temperature can be very important in determining the useful life of chemically unstable artifacts such as photographic films and acidic paper.

Incorrect relative humidity can be broken down into four subgroups: damp (over 75%), above or below a critical value, above 0%, and fluctuations. Mould growth can occur when the relative humidity is over about 75%, and certain minerals or contaminated metals deteriorate above or below critical relative humidity values. Some chemical deterioration reactions slow as the relative humidity is reduced, and stop when the relative humidity drops to 0%. Relative humidity fluctuations cause swelling or shrinkage of organic components, which can result in fracture, crushing, or delamination of organic components. Although incorrect relative humidity can result in considerable damage to vulnerable artifacts, in most cases it does not lead to complete destruction of artifacts. (For more information about relative humidity, please see the article by Stefan Michalski in this Newsletter.)

We have found the "Framework for Preservation of Museum Collections" to be an extremely useful tool in assessing the risks posed by particular situations (see Figure 1). The Framework's usefulness is not only due to its comprehensive nature, but also because it identifies potential areas of risk rather than directly identifying deficiencies.

Example 1

Consider a hypothetical situation where a large gallery receives a loan request from a small community museum nearby for a series of graphite pencil sketches on white rag paper that are of particular historical significance to the district. To make the situation more interesting, suppose that the director of the large gallery would like to agree to the loan but the curator involved has grave concerns about the risks to the works of art, and that the conservator is receiving subtle pressure from both sides. One method of resolving this predicament would be for the conservator to meet with the responsible person from the requesting institution and to use the Framework to describe the range of potential dangers to the works of art, identify the agents of deterioration that are pertinent in this situation, and then find ways of reducing the risks.

If the large institution is concerned about direct physical damage occurring during transit and handling, it may be possible to arrange for staff from the large museum to deliver and install the works. Security will clearly be a major concern, so arrangements must be made for securing the museum building, for exhibiting the works (i.e., display case, alarms), and for the presence of security personnel. Concerns about fire suppression, leaky roofs, and pest control will have to be discussed. Because the works in question are on untinted rag paper and are in stable condition, light levels are not a major concern within the range of 50 lux to 300 lux, as long as the ultraviolet component is filtered out. A discussion of the temperature and relative humidity within the borrowing museum shows that the temperature control is moderately good (between 18°C and 24°C), but that the relative humidity can only be maintained at 25%. Because the works are properly hinged and matted and because no thick paints are present, this will not pose any serious risk. Therefore, it may turn out that the only major risk that needs to be addressed is security. Further discussion between the borrowing institution, the reluctant curator, the director, the conservator, and possibly a security expert may be necessary to determine whether or not this risk can be safely controlled. No matter what the outcome, at least the decision will have been made on a factual, rational basis that can be clearly understood by all involved.

Example 2
Museums are under increasing pressure to allow more public access to their collections. The Framework may be useful in addressing the risks involved with this access.

Let us consider another hypothetical situation where a curator is planning to include a number of pieces of 19th- and 20th-century furniture in a public session to let members of the public interact more closely with the collection. In addition to security and transit concerns, there may be an increased risk of artifacts being broken and contaminated (i.e., soiled) due to improper or unauthorized handling. Also, in this case, it is possible that a number of the pieces are quite vulnerable to relative humidity fluctuations, in which case humidity control is essential. All of these considerations may result in a decision to have the public session take place in an available gallery within the museum rather than in some outside location.

Conclusion
The nine agents of deterioration outlined on the "Framework for Preservation of Museum Collections" make up a comprehensive list of the various situations that can threaten museum, gallery, or archival collections. CCI staff members have found the Framework to be an extremely useful tool for identifying risks to museum collections and for suggesting appropriate methods of control. For a copy of the "Framework for Preservation of Museum Collections," please contact Extension Services at CCI. ♦

A Shipping Case Study

by Paul Marcon

What really happens to a 45 kg piece of checked luggage when it travels by air? Members of the Art in Transit Research Program decided to find out, with the help of an electronic data logger.

CCI has recently acquired two electronic data loggers that will be used to obtain a clearer picture of shipping events and hazards as part of the Art in Transit Research Program. Each logger contains electronic circuitry capable of measuring shocks that exceed a pre-determined level. An internal clock records the date and time of each shock event. This information is stored electronically for later downloading to a computer. When the data is downloaded, the direction of impact is calculated and a summary is produced in which the shock and impact events from all sources (e.g., drops, kicks) are expressed in terms of an equivalent drop height.

In order to become more familiar with these devices, one was placed inside a 45 kg packing case that contained demonstration material and fragile electronic equipment. This case was shipped to a series of Art in Transit workshops that were presented by CCI in collaboration with the Smithsonian Institution and the National Gallery of Art in Washington, D.C.

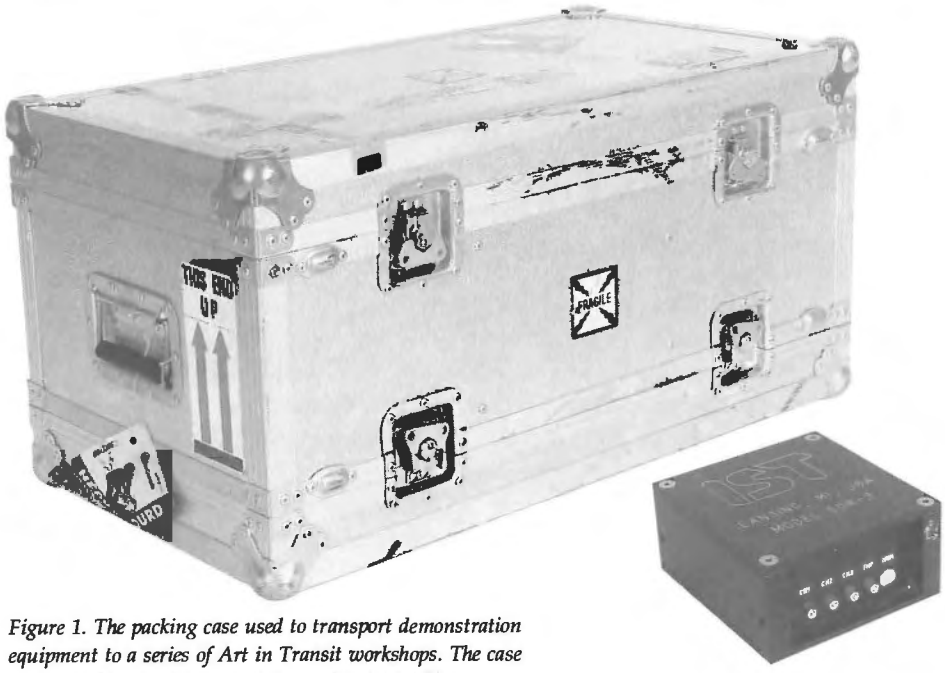

Figure 1. The packing case used to transport demonstration equipment to a series of Art in Transit workshops. The case measures 80 cm x 40 cm x 42 cm and weighs 45 kg. Inset: The electronic data logger inside the packing case prior to shipment.

A total of 17 flights were monitored, covering a total distance of 20,000 km to venues in Vancouver, B.C.; Los Angeles, California; Chicago, Illinois; and Washington, D.C. An additional flight to Regina, Saskatchewan, was also monitored. For all of these flights, the case was sent through the usual luggage stream as ordinary checked baggage with "Fragile" and "This End Up" stickers attached.

During the 17 flights, the packing case and its fragile contents were subjected to 34 rounds of airport baggage handling personnel and equipment. Here is what happened.

The case experienced a total of 843 impact events. All of the recorded events occurred during handling operations at the 34 transfer points. An impact summary, expressed as equivalent drop heights, follows.

Equivalent Drop Height	Number of Events
0 - 15 cm	799
15 - 30 cm	27
30 - 45 cm	14
45 - 60 cm	1
60 - 75 cm	1
75 - 90 cm	1

The data recorded during the 17 flights revealed that the packages received many drops from lower heights and few drops from higher heights. This is consistent with generalizations found in the packing literature. The three largest impacts (equal to drops higher than 45 cm) each occurred on separate journeys.

Of the 843 impact events that were recorded, 68% were impacts against a flat side of the case, 26% were impacts along an edge, and 6% were impacts against the corners of the case. This also agrees with generalizations found in the literature: as package size increases, the probability of edge and corner drops decreases.

Of 571 flat drops, 285 were against the bottom of the case. The other flat surfaces of the case received between 12 and 105 impacts. The surface that received 105 impacts was the back of the case (opposite the front handle). This illustrates the effect that the orientation and placement of the handles can have on how a package is manipulated. The large number of drops to the bottom of the case also indicated that it was frequently handled and moved with the "This Side Up" stickers in the correct direction. It is worth noting, however, that trying to lift the case with the handles upside down is quite painful, which may have had a greater effect than the labels for maintaining the correct orientation of the case!

The highest impact recorded during the 17 flights was equivalent to an 84 cm drop. This impact occurred on the third of the five trips.

The four most severe drops ranged from 44 cm to 84 cm. Two of these drops occurred at Canadian airports during handling operations for flights with two different Canadian-based carriers, and two occurred at U.S. airports during handling operations for flights on two different U.S.-based carriers.

So, what happened to the fragile equipment? Nothing, because the cushioning inside the case had been selected to keep the transmitted shock levels well below levels that would damage the equipment for a 75 cm drop. As a result, the highest shock level transmitted to the equipment inside the case during the greatest (84 cm drop equivalent) impact was only 36 G, and the equipment can withstand shocks of up to 70 G.

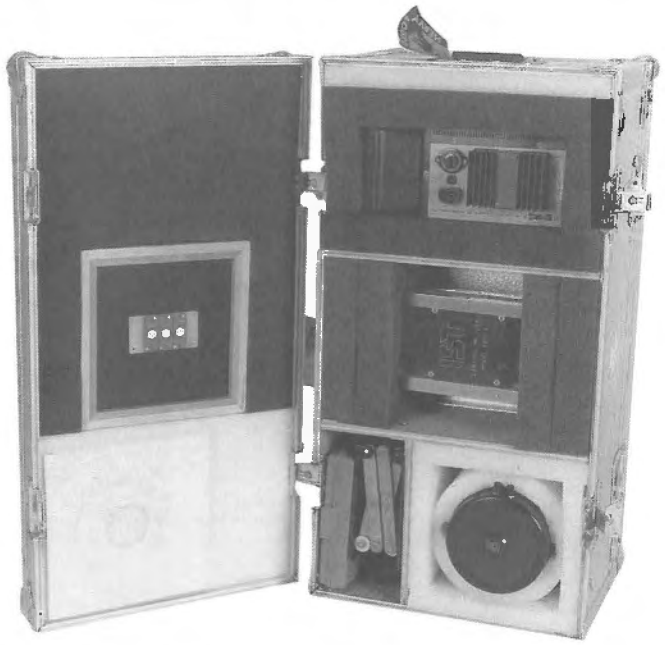

Figure 2. The data logger measures 11 cm x 11 cm x 6 cm. It can record the time and date of the occurrence of hundreds of shocks over extended periods of time.

In order to avoid shipping damage, one should benefit from the observations and experience of others to arrive at reasonable estimates of handling risks. Learn the methods frequently used by commercial package designers, which involve relating package characteristics such as size or weight to the most likely handling methods, in order to estimate the height from which a package may be accidentally dropped. The reasoning behind this approach is that as packages become larger and/or heavier, the height to which they are lifted, and from which they are likely to be dropped, is generally expected to decrease.

A summary of probable drop heights based on different handling methods is provided in Table I. When shipping highly valuable or fragile items, design packages to a higher-than-anticipated drop height. For example, a drop height of either 60 cm or 75 cm could have been used to design the cushioning for the case described in this article. In light of the value and fragility of the contents, the cushioning was designed for a maximum drop height of 75 cm. When trucks are used to transport fragile or valuable items, it is also common to anticipate an accidental drop from the tailgate. In this situation, a 75 cm drop height can be used regardless of package weight.

The results of this empirical study show a good agreement between the 75 cm design drop height obtained from probable drop height tables and the actual airport handling data for a 45 kg package. The data also illustrates that the design of a cushioning system should predict a reasonable worst case scenario even if it has a relatively low frequency of occurrence. And, finally, the results show that the worst case scenario will eventually happen!

Table I
Probable Drop Heights

Weight Range (kg)	Type of Handling	Drop Height
0 - 5	1 person throwing	120 cm
5 - 10	1 person carrying	105 cm
10 - 20	1 person carrying	90 cm
20 - 45	1-2 person(s) carrying	75 cm
45 - 115	2 persons carrying	60 cm
115+	Mechanical equipment carrying	45 cm

Note: For light packages shipped by parcel post, the drop height can be up to 3 m.

CCI has developed a Cushion Design Calculator and PadCAD, a computer program for cushion design, to assist packers with cushion design problems. For further information on either of these products, please contact the Extension Services Division at CCI. ♦

Relative Humidity and Temperature Guidelines: What's Happening?

by Stefan Michalski

There is a rumour going around that CCI no longer cares about temperature and humidity specifications! That there's no need to worry about those impossible standards! Well, the truth is that our approach has changed, but the issue has not gone away.

Conservation research scientists at CCI have shifted from defining a single, simplistic standard to identifying degrees of correctness or, more precisely, degrees of incorrectness. We try to estimate the benefit of basic control of the environment and the benefit of increasing sophistication. The following article summarizes CCI's current approach to temperature and relative humidity.

Testing the effects of changing RH on the behaviour of model canvas paintings and lining materials.

Temperature

Many artifacts will tolerate extreme cold (-30°C). Low winter temperatures indoors can reduce such problems as chemical self-destruction, pests, mould, energy consumption, and condensation in walls. At the other extreme, many artifacts will also tolerate brief excursions to 50°C. Aside from this general tolerance, three forms of incorrect temperature can be identified for a museum: temperatures that are too low, temperatures that are too high, and temperature fluctuations.

Temperatures that are too low are a problem for plastics and paints because these materials become brittle at low temperatures. Acrylic paints, for example, are quite leathery and robust at temperatures that are comfortable for humans, but turn glassy and increasingly brittle below 5°C. All paintings and coatings may crack at Canadian winter temperatures (below 5°C) either simply by contraction or by accidental blows to the paint.

Temperatures that are too high are incorrect for materials that self-destruct chemically within a human lifetime, such as acidic paper, nitrate and acetate films, celluloid, and rubber objects. The only practical solution for large quantities of these items is cold storage. Each 5°C drop will roughly double the lifetime of such materials, e.g., they will last a millennium at 0°C instead of a few decades at 25°C. Temperatures that are too high are also a problem for those artifacts that contain waxes or resins that soften above 30°C, such as lined paintings or artifacts that contain pitch.

Temperature fluctuations can be incorrect for artifacts that contain restrained brittle layers (e.g., enamels). Generally, however, temperature fluctuations by themselves rarely cause problems.

Relative Humidity

The single magic number of 50% RH, which was advocated in the past, works for many artifacts but not for many others. The fluctuation specification of ±3% RH, although initially seen as simply cautious and conservative, turned out to be virtually impossible to achieve in the real world. Three decades of museum experience led to the same questions over and over again: Why these numbers? How important are deviations, given the difficulties involved?

In our experience, real examples of incorrect relative humidity in museums fall into one of four categories: damp, above or below a critical humidity, any humidity over 0%, and humidity fluctuations. Each incorrect RH applies to certain artifacts, and each causes very different rates of deterioration. Instead of stipulating one all-purpose and impossible "correct" humidity, CCI scientists outline the various incorrect humidities and emphasize the benefits of each level of control achieved. Overall, it is a return to the common-sense notion of avoiding extremes, augmented (rather than dominated) by scientific knowledge of more subtle effects.

Damp causes mould and rapid corrosion. Numerically, "damp" begins at 75% RH, but more important is the recognition that danger grows rapidly for every step beyond this point: 80% RH is much more incorrect than 75% RH, 85% RH is much more incorrect than 80% RH, and so on to 100% RH. For example, at room temperature, the time a museum can take to correct loss of control before mould appears on the most susceptible artifacts drops from about two months at 75% RH to about two days at 90% RH. Clearly, this

influences not just building design but how museum staff must respond to humidity readings.

Relative humidities above or below a critical RH affects minerals that hydrate, dehydrate, or deliquesce at a particular RH. Besides natural history collections, this applies to contaminated metal objects (particularly marine or archaeological artifacts) and to some types of glass. Although damp may appear to be simply a type of "above a critical RH," in practical terms damp is so much faster and generic in its attack that it must be considered on its own. In contrast, susceptible minerals and contaminated metals are very specific in their critical RH values. Museum control depends on special data, special containers, and special rooms. In fact, this particular form of incorrect RH has been recognized and acted on for almost a century in archaeological metal collections.

Any RH above 0% is incorrect for artifacts that chemically self-destruct in a human lifetime via some process that requires moisture. The best known examples are acidic paper and acetate films. The data suggest that if the humidity were actually to reach 0% RH, then these processes would stop. However, maintaining RH below 5% year round is impractical. As shown in Table I, temperature and humidity are linked on this issue. Although low temperature has the greater effect on an object's lifetime, low RH can be achieved more easily. Individual artifacts can be sealed in inexpensive containers with desiccant. On the scale of an entire building, low RH requires far less energy or building modification, and people can work in a building with low humidity more easily than in a building with low temperature. Also, Canadian libraries and archives can achieve mass desiccation (as compared to mass deacidification) for free during the winter by using heating systems with no humidifiers.

Fluctuations in RH are incorrect for artifacts that contain restrained moisture-sensitive layers. This, of course, includes most of many museum collections. Certain artifacts, especially those that have recently been conserved, may also be very sensitive or vulnerable to RH fluctuations and may require special protection. Within the context of an overall preservation plan, however, it must be admitted that such damage can be repaired (at a cost), unlike the damage from such agents of deterioration as direct physical forces, fire, water, theft, pests,

Table I
Effect of Incorrect RH and Incorrect Temperature on Museum Materials

	Stiff or brittle organic materials[a]	Flexible organic materials, chemically stable[b]	Flexible organic materials, chemically self-destructing[c]	Inorganic materials[d]
Damp (over 75% RH)	Mould. Softening of glue, some paint, wood. Canvas may shrink.	Mould. Softening of size, binders. Textiles may shrink.	Mould. Softening of size, binders.	Mould. Rapid corrosion of base metals.
Above or below a critical RH				For some: corrosion, crizzling, disintegration.
Above 0% RH			Disintegration and yellowing. If object life is 50 y @ 50%, then 100 y @ 30%, 200-400 y @ 10%.	
Fluctuation around a middle RH (stresses are zero)	Rate or risk of fracture growth: @±5%: P, V, A, W: none @±10%: P: tiny W, A: none-tiny @±20%: P: small W, A: tiny-small @±40%: P: severe W, A: small-severe	If brittle image layer, as P. If restrained by frame, etc., as W.	If brittle image layer, as P. If restrained by frame, etc., as W.	Fluctuations crossing a critical RH disintegrate some contaminated ceramics, stones, metal patina.
Temperature too high	Over 30°C, softening of some adhesives, waxes, pitch.	Over 30°C, softening of some adhesives, waxes, pitch.	Disintegration and yellowing. If object life is 50 y @ 20°C, then 200 y @ 10°C, 5000 y @ -15°C	Some minerals disintegrate.
Temperature too low	Embrittlement, e.g., acrylics below 5°C.	Embrittlement.	Embrittlement.	
Temperature fluctuation	Rate or risk of fracture growth: @±10°C: P, V, A: none-tiny @±20°C: P, V, A: none-small @±40°C: P, V, A, W: none-severe Plus indirect effects if RH fluctuates.	If brittle image layer, as P. If restrained by frame, etc., as W.	If brittle image layer, as P. If restrained by frame, etc., as W.	Some composites (e.g., weak enamelling), as P.

[a] For example, wood (W), oil and tempera paintings and polychrome (P), varnish (V), acrylic paintings (A).
[b] For example, non-acidic paper and textiles, parchment, stable B & W photographs.
[c] For example, acidic paper, acetate films, colour photographs.
[d] For example, metals, minerals, ceramics, glass.

some contaminants, fading due to light, extreme damp, and chemical self-destruction. Humidity fluctuations large enough to cause noticeable fractures in a single cycle can be considered "critical fluctuations". Fatigue mechanics shows that fluctuations that are below a critical level will only damage artifacts in very tiny increments. Keeping the straw off the camel's back has the most benefit!

In complex assemblies like furniture or paintings, each sub-assembly has its own critical fluctuation. Therefore, the issue becomes how to know all the critical values. The simplest approach is to review local history: What is the greatest fluctuation that lasted long enough for the whole collection to have responded? This is the collection's "proofed" fluctuation. In most Canadian museums, it is fair to estimate this as at least ±25% RH fluctuation from the local annual average. Thus, fluctuations smaller than this can only cause very slow cumulative damage. Another approach to determining critical fluctuations is to do analyses. Currently, research on paintings and wood suggest critical fluctuations for most artifacts begin at ±25% RH. Histories of artifact damage also suggest that fluctuations must reach beyond ±25% RH to cause sudden noticeable damage. History further demonstrates that many humidity-responsive assemblies tolerate extreme fluctuations of ±40% RH without noticeable damage if they are free to move.

Finally, no discussion of environmental control makes sense without reference to reliability. It is far more beneficial in the long run to build practical, fixable, forgiving systems that control the worst forms of incorrect humidity than it is to build elaborate building systems that control all forms of incorrect humidity for a few years and then fail (often creating worse conditions than those they replaced).

Conclusion

Has CCI radically changed environmental recommendations? No. A glance at Table I shows that institutions with the resources to give the best possible care to paint and wood have only a slightly wider permissible range of fluctuations (up to ±10% RH) than they did before. Fortunately, CCI's experience shows that this range is reasonable for good mechanical systems or for RH-controlled cases. The biggest change is the recognition that the large expenditures of resources necessary to achieve ±5% RH control as opposed to ±20% RH control bring modest benefits to humidity-related deterioration. These new environmental guidelines allow museums room for negotiating the difficulties of tight budgets, historic buildings, and essential humidity requirements.

Further Reading

Stefan Michalski, "Relative Humidity: A Discussion of Correct/Incorrect Values," *ICOM-CC 10th Meeting, Washington, D.C.*, (ICOM-CC: Paris, 1993), pp. 624-629. ♦

Reducing the Risk to Collections from Pests

by Tom Strang

Pests have a great potential for destroying museum collections. Therefore, integrating pest management into a museum's functions is essential for long-term preservation of stored artifacts.

The tolerable level of pest activity within a collection is often very low due to the unique and valuable nature of some of the items. Many valuable objects are small or are valued for their fine surfaces, e.g., a type specimen of an insect, a richly embroidered textile. Other artifacts can tolerate a greater amount of pest activity before they are truly compromised, e.g., totem poles, polychromes. In some objects, the pest damage is even considered an indication of age or is a contribution to authenticity.

However, the effects of pests are cumulative. Over time, continual low pest activity can be as devastating to a

Figure 1a. Poor organization of collections creates pest habitat and prevents effective sanitation.

Figure 1b. Organized collections easily allow sanitation and inspection activities.

collection as a rapidly growing infestation. Both will need to be controlled for museums to achieve their objective of trying to preserve their collections in perpetuity.

Museums have a long history of steeping objects directly in pesticides (e.g., continuous in-cabinet fumigation) and of applying preservatives with an arsenic or mercury base. Sometimes these procedures were used illegally or ineffectively. For example, thymol was never registered as a fumigant in Canada, yet it was used as one to combat mould on books. When these chemicals were no longer allowed to be used, museum personnel perceived that their collections were at increased risk because other protective measures, the effectiveness of which was unfamiliar anyhow, were not in place. Preserving objects by making them, or the surrounding air, continuously toxic had meant that museums did not have to invest in other, more passive, methods of pest control. For example, many cabinets were not effectively sealed and sanitary conditions were not always maintained.

There are, however, strong alternatives and replacements to the missing fumigants and pesticides. Current efforts in museum pest management are providing means of passive control, are revising older pesticide-free extermination systems, are introducing pest control materials that are new to museum personnel, and are demonstrating how sanitation can be greatly improved in collections.

Pest Management

A pest management program begins with a survey to identify the risks of the current system. Consider the three means by which museums control pests: the building and its surroundings, portable fittings and hardware, and staff activities and procedures. In the survey, details of these three methods are evaluated or are noted for their absence, e.g., tight construction, access for thorough sanitation, collated pest reports, quarantining loans. A pest management program incorporates existing strengths and lists specific improvements. The program must incorporate contributions of all three means of control and must fairly represent the differences in scope, cost, and effectiveness of each.

A museum's pest management program must be implemented by an individual or group with the authority to effect improvements within the museum. These improvements will require the cooperation of museum staff who carry out a variety of functions: pest control, sanitation, food services, conservation, curatorial, public programming, engineering, planning, and fund raising. A representative of each of these functions should be involved in the pest management program so that dangers to collections from pests can be clearly expressed and remedial activities can be coordinated across jurisdictions, e.g., effective sanitation within collection and public areas, compliance with quarantine procedures.

Implementing and maintaining a pest management program are conveniently organized in CCI's "Framework for Preservation of Museum Collections" by five stages of control: avoid, block, detect, respond, and recover/treat.

Avoid

Effective sanitation is the single most important factor in pest control: contain garbage, vacuum frequently, establish sanitary perimeters, and eliminate clutter. Sanitation reduces or eliminates attractors such as food and habitat (see Figures 1a and 1b). Other attractors such as ultraviolet-rich lights can be manipulated to reduce pest concentrations near or within the building.

Pests are effective colonizers and are often widespread geographically. Their presence may be difficult to avoid. However, problems from pests can be reduced by carefully choosing the location of the facility, e.g., avoid areas near dump sites. Practice effective sanitation of the grounds to decrease the local population of pests.

Block

Collections are threatened by pests that infiltrate from outside, that are brought in on material, and that are currently resident in the building. The degree to which the collections are contained is most important in preventing widespread damage.

The majority of rodent pests can be excluded from the building by eliminating cracks and holes over 6 mm wide; most insect pests can be excluded by eliminating cracks and holes over 0.5 mm wide. Properly detailed modern construction can greatly control the movement of moisture

Figure 2. Although the window is wide open, the contents of the display case are completely protected from pests.

thorough walls, which is a major factor in building deterioration. The same techniques used in the construction of food processing facilities can essentially eliminate pest infiltration in museums. Considering the cost of building a museum, it is important to insist on attention to construction details to prevent infiltration of rodents or insects.

Within the building, the level of containment becomes extremely important. Quarantine affected materials to prevent spread and to increase the time available to respond to problems. Use tightly sealed cabinets for storing objects.

If the collection space is infested, or if artifacts stored on shelves are considered vulnerable, objects can be safely sealed in polyethylene bags. Bagging confers considerable protection and quarantines individual objects. Individually bagged items can be treated while the storage area is being disinfested. Bagged items are not exposed to chemical pesticides that might be used to combat pests in the storage area, such as crack and crevice sprays or area fogs, and can be left enclosed until they are required for use.

Effective containment also protects against other agents of deterioration such as smoke, water, contaminants, and extreme humidity (see Figure 2).

Detect

Early warning is one of the mainstays of pest management. The available tools — adhesive traps, pheromone technology, light traps, organized reporting — are effective, but all require periodic inspection and action (see Figure 3).

Figure 3. Large insects being eaten by dermestid on adhesive trap.

Assess pest management activities periodically to ensure their continued effectiveness. Maintaining long-term records of pest activity allows an institution to evaluate changes in control activities when they occur. Records of pests should include the following: species or genus, number, location, and date of sighting.

Respond

Eliminating pests from collections and buildings requires effective prevention and eradication techniques that do not damage artifacts. These range from increased sanitation to the specific application of controlled atmosphere fumigation, thermal control, and pesticides.

Beneficial changes in registration for insect growth regulators, gradual introduction of functional commercial pheromone lures for museum pests, and safer formulations of pesticides increase the scope of pest control for museums. The pest management approach reduces the role of chemical pesticides from prophylactic to tactical.

Controlled atmosphere fumigations with 0.1% oxygen content or atmospheres with greater than 60% carbon dioxide are proving to be effective replacements for phosphine, methyl bromide, and ethylene oxide fumigants. Using low (below -20°C) and high (above 60°C) temperatures on bagged artifacts is an accessible and effective method for eliminating insects from artifacts.

Another response is long-term planning and review of the pest management program already in place in a museum. Improve any shortcomings discovered in the "avoid" through "respond" control stages.

During and after responding to a pest outbreak, especially a severe incident, record all the costs incurred. List the losses to planned activities due to the pest incident. Log the time and salaries required to combat the pest. Note the logistics of the response, what worked, and what did not. List the extent of damage to objects and their values. Estimate the costs and time for restoring damaged objects. Use this information to illustrate to authorities the need for more stringent organization of eradication techniques. For example, when moving collections from old to new sites, every object is observed and handled, making this an ideal opportunity to eliminate pests from the objects. Other requirements that can be justified by this data are a capital purchase of fumigation equipment, annual acquisition of sufficient adhesive traps, or allocating staff time to preventive activities such as inspecting or rehousing the collection.

Should a pest infestation occur, use it as an opportunity to train all people within the museum in the danger and mitigation of pest activity. Retain illustrative material for future staff orientation.

Recover/Treat

Restoring structural damage and aesthetic losses only makes sense if the affected object can be returned to an uninfested collection space or to another safe location. Spending a lot of time restoring new pest damage to objects patches the wrong holes in the collection.

Conclusion

Museums are not unique in adopting a systematic, layered pest control strategy. It is present in all professional fields that seek to preserve human goods and life. A pest management program is successfully integrated when requirements are not seen as impositions and crisis driven but rather as ongoing, effective, and comprehensive.

A complete bibliography listing sources on aspects of pest management systems and on specific control techniques is available from the author at CCI. ♦

The PREMA 1990-2000 Program

by R.L. Barclay

Since 1987, CCI staff have contributed to the PREMA Program organized by the International Centre for Conservation in Rome (ICCROM). (See Bob Barclay's article "PREMA Zambia" in *CCI Newsletter* No. 9.) PREMA is a program to ensure the conservation of sub-Saharan African museum collections and to establish a network of African professionals who can assume responsibility for the conservation of these collections. Five basic activities comprise the PREMA program: a one-year international university-level conservation management course; yearly three-month National Courses in selected African countries; a technical cooperation program that provides materials and equipment as well as funding for construction; regional seminars on preventive conservation for museum directors; and training teachers to work with museum staff in Africa. Sound education is the foundation of this program, and technical support, regular communication, and upgrading of skills and information are built upon this base.

During a pilot survey of African museums, a number of shortcomings were identified. Most collections were of unstable ethnographic material (comprising as much as 70% wooden objects), and few of these collections had access to conservation expertise. Approximately 15% of museums were up-to-date with their collection inventories, and infestation, overcrowding, and environmental problems were common. Generally speaking, the museum staff in charge of the day-to-day handling of objects had little background in museology and a lack of conservation awareness. The results of this survey indicated the need for a very broad approach to the conservation of collections. It would require the involvement of all museum staff, global management of those environmental factors which could be sustained locally, and a preventive approach oriented towards caring for objects rather than towards treating them.

PREMA participants at the National Course in Accra, Ghana, examine museum objects before beginning conservation treatment.

CCI's role in the PREMA project has primarily been one of supplying teachers for various conservation course units. The preventive approach that had been honed in years of activity with the Mobile Conservation Laboratory and with workshops, seminars, and other presentations proved to be surprisingly relevant in Africa. Staff were involved in teaching international course sections at ICCROM in Rome, and also in teaching sections of National Courses in Ghana and Zambia. In 1990, the international course was transferred from Rome to Africa. The first African course took place at the Center for Museum Studies at Jos, Nigeria, in 1993. Once again, CCI staff were involved with teaching duties. This past summer, a member of CCI's Ethnology staff completed a three-week teaching assignment for a National Course at the Musée d'Art et d'Archéologie and the Musée du Palais de la Reine in Antananarive, Madagascar.

The PREMA Project has been exciting and rewarding for participants, lecturers, and organizers. The huge challenge that this unprecedented demand presented has been met on many fronts. Nevertheless, as the project moves into its next phase, centred primarily in Africa and handing over to African organizers, there is still much fine tuning to be done and many philosophical hurdles to be overcome.

The conference of the International Institute for Conservation, to be held in Ottawa in September of 1994, will provide a convenient venue for teachers, organizers and participants to meet and discuss future directions of the program. Among the topics to be discussed will be political and administrative instability, unreliability of infrastructures, and indeed the whole concept of "museum" and what it means to our African colleagues. There are administrative and practical difficulties in establishing smooth-running courses and workshops, no matter what part of the world one works in. Such problems are to be expected and must be anticipated, but in the African situation, because of instability and weak communications, they tend to become exaggerated and exacerbated. While there is a demand for flexibility, there is also the necessity for solid and reliable structures to provide confidence. On the philosophical side, it is self-evident that in order to inculcate a preventive attitude to collections and their management, participants must have faith in the concept. This poses the question of how our Euro-centric ideas of the museum harmonize with the Africans' understanding of their cultural heritage and its preservation. This is an enormously complex question, but it must be faced and tackled in the near future.

There is no question that the excitement, reward, and challenge of the PREMA Program will go unabated. The pressure between now and the year 2000 will be to provide and maintain a secure base from which our African colleagues can operate. If the past successes of PREMA are any indication, the necessary energy, commitment, and thoughtfulness will be found in abundance. ♦

A Safety Reminder

by Michael Harrington

The staff at CCI have the opportunity to visit colleagues in many labs, studios, and workshops around the country. During the course of these visits, we sometimes come across disturbing situations. For example, we have noted an increasing use of solvents, strippers, and cleaning agents that contain the chemical D-LIMONENE, a major component of citrus rind oil. The trade names of some of the products that contain this chemical are Citrasolve, Citrus Clean, Natural Citrus Solvent, and Citristrip.

Of concern is not the use of these products *per se*, but the apparent belief, fostered by claims of manufacturers and by advertising for the home use market, that these products are completely safe and non-toxic. Information published by Arts, Crafts, and Theatre Safety in New York ("D-Limonene," *Art Hazard News*, vol. 4, no. 7, July 1990, updated 3/12/94) shows subacute toxicity in the same range as pentachloroethane, 1,4-dichlorobenzene, and unleaded gasoline and other hydrocarbon solvents. Workplace limits set for this chemical by the American Industrial Hygiene Association at 30 parts per million (ppm) are more restrictive than the Permissable Exposure Limits set by the Occupational Safety and Health Administration for turpentine (100 ppm), toluene (50 ppm), and n-hexane (50 ppm). As well as the inhalation risk, skin irritation and allergies have been noted, especially in people who are previously sensitized to other "natural" solvents like turpentine or anise oil.

Therefore, these "natural" substances must be treated with the same precautions as those afforded to other very toxic solvents. This includes extracting vapours at source, preventing skin contact, and using proper handling and disposal procedures.

For more information about D-LIMONENE, the CCI Library maintains subscriptions to *ACTS FACTS* and to *Art Hazard News*, has current copies of the *Manual of Recommended Practice in Industrial Ventilation*, and holds a wide range of reference materials pertaining to chemical and workplace safety.

It can be a dangerous world out there. Let's take care to protect ourselves. ♦

Framework for Preservation of Museum Collections

CCI is proud to announce that the "Framework for Preservation of Museum Collections" is now available. This chart is intended to assist conservators, collection managers, and other museum professionals in assessing the threats to their collections.

The chart groups threats to museum collections under nine agents of deterioration: direct physical forces; thieves, vandals, and displacers; fire; water; contaminants; radiation; incorrect temperature; and incorrect relative humidity. It further outlines methods of control that may be carried out in terms of building features, which include features that are permanently attached to or that are part of the main structure of the building; portable fittings, which include fittings and equipment that are not integral parts of the building; and procedures that can be carried out by museum staff. Control at the building or portable fittings level is further broken down into methods that are suitable for storage, display, or transit situations. Stages for controlling each agent of deterioration are listed under five general headings: avoid, block, detect, respond, and recover/treat.

The "Framework for Preservation of Museum Collections" is an extremely useful tool for identifying risks to museum collections and for suggesting appropriate methods of control.

Price: $20.00 CDN — Canadian residents add $7.40 CDN ($1.40 GST and $6.00 postage and handling). Outside Canada, add $8.00 CDN (postage and handling).

To order, send a Canadian, U.S., or International money order, payable to the Receiver General for Canada, to:
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Canadian Conservation Institute
Department of Canadian Heritage
1030 Innes Road, Ottawa, Canada K1A 0M5
Tel.: (613) 998-3721 Fax: (613) 998-4721

Please note that our new postal code is K1A 0M5

Address correspondence to
Canadian Conservation Institute
1030 Innes Road, Ottawa, Canada K1A 0M5

A Study of the Materials and Techniques of Alfred Pellan

by Marie-Claude Corbeil, Elizabeth Moffatt, and David Miller

June 1993 saw the opening of a retrospective on the work of Alfred Pellan, organized jointly by the Musée du Québec and the Musée d'art contemporain de Montréal. At that time, the Analytical Research Services Division of the Canadian Conservation Institute (CCI) initiated a study of the materials and techniques used by Pellan. This study is part of a larger project on 20th-century Canadian painters, the Canadian Artists' Painting Materials Project (see *CCI Newsletter*, No. 10, September 1992, p. 9).

Alfred Pellan (1906-1988) was a dominant figure in Canadian painting. His substantial and varied work is not confined to one genre or medium. To describe it, one might cite Germain Lefebvre: "The extravagance and fantasy that suddenly erupt without warning, the need to dream, to elude norms and rules: that too is Pellan, precisely!"[1] [trans.] For Pellan, however, creativity and experimentation did not necessarily mean rejecting technique. To quote Germain Lefebvre once again: "Pellan professed a deep respect for the requirements of the artist's craft, for the necessity of techniques and practices of art."[2] [trans.] After all, Pellan himself said, "I think it would be beneficial if art schools offered chemistry courses. To some extent, it is the basis of painting to know what one is working with; it is essential to know the materials."[3] [trans.] Hence it was with great curiosity and enthusiasm that we embarked upon a project with the purpose of documenting the materials and techniques used to create the exuberant universe of Pellan.

First, we went to Quebec City in September 1992 to attend a meeting designed to lay the project's groundwork, to set its objectives, and to obtain samples from the Pellan paintings that belong to the Musée du Québec. Some of the paintings were at the Centre de conservation du Québec for treatment; the others awaited us at the museum.

On the whole, sampling proved to be a delicate operation, partly because the paintings were in excellent condition, and partly because the paint layer was thin and sometimes hard. In deciding on a sampling strategy, we attempted as much as possible to take samples of all the colours present, and to take them from areas that were not easily visible, such as the tacking margins or the edges of the painting that are ordinarily hidden by the frame's rabbet. If we had to take samples, even tiny ones, from the visible portion of the image, we were careful not to disfigure the work. Samples were often obtained from areas that had already been damaged, for example, where there were losses or cracks. There were very few damaged areas in Pellan's works. When the work was highly textured, it was easy to take samples, even in the most visible places. In many cases, however, the paint layer was very smooth and thin, and we preferred to limit the number of samples, even when the picture presented a wide range of colours.

During the trip to Quebec City, we obtained samples from 13 works. We later took samples from the painting entitled *Et le soleil continue*, which was being treated at CCI. Two works on paper were also sampled while they were being treated at the Centre de conservation du Québec, but we preferred to restrict our study to paintings, even though Pellan used a wide variety of media.

Figure 1. Sampling paintings at the Musée d'art contemporain de Montréal.

In January and April 1993, we visited the Musée d'art contemporain de Montréal to examine and sample paintings in the collection (see Figure 1), bringing the number of works sampled to 26. Over 250 samples have been obtained. Most are paint samples, but a few cross-sections and samples of ground, varnish, and canvas fragments are also included.

The study is primarily concerned with the materials used by the artist, such as the pigments, paint media, and varnishes. From the results obtained thus far, we can conclude that Pellan's palette was extremely rich and that his need to experiment was reflected not only in the themes and execution of his works but also in his choice of pigments. All types of pigments were found: traditional pigments such as vermilion, yellow ochre, red ochre, ultramarine, and bone black; 19th-century pigments such as cadmium yellow, cadmium orange, emerald green, and cobalt violet; and finally a wide variety of organic pigments developed in the 20th century such as toluidine red, hansa yellows, and para red.

We also examined certain technical details, such as the preparation of the canvases, the types of supports used, and

the signatures. It is indeed interesting to know whether the artist preferred one particular type of support, whether he prepared his own canvases or used commercially prepared canvases, and whether he mixed his colours. For this type of information, mere observation does not suffice. We therefore asked Mrs. Pellan to collaborate with us by sharing her knowledge of Pellan's technique.

The data obtained from the analyses were entered onto a database, which will serve several purposes: to plan treatments, to respond to possible questions about attribution, to predict a work's behaviour, and so on. These results have already made it possible to explain the unusual behaviour of certain paintings, behaviour which has dictated specific recommendations to the conservator in charge of treatment with regard to display and storage of works. Such was the case with the painting entitled *Et le soleil continue*, which was treated at CCI: a circle of very thick red paint had cracked, releasing a long trickle of still-liquid red paint. Infrared spectroscopic analysis revealed that the red pigment was toluidine red, while analysis by gas chromatography/mass spectrometry indicated that the paint medium either was a mixture of linseed oil and poppyseed oil or was safflower oil. The use of a slow-drying oil, such as poppyseed oil or safflower oil, with a pigment that is also a poor dryer may explain the poor drying properties of this paint. Consequently, this is a problem inherent to the work that cannot be corrected by practical means. The conservator in charge of treatment, Helen McKay, believing that the paint would continue to drip, made a number of recommendations. These included storing the picture horizontally to slow any dripping, and, if the painting must be displayed, placing it in a horizontal or quasi-horizontal position. As a result, this work was shown on a slight incline in a display case at the exhibition that was held last year in Montreal.

While the primary purpose of analyzing the samples taken from Pellan's paintings was to collect data on the artist's materials and techniques, the analysis also enabled us to discover some very interesting details about the composition of a few pigments, such as, for example, the presence of by-products. Furthermore, the challenge posed by this project afforded us an opportunity to test and refine our work methods. This project, which should be completed by the end of 1996, has yielded much more than we had hoped.

The exhibition entitled *Alfred Pellan: A Retrospective* was presented in London, Ontario, from May 7 to July 3, 1994, and will move to Winnipeg, Manitoba, from February 25 to April 30, 1995.

Notes

1. Lefebvre, Germain, "L'art est une fête," in *Alfred Pellan* (Quebec City: Musée du Québec, 1993), p. 17.

2. *Ibid.*

3. Comments quoted by Germain Lefebvre in *Pellan : sa vie, son art, son temps* (LaPrairie: Éditions Marcel Broquet, 1986), p. 203. ♦

Focus on...
CCI and the Sharon Temple Museum

by R.L. Barclay

The CCI Newsletter *introduces a new feature,* Focus on... . *Each issue will highlight CCI's ongoing relationship with a Canadian institution. In this issue, the spotlight is on CCI's association with the Sharon Temple Museum.*

The village of Sharon lies a few kilometres north of Newmarket, Ontario, and is the site of the Sharon Temple, a building that has often been described as Canada's most precious wooden object. The Temple was erected in the 1830s by the American builder Ebenezer Doan, to the order of David Willson. Willson was the leader of the breakaway Quaker sect known as the Children of Peace, who had settled in the Hope area at the beginning of the 19th century. Once the sect gained a firm footing in the locale, Hope was renamed Sharon after the plain of that name in the Bible (1 Chronicles 27:29). In the final phase of the sect's occupation, buildings on the site included a Meeting House, the central and dominant Temple, and a specially designed Study (a small building devoted to

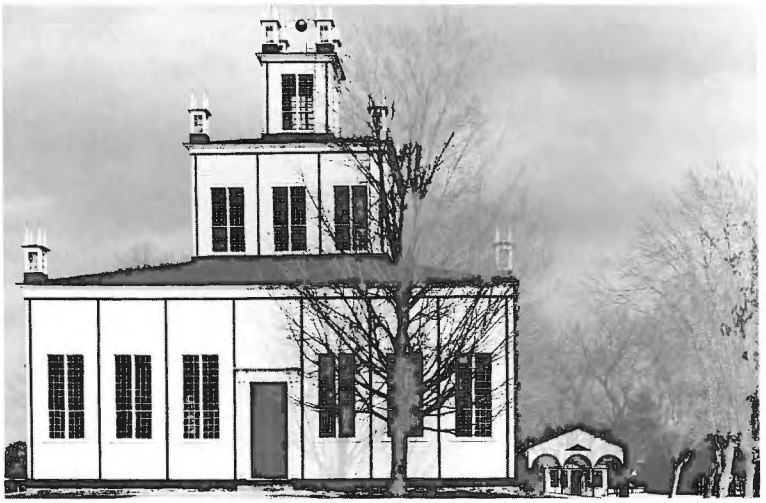

Figure 1. The Sharon Temple from the west. The square windowed towers that rise above the roof line are lanterns, which contain sconces for candles. A gold ball is hanging on four chains between the four upper lanterns. In the background is David Willson's study.

David Willson's intellectual activities) (see Figure 1). The Temple and the Study survive, and other buildings of local historical interest, including Ebenezer Doan's house, have been moved to the site.

Music had a very high priority with the Children of Peace. Quite early in the history of the sect, two pipe organs were commissioned from local contractor Richard Coates. Coates emigrated to Upper Canada where he set himself up as a woodworker, first in York and then later in the Oakville area, while apparently also involving himself in Sharon's musical activities. The first organ he produced had no keyboard; it used wooden barrels pre-programmed with 10 tunes each (see Figure 2). Wire pins and bridges that had been hammered into the surface of the barrels operated the organ when the barrel was rotated, much like the mechanism of today's music boxes. Air was supplied to the four ranks of wooden pipes from a hand- or foot-operated bellows. The second organ was equipped with a keyboard and, of course, required the services of an organist familiar with the instrument. Air still had to be pumped by hand, however.

The Canadian Conservation Institute first became involved with the Sharon Temple in 1978 when a sample of wire from the organ barrels was submitted to the Analytical Research Services Division (ARS) for identification. The barrel organ was being restored privately at that time so that concerts could be held in the Temple. A new barrel was being made for playing selected tunes because the old barrels were in no state to support sustained use. The accuracy of replicas of the bridges and pins would depend upon whether the material used originally could be duplicated. ARS concluded that it was a low-zinc brass, quite commonly available in the early 19th century, and the Temple could make a brass replica.

In 1983, the curator, Ruth Mahoney, requested advice from CCI's Ethnology and Furniture Division on caring for the degraded finish of the keyboard organ. Suggestions had been made by non-museum personnel that the casework of the organ be stripped and refinished. Our examination showed that this was the original grained and varnished surface, and was quite a rare early example of this work. The curator's decision to retain the casework in its original state was supported by CCI. This contact resulted in further consultations the following year on the care and upkeep of the barrel organ, which by this time was in playing condition and was getting a great deal of use. The curator was concerned about the extent of restoration that had been necessary to make the instrument playable, and also about the wear and tear on the mechanism, especially during the summer months when frequent demonstrations of the instrument were given in the Temple. CCI advised that, as a historic object of great significance, the organ should not be played until a full review of its condition was made and a program of examination and treatment was pursued. This necessitated several more visits to Sharon by CCI staff over a period of years, during which time conservation treatments were carried out on the operating mechanism and the casework. This treatment is continuing with the aim of allowing the organ to be played under closely monitored conditions and at very infrequent intervals.

Figure 2. The barrel organ supplied by Richard Coates. The barrel lies horizontally below the pipes and is turned by a crank-and-worm gear. The bellows is in the casework below the barrel, although at the time this picture was taken an electric blower had been installed.

While conservation treatment of the Coates barrel organ was underway, the Sharon Temple Museum was granted funding to do much-needed restoration work on the fabric of the Temple. This included re-roofing, which was long overdue. During roofing work, several intriguing construction features were discovered, including small sheet metal chimneys that had been inserted in the lanterns, presumably to allow air circulation. Sections of metal flashing were also discovered below the later layers of roofing. Analysis of these metal parts by CCI's Analytical Research Services Division helped the curatorial staff to draw conclusions about the Temple's original methods of construction. At the same time as this analysis was being pursued, a sample of the very deteriorated golden ball, which had originally hung between the upper lanterns of the Temple, was submitted for analysis. Documentary evidence indicated that the ball, which was made of sheet iron, had once been sent to Newmarket for gilding. Unfortunately, this could not be verified — no trace of gold could be found in the analysis, but there were indications that gold-coloured paints might have been used.

Over a period of more than 15 years, CCI and the Sharon Temple have carried on a mutually rewarding dialogue. Scientific services have assisted in resolving important questions regarding early construction materials and techniques, while conservation advice and treatment have been applied to the care and preservation of valuable historic resources. This kind of long-term interaction is a model for the way CCI's services can be delivered to the museum community. Both the Sharon Temple Museum and CCI look forward to a continuation and expansion of such fruitful relationships. ♦

CCI Library Launches BMUSE Museology Bibliography

by Alicia Prata

Unbeknowst to many people, the Canadian Conservation Institute (CCI) Library in Ottawa has one of the richest collections of museological literature in Canada. Bibliographic references to the literature are available internationally to researchers through an online database, called the Bibliographie muséologique/Museology Bibliography (BMUSE), which is supported by the Canadian Heritage Information Network (CHIN).

BMUSE is consulted by museum curators, conservators, researchers, registrars, librarians, students, and other museum professionals. It is a collaborative effort of the CCI Library in Ottawa, Canada, and the UNESCO-ICOM Museum Information Centre in Paris, France. The database provides users with better access to current and retrospective literature, and can be searched by author, title, subject, name of museum, etc., in English or in French.

The query language for BMUSE is called BASIS, which is the common language used by all of the CHIN databases. The data is entered in English or French, with keywords in both languages. The most common way of searching the database is to use the FIND command: e.g., FIND DIORAM* (* will search dioram, dioramas, dioramic, etc., in the title, subject, and abstract fields). The boolean operators can also be used to search: e.g., FIND MUSEUM* AND EDUCATION*; FIND HERITAGE AND INTERPRETATION AND USA OR CANADA; FIND SCHOOL* AND LEARN*, etc. It is not necessary to know the precise terms that are used in the database. If the term requested has not been used, the system will give a negative search result. However, the LOOK command will give a list of all indexed terms: e.g., LOOK XSUBKY=E* will give a list of all the subject terms in the database beginning with E, such as ECOTOURISM, EDUCATION, ESTABLISHMENT OF A MUSEUM, ETHICS, ETHNIC GROUPS, EVALUATION, EXHIBITION, etc.

The CCI Library regularly indexes journals such as *Muse*, *Musées*, *Musées et collections publiques de France*, *Museums Journal*, *Museum International*, *Museum Development*, *Museum Management and Curatorship*, *History News*, *Curator*, *Exhibitionist*, *The Exhibition Builder*, and a dozen other journals for the BMUSE database.

Currently, BMUSE contains over 15,000 records, all contributed by the CCI Library. This year, the UNESCO-ICOM Museum Information Centre is preparing to load 35,000 of its records to the database. The Centre de documentation of the Direction des Musées de France, Ministère de la Culture et de la Francophonie, will also contribute to the database in the near future. Once all the records from the founding members are loaded, the database will contain over 50,000 references to museum-related literature published worldwide from the early 1900s to the present.

For information on the database and on searching strategy, please contact
Elizabeth Kirby at
CCI Library Services
Tel.: (613) 998-3721, ext. 157
FAX: (613) 998-4721
Internet address:
Elizabeth.Kirby@banyan.dgim.doc.ca

For information regarding online access, please contact
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Ottawa, Ontario K1A 0C8
Tel.: (613) 992-3333
FAX: (613) 952-2318
Internet address:
Service@calvin.chin.doc.ca

Internships and Fellowships

In response to the diverse training requirements of the conservation community in Canada and abroad, the Canadian Conservation Institute offers Internship and Fellowship programs.

Internships are classified according to need, and comprise four distinct categories: curriculum internships, specialized technique internships, professional development internships, and conservation research internships.

The Fellowship program encompasses work in designated laboratories at CCI, as well as participation in CCI services to museums, galleries, and related institutions and associations throughout Canada (e.g., surveys, workshops).

The following individuals have recently participated or are currently involved in one of these programs at CCI.

Internships

Monika Harter, student, Fachhochschule, Köln, Germany. March 1 to August 31, 1994 (Curriculum Internship — Ethnology).

Kirsi Hiltunen, student, Vantaa Institute of Arts and Crafts, Vantaa, Finland. May 2 to October 28, 1994 (Professional Development Internship — Fine Arts).

Nancy Odegaard, Conservator, Arizona State Museum, University of Arizona, Tuscon, Arizona, U.S.A. March 21 to April 15, 1994 (Professional Development Internship — Ethnology).

Fellowships

The following people have begun the first year of their fellowship at CCI.

Dr. Vasilike Argyropoulos, graduate of the Ph.D. program in Archaeological Sciences, University of Bradford, England. April 5, 1994 to March 31, 1995 (Conservation Processes Research Division).

Renée Dancause, graduate of the B.Sc. program in Home Economics, University of Alberta, Edmonton, Alberta. April 5, 1994 to March 31, 1995 (Textiles Section).

Chantal Emond, graduate of the Masters program in Art Conservation (Paper Objects), Queen's University, Kingston, Ontario. April 5, 1994 to March 31, 1995 (Works on Paper Section).

Daniela Kolbach, graduate of the Art Conservation Techniques Program, Sir Sandford Fleming College, Peterborough, Ontario. April 5, 1994 to March 31, 1995 (Furniture and Wooden Objects Section).

Patricia Smithen, graduate of the Masters program in Art Conservation (Paintings and Painted Objects), Queen's University, Kingston, Ontario. April 5, 1994 to March 31, 1995 (Fine Arts Section).

The following people have begun the second year of their fellowship at CCI.

Diana Dicus, Objects Conservator, Pacific Regional Conservation Center, Bishop Museum, Honolulu, Hawaii. April 1, 1994 to March 31, 1995 (Ethnology Section).

Dr. Alison Murray, graduate of the Ph.D. program in Conservation Science, Johns Hopkins University, Baltimore, Maryland, U.S.A. April 1 to September 15, 1994 and January 16 to March 31, 1995 (Analytical Research Services Division).

Laura Wardlaw, graduate of the Masters program in Art Conservation (Artifacts), Queen's University, Kingston, Ontario. April 1, 1994 to March 31, 1995 (Archaeology Section).

CCI Services: Seminars, Lectures, Workshops, and Visits

To respond to specific needs within the museum community, CCI, in co-operation with provincial museum and art gallery associations, offers workshops, seminars, and lectures related to the conservation and care of museum and art gallery collections. CCI staff also participate in and present lectures to meetings of professional groups and associations.

March 1994

Jean Tétreault gave seminars on materials for the display, storage, and transportation of artifacts at Algonquin College, Ottawa, in March; at The Textile Conservation Center, Hampton Court Palace, London, England, in May; in Basel and Zurich, Switzerland, in June for the Schweizerisches Institut fuer Kunstwissenschaft, Abteilung Kunsttechnologie; and in Paris in June for ARAAFU.

Gaelen Gordon examined a hanging at the McKay United Church, Ottawa.

Judy Logan gave two lectures at Gloucester High School, Gloucester, Ontario, for Grade 11 Archaeology and History classes.

Esther Méthé assisted staff of CCI's **Environment and Deterioration Research Division** with a survey at the Montreal Holocaust Memorial Centre, Montreal, Quebec.

Susan Walker visited the Hastings County Museum in Belleville, Ontario, to return and install two pastel paintings into their frames.

Elizabeth Moffatt presented the paper "Infrared Spectroscopic Analysis of Artists' Materials with Examples from the Works of Three Canadian Painters" at the meeting of the Infrared User's Group for the Analysis of Historic and Artistic Materials, Philadelphia Museum of Art, Philadelphia, Pennsylvania.

James Bourdeau visited the Musée des Augustines de l'Hôtel-Dieu in Quebec City to examine several paintings and to face and wrap one painting for transit to CCI.

Peter Vogel carried out *in-situ* work at the Senate on a painting belonging to the Office of Senator Lowell Murray.

Seminars

"Soin des peintures"
James Bourdeau and Collette Naud (CCQ) at the Musée d'art de Joliette, Joliette, Quebec.

"The Permanence of Contemporary Artists' Materials and Techniques: Paintings and Paper"
Debra Daly Hartin and Sherry Guild at the Memorial University of Newfoundland Art Gallery, St. John's, Newfoundland.

"Conservation of Inorganic Archaeological Materials"
Judy Logan and Laura Wardlaw at the University of Winnipeg, Winnipeg, Manitoba.

"Care of Furniture and Wooden Objects"
Gordon Fairbairn and Nora Nagy for the Annapolis Valley MacDonald Museum, Middleton, Nova Scotia.

April 1994

Judy Logan gave an overview of the activities of CCI's Archaeology

Laboratory at the annual meeting of the Ottawa Chapter of the Ontario Archaeological Society. Judy also gave a presentation on field work in Jordan at the meeting of the Ottawa Regional Group of the International Institute for Conservation—Canadian Group.

George Prytulak provided on-site advice to the Muskoka Heritage Foundation regarding the restoration of the steam yacht *Wanda II* in Gravenhurst, Ontario. George also made site visits in Ontario to the Smiths Falls Railway Museum, the Hamilton Steam Museum, Doon Heritage Crossroads, and the Milton Agricultural Museum.

Gordon Fairbairn gave an informal talk on furniture conservation to the Friends of the Mississippi Valley Textile Museum in Almonte, Ontario.

Jean Tétreault gave the paper "Display Materials: The Good, the Bad and the Ugly" at the Conservation and Exhibition meeting of the Scottish Society for Conservation and Restoration (SSCR) in Edinburgh, Scotland.

Peter Vogel visited the Church of Saint-André de Kamouraska, in Saint-André-de-Kamouraska, Quebec, to assist with the reinstallation of the painting *Martyre de saint André apôtre*, painted by Louis Hubert Triaud and treated at CCI over the past year.

Ela Keyserlingk met with the staff of the Conservation Department of the University of Cologne, Cologne, Germany, to discuss the training of textile conservators.

A.P. (Joe) Dorning attended the Museums Association of Saskatchewan conference in Humbolt, Saskatchewan.

David Tremain presented lectures at a Disaster Preparedness and Response Workshop organized by the U.S. Parks Service in Williamsburg, Virginia.

Deborah Robichaud was a member of a panel discussion on "International Visits and Training Opportunities" at the American Association of Museums conference in Seattle, Washington.

Stefan Michalski presented three lectures in Copenhagen, Denmark: "Mechanical Properties of Paintings," "A Systematic Approach to Preservation," and "Light and Museums." Stefan also gave a presentation on "Some Recent Research at CCI" in Oslo, Norway.

May 1994

Several CCI staff members attended the annual conference of the International Institute of Conservation—Canadian Group (IIC-CG) in Toronto, Ontario. **Esther Méthé**, **Elizabeth Moffatt**, and **Gregory Young** each presented papers on the analysis and treatment of the Royal Ontario Museum's Gondar Hanging. **Sherry Guild** presented a paper, co-authored by **Wanda McWilliams**, **Robyn Douglas**, and herself, on "The Use of the Ultrasonic Mister in the Treatment of Works on Paper." **Joan Marshall** presented the paper "Some Ethical Considerations in the Treatment of Two Nineteenth-Century Costumes." **Charlie Costain** presented "The Evolution of Environmental Norms in Canadian Museums." **Patricia Smithen** presented the paper "The Conservation and Restoration of the Church of Our Lady of Good Hope. Part II: Logistics and Treatments," co-authored with Jane Tisdale, Sue Braovac, Leslie Galbraith, and John Griswold of the Queen's University Masters program in Art Conservation. **Stefan Michalski** gave the paper "The Penetration of Acids into Paper and Books: Modelling of Four Commonly Observed Patterns and the Implications for Cost-Effective Storage Systems." Stefan also presented "The Museum Environment: Changing Meaning, Context, and Specifications" at the Doing More with Less workshop. **Tara Grant** was elected Secretary of the IIC-CG at the annual general meeting.

Charlie Costain chaired a meeting of a focus group on paper research, held at the McMichael Canadian Collection in Kleinburg, Ontario. **Sherry Guild** assisted with the organization and running of the meeting, and **Season Tse** attended to discuss CCI's on-going research in this field.

Debra Daly Hartin served as an external examiner at Queen's University in Kingston, Ontario, for students graduating from the Master of Art Conservation program.

Michael Harrington and **Nora Nagy** made the awards that were presented to the winners of the Minister of Canadian Heritage's Art Competition. The awards were made of highly finished birds-eye maple in the shape of an artist's palette.

Tom Strang presented a poster entitled "Density to Volume Percent: Computer Models for Ethanol and Isopropanol Solutions," and **Chuck Gruchy** presented a paper on CCI's activities related to the preservation of natural history collections, at the Society for the Preservation of Natural History Collections (SPNCH) conference in St. Louis, Missouri.

Bob Barclay and **Diana Dicus** visited the Sharon Temple Museum, Sharon, Ontario, to install a barrel in the Temple's barrel organ.

Ian Wainwright attended the 1994 International Rock Art Congress in Flagstaff, Arizona, and presented the paper "Microanalysis of Accretions on Rock Paintings and Petroglyphs."

Sherry Guild and **Chantal Emond** carried out a collection survey of works on paper at the Arts and Letters Club of Toronto, Toronto, Ontario.

Seminars
"A Framework for Preventive Conservation"
Paul Marcon and Jean Tétreault at Ravenwood, Charlottetown, P.E.I.

"Artifact Mounting Workshop"
Bob Barclay, Carole Dignard, and Diana Dicus at the Moncton Museum, Moncton, New Brunswick.

June 1994

Stan Frydryn, **Judy Logan**, and **Helen McKay** carried out a survey of part of the collection of the Hastings County Museum, Belleville, Ontario.

Bob Barclay, Secretary-Treasurer of CIMCIM/ICOM, attended the annual meeting of this organization in Edinburgh, Scotland.

Several members of CCI personnel staffed a booth at the Westport Antiques Fair, Westport, Ontario, to promote preservation and care of collections to the general public.

July 1994

Deborah Robichaud and **Charlie Costain** attended the Canadian Museums Association conference in St. John's, Newfoundland. Deborah also attended the annual conference of the Museums Association of Newfoundland and Labrador.

Carole Dignard taught a three-week segment on preventive conservation and mount making at PREMA's regional conservation course in Madagascar.

Bob Barclay co-taught at a one-week course entitled "Caring for Musical Instruments," sponsored by the Museums and Galleries Commission and held at the Horniman Museum, London, England.

Peter Vogel carried out *in-situ* conservation work on a number of icons at the Basilian Fathers Museum in Mundare, Alberta, to prepare them for transport to CCI where they will receive full conservation treatment.

Tom Stone visited a number of museums in western Canada to examine the condition of treatments that CCI undertook between 12 and 20 years ago.

Staff from the **Archaeology Section** visited Sainte-Marie among the Hurons, Midland, Ontario, to survey their collection of archaeological iron.

Seminars
"Storage and Display of Textiles" Janet Wagner and Joan Marshall at the Vernon Museum and Archives, Vernon, B.C.

August 1994

Tara Grant spent three weeks (August 21-September 11) at an archaeology site near Iqualuit, Northwest Territories, teaching conservation techniques as part of a field school run by Arctic College.

Bob Barclay visited a number of museums in the Maritimes to examine the condition of treatments that CCI undertook 12 to 20 years ago.

Deborah Stewart presented a paper on disaster preparedness for the Organization of Military Museums of Canada in Val Cartier, Quebec.

Conservation of Historic and Artistic Works on Paper

The book *Conservation of Historic and Artistic Works on Paper* is now available. This publication contains the proceedings of the conference "Symposium 88", which was held in Ottawa in October 1988.

This book includes articles that range from general topics such as the survey, storage, and display of collections to specific conservation topics related to treatment of book, archival, and fine art materials. Specialty articles cover historical studies of artists' materials and of conservation treatments as well as the scientific study of paper and its conservation treatment.

The papers are grouped according to the following subjects:
- The Preservation, Storage, and Display of Collections
- The Conservation of Archival Materials
- The Study and Conservation of Bound Materials
- The Treatment of Works of Art on Paper
- The Historical Study of Paper Artifacts and Their Conservation Treatment
- Scientific Studies Associated with Conservation Treatments
- The Scientific Study of Paper
- Panel Discussion—The Ethics of Disbinding Book-Related Artifacts
- Panel Discussion—The Conflict between Conservation Treatments and the Preservation of Artists' Materials and Intent

Price: $45.00 CAN—Canadian residents add $3.15 GST and $6.00 postage and handling. Outside Canada, add $8.00 CAN postage and handling.

To order, send a Canadian, U.S., or International money order, payable to the Receiver General for Canada, to:
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CCI on Internet

CCI staff can now be reached through electronic mail (e-mail) on the Internet Network. To send e-mail to a staff member, compose the address as follows:

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banyan.dgim.doc.ca

Use the names of staff as they appear on the CCI Staff List, which is distributed with the CCI Newsletter.

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