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**Research & Development Projects  
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Department of Canadian Heritage  
1030 Innes Road  
Ottawa ON K1A 0M5  
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## ADHESIVES

**Project Title:** **The Effect of Modifiers on the Stability of a Vinyl Acetate/Ethylene (VAE) Copolymer Emulsion Adhesive**

**Project Description:** The purpose of this study is to identify modifiers that do not adversely affect the stability or that improve the stability of a vinyl acetate / ethylene (VAE) copolymer emulsion adhesive so that a relatively good conservation emulsion adhesive can be formulated by the conservators themselves, tailored to their needs.

This project is a direct spin-off of previous research done on poly(vinyl acetate) (PVAC) adhesives. PVAC adhesives are very popular adhesives being used in every facet of conservation - furniture, paper, ethnographic objects and textiles to name just a few. In the previous CCI PVAC research, the vinyl acetate/ethylene (VAE) copolymer emulsion group (i.e., adhesives such as Jade No. 403) had very good properties upon aging (neutral pH, low volatile emission, low yellowing, good flexibility, adequate strength) and suggested a closer examination was warranted. As well, although several PVACs were identified in the PVAC research with good qualities for conservation, there were still problems in that some choices were unpleasantly odoriferous, some were too tacky and some were no longer available. A good conservation emulsion adhesive was still elusive. It was decided to examine the VAE group in more detail and at the same time investigate the question of additives. Are the additives necessary? What do they do to the aging properties of an adhesive? Can we start with a VAE that has no additives and add our own modifiers in known concentrations and see what happens upon aging? This research will help to answer these questions.

Common additives (modifiers) will be selected and added in known concentrations to a well-characterized VAE emulsion. Samples will be made and subjected to dark and light aging for several years. Yellowing, pH, flexibility, cohesive strength, gloss and removability will be monitored for significant changes upon aging. Results will be written up and submitted for publication in an appropriate conservation journal.

The many conservators in Canada and abroad who use VAE emulsion adhesives such as Jade No. 403 or Vinamul 3252 will benefit from this work.

**Dates:** 1994 -2009

**CCI Project Leader:** Jane Down

**Project Team:**

**Non-CCI Team Members:**

**Links/Partnerships:**

**Progress Summary:** 2003-2004: The project was begun in 1994. The VAE emulsion adhesive selected for testing by a group of conservators and scientists was Dur-O-Set E-150 which did not contain any additives except those added for polymerization and emulsion stabilization. The modifiers selected for testing were plasticizers dibutyl phthalate, ditridecyl phthalate, and polyethylene glycol dibenzoate; solvents toluene, methanol and diacetone alcohol; wetting agents anionic di-(2-ethylhexyl) sulphosuccinate and non-ionic acetylenic glycol; thickeners methyl

cellulose, wheat starch, fumed silica, polyethylene oxide, and neutral acrylic acid salt; fillers calcium carbonate, talc and china clay; freeze-thaw stabilizer ethylene glycol, and humectant glycerin. Initial testing of the prepared films of VAE containing the modifiers began in 1995 for pH, yellowing, and gloss. Flexibility, strength and removability testing began in 1996. Measurements on all samples were taken each year until 1998. In February 1998, the data from the first two years was assessed. Since, in most cases, differences upon aging were not dramatic, it was decided to skip the third year of testing in order to lengthen the aging period. The results for the first two years were written up in a report, which is now available from CCI.

In 2000-2001, the 4<sup>th</sup> year measurements for pH, yellowing, gloss, strength and flexibility were taken and all data was analyzed. The samples continue to age awaiting a final measurement after about 10 years of aging.

2004-2005: Samples continued to age (dark and light aging), however, the lights in the light aging chamber were extinguished in July 2003 when they were covered and moved from the testing room - to allow renovations to commence.

2005-06: No progress due to renovations.

**Project Proposal:**

2006-2007: Before this project can move forward, the renovations must be complete, the labs unpacked and the chamber around the Instron built. Also, the light aging chambers must be installed in their new room, turned on, cleaned, refitted and re-calibrated. Then the VAE samples must age for a few more years so that the total light aging will equate to about 10 years. Once this has happened, then the final dark and light aging measurements can be taken for stress/strain, pH, gloss and removability, and the project can be written up for publication in a referred journal. This is assuming, of course, that contamination from the renovations has not ruined the samples completely.

**Publications:**

J.L. Down, "Adhesive Projects at the Canadian Conservation Institute", Preprints of the SSCR Resins Ancient and Modern Conference, Aberdeen, Scotland, pp. 4-12, 13-14 September, 1995.

J.L. Down, "Towards a Better Emulsion Adhesive - A Preliminary Report on the Effect of Modifiers on the Stability of a Vinyl Acetate / Ethylene Copolymer Adhesive", Technical Report No. 1 (Ottawa: Canadian Conservation Institute) 1999.

**CCI Number:**

68451

## ADHESIVES

**Project Title:** Evaluation of Cyanoacrylate Adhesives for the Conservation of Fossils

**Project Description:** The purpose of this study is to determine if cyanoacrylate adhesives are suitable for the conservation of fossils. Valuable vertebrate fossils are being conserved regularly with cyanoacrylate adhesives. This puts these priceless specimens at risk because cyanoacrylate adhesives have never been scientifically assessed for their long-term stability or suitability for this application. This project attempts to begin this process by examining various aspects of cyanoacrylate adhesives in relation to fossils. If cyanoacrylates degrade, they produce formaldehyde so this formation can be followed in the presence and absence of fossil material to determine if fossil material catalyses or slows the degradation of various types of cyanoacrylate adhesives (i.e., ethyl, butyl, and ones containing polymers to thicken the cyanoacrylate) (phase 1). Since the literature suggests that moisture and exposure to light cause cyanoacrylate adhesives to degrade, various cyanoacrylates are being examined under low, medium and high relative humidity and also under UV light to see if fossil/cyanoacrylate bond strengths are retained (phase 2). There are also questions concerning application techniques, removability of the cyanoacrylates from the fossil material, and comparisons to other adhesives that need to be examined (phase 3).

The project will be divided into three phases. The results of one phase will influence how the next phase is conducted.

All results will be written up and published in a journal widely available to the palaeontology community.

The palaeontology community in Canada and abroad will benefit from this work.

**Dates:** 2002 to 2007

**CCI Project Leader:** Jane Down

**Project Team:** Jane Sirois, Elzbieta Kaminska. The Society of Vertebrate Palaeontology; Jim McCabe, Royal Tyrrell Museum of Palaeontology, Drumheller, AB

**Links/Partnerships:** The Society for Vertebrate Palaeontology has partially funded the project.

**Progress Summary:** 2002- 2004: In October 2002, Jane Down received the Society of Vertebrate Paleontology Preparator's Award which helped to partially fund the first phase of this research. The research made use of the fact that if cyanoacrylates degrade, they produce formaldehyde. This degradation was monitored in the presence and absence of fossil material collected from different sites. Fossil samples were received from Dinosaur National Monument in Utah, Badlands National Park in South Dakota, Royal Tyrrell Museum in Alberta, and the Mammoth Site in South Dakota. Since cyanoacrylates seem to degrade in alkaline environments, a variety of fossil material from the different sites that was acidic, neutral and alkaline was selected for testing to see if this or the diverse mineral content affected the degradation process. Ethyl, butyl and ethyl cyanoacrylate with added poly(methyl methacrylate) were selected for testing to determine if one degraded less than another (in the medical literature, it was shown that butyl cyanoacrylate degraded more slowly than the ethyl variety under specific medical conditions).

To characterize the fossil material, a composition and elemental analysis of the fossil was determined by SEM/XES, XRD, and ICP analysis. Further characterization was accomplished by determining the moisture content, ash content (% inorganic material) and porosity of the fossil material.

The procedure for determining formaldehyde concentration from the hydrolysis of various cyanoacrylate adhesives in the presence and absence of various fossil materials was developed and implemented. The results confirmed that butyl cyanoacrylate degrades more slowly than ethyl cyanoacrylate, whether fossil is present or not. The results also suggest that acidic fossil material slows the degradation of cyanoacrylates, while neutral and alkaline fossil materials increase the degradation. The age of the cyanoacrylate may also play a role in its degradation, the older cyanoacrylates showing more degradation than the younger samples.

2004-2005: Paper entitled "The Degradation of Cyanoacrylate Adhesives in the Presence and Absence of Fossil Material" was completed and the manuscript sent to the Journal of Vertebrate Paleontology in July 2004. Manuscript received back, fall 2004. Revision in progress.

2005-2006: The revisions to the paper entitled "The Degradation of Cyanoacrylate Adhesives in the Presence and Absence of Fossil Material" were completed and submitted for publication.

**Project Proposal:** 2006-07: Awaiting publication.

**Publications:** E. Kaminska, "The Stability of Cyanoacrylate Adhesives in the presence and Absence of Fossil Material", in press December 2003.

A talk entitled "The Degradation of Cyanoacrylate Adhesives in the Presence and Absence of Fossil Material" was presented at the annual CAC conference in Quebec City in May 2004.

**To be revised** - A talk entitled "The Degradation of Cyanoacrylate Adhesives in the Presence and Absence of Fossil Material" was presented via a narrated Powerpoint presentation to the Society of Vertebrate Paleontology in their Preparator's Symposium on October 19, 2005.

A talk entitled "The Degradation of Cyanoacrylate Adhesives in the Presence and Absence of Fossil Material" was presented at the AIC conference in Minneapolis to the Object Group in June 2005.

**CCI Number:** 68832

## ADHESIVES

**Project Title:** Evaluation of Tapes and Heat-set Tissues

**Project Description:** The purpose of this project is to study the chemical, mechanical and removability properties of various commercially available tapes and heat-set tissues to understand their impact on paper and to determine which might be less damaging.

Tapes of all kinds have found their way into museum and archival collections. Many tapes that have been used were inappropriate and have stained the documents and fallen off, thus damaging the documents and no longer even providing an adhering function.

Heat-set tissues have also been used in conservation applications, but not without questions as to their suitability and safety.

This project arises as a result of many questions about tapes and heat-set tissues. As well, issues with these products have surfaced when research priorities have been solicited from the Canadian Association for Conservation of Cultural Property (CAC), the American Institute for Conservation (AIC, Research Priorities in Art & Architectural Conservation, 1994) and the Canadian Council of Archives (CCA).

Various commercially available tapes and heat-set tissues will be obtained and analyzed to determine major chemical components. As well, pH measurements will be taken. Screening of the products by chemical analyses and the pH measurements will reduce the number for full scale testing. The products may be further screened by their harmful volatile components if a test can be developed.

The full scale testing will include tests on how innocuous the products are to substrates, how removable they are, and how user-friendly they are during application. As well, tests on long-term strength of all components and bond strength to certain substrates will be conducted. Flexibility/brittleness will be investigated, as well as colour change and carrier suitability. The products will be aged for 5-10 years in the dark under ambient conditions and under lights according to methods already in place. The results will be analyzed and limitations and assessment of suitability will be made. A report will be written and submitted for publication.

All paper conservators who use tapes and heat-set tissues or who have to remove these products from artefacts will benefit from this work.

**Project Date:** David to follow up

**CCI Project Leader:** Jane Down

**Project Team:** Season Tse; Scott Williams; Sherry Guild; John Grace, Wanda McWilliams (Library and Archives Canada), Elissa O'Loughlin (The Walters Art Museum, Baltimore, MD)

**Progress Summary:** 2001 - 2004: A meeting was held on June 6, 2001 at CCI with the project leader and all CCI and outside team members. The purpose of the meeting was to formulate the project and workplan. Work began on the screening program during the fall of 2001 when a list of various tapes and heat-set tissues was



compiled and all tapes and tissues were ordered. As the tapes and tissues came in, they were catalogued and classified for analysis.

2002-2003: the tapes and heat-set tissues (147 in all) were analyzed by Infrared Spectrophotometry for their major chemical components by Scott Williams. A preliminary look at the analyses for screening purposes has been carried out and the products have been placed in tables according to their carrier type and adhesive.

Because it is not possible to obtain enough samples to do standard pH measurements on all the tape components, other methods of measuring pH on very small samples were investigated. These included a microelectrode technique, pH pencil, and universal indicator. It appears that the microelectrode technique will work best but further development of the technique is required before the pH measurements can commence.

2004-2005: Various methods of measuring pH of the tapes were tried. It was hoped that pH of the adhesive component alone and the carrier alone could be accomplished but all methods failed. Surface pH is not acceptable because the long extraction time required for the components causes the drop of water to evaporate and absorb CO<sub>2</sub>. Measuring surface pH under nitrogen did not work. It was thus decided to measure the extracted pH of the composite i.e., adhesive and carrier together. A reliable and effective method of measuring pH with the microprobe has been developed. The pH measurements of all the tapes and heat-set tissues are well under way and should be finished by early March 2005. The use of AD strips to measure harmful volatiles for the screening of the tapes and heat-set tissues was not effective. The technique is not sensitive enough. It is hoped that by the end of the fiscal year (March 2005), that the screening of the products can occur (i.e., chemical analysis and pH will be completed by then). A meeting of the original group who helped to plan the project will be convened in March 2005 to do the screening as a group so that consensus can be reached on which products to test in the full scale testing program.

2005-06: The pH measurements of all the tapes and heat-set tissues (THST) were completed. These results and the chemical analysis results were used to screen the products in a meeting of the THST committee held in March 2005. Forty four of the 146 products were selected to undergo the full-scale testing program. The criteria used for selection was that the product was rejected for testing if the pH was less than 6 or greater than 8, although a token very low and very high pH product were included; contained poly(vinyl chloride), rubber, rosin or styrene butadiene, although a token product of each was included; or the product was coloured although a token black product was included. The products were also tested for optical brighteners and the paper products were tested for lignin but these tests were not used for screening. The results of the screening were presented at two conferences, the IADA conference "This Will Stick Forever" in Budapest, Hungary in May 2005, and the AIC conference in Minneapolis in June 2005. A paper on the screening and planned full-scale testing entitled "The CCI Tapes and Heat-set Tissues Project: Description and Status" was written and submitted to PapierRestauration for publication. Further work on the preliminary tests and sample preparation for the full-scale testing could not be accomplished because the renovations were not complete.

**Project Proposal:**

2006-07: Before this project can move forward, the renovations must be complete, the labs unpacked, the chamber around the Instron built, the light aging chambers installed in their new room, turned on, cleaned, refitted and recalibrated, and the dark aging room refitted and cleaned. Once these tasks have

been completed, then the preliminary testing to work out details for the full-scale testing can begin. When preliminary testing is complete, sample preparation can begin.

**Publications:**

**Need to be revised** - A talk entitled "Report on the CCI Tapes and Heat-set Tissues Project" was presented at the IADA conference "This Will Stick Forever" in Budapest, Hungary in May 2005, and the AIC conference in the RATS Group in Minneapolis in June 2005.

A paper entitled "The CCI Tapes and Heat-set Tissues Project: Description and Status" was written and submitted for publication to *PapierRestauierung*. It will be published March 2006.

**CCI Number:**

68827

## AMBER

**Project Title:** The Characterization of Canadian Amber

**Project Description:** The purpose of this project is to characterize a group of amber samples from a variety of Canadian sources using FTIR spectroscopy and GC-MS to determine chemical composition and whether amber from different locations can be distinguished.

Preliminary results indicated that Canadian ambers have unique fingerprints that are different from those of European ambers. The chemistry of Canadian ambers is not well known. The project will investigate the chemistry of these materials that were important to early Native people and may help archaeologists establish trade routes.

The users of this work are Canadian museums and archaeologists.

**Project Dates:** 2001-2007

**CCI Project Leader:** Jennifer Poulin

**Project Team:** Kate Helwig

**Links/Partnerships:** Geological Survey of Canada, Canadian Museum of Nature, Canadian Museum of Civilization, Royal Tyrrell Museum of Palaeontology and others.

**Progress Summary:** 2001-2003: obtained twenty amber samples from a variety of sources and undertook preliminary FTIR spectroscopic analysis. Undertook background literature search.

2003-2004: began to develop GC-MS method to characterize amber.

2004-2005: initial analysis of samples was undertaken.

2005-2006: All amber samples were analyzed by GC-MS

**Project Proposal:** **2006-2007:** Further analysis of amber samples by pyrolysis-GC-MS and FTIR microscopy will be undertaken.

**Publications:**

**CCI Number:** 86101

## ARCHAEOLOGY

**Project Title:** Iron Stain Removal from Archaeological Composite Artifacts made of Wood and Iron

**Project Description:** The waterlogged wood component in archaeological wood/iron artifacts is frequently seriously stained with iron corrosion products that are often orange in colour. The purpose of this project is to determine which of eight chemical solutions is the most suitable for quickly removing surface staining from the wood while minimizing the damage to iron prior to treatment of the waterlogged wood. The eight chemical solutions are: 10% w/v sodium hydrosulfite, 2% w/v thioglycolic acid, 2% w/v oxalic acid, 1% w/v poly(vinyl pyrrolidone), 1% v/v phosphoric acid, 1% v/v phosphoric acid plus 1% w/v poly(vinyl pyrrolidone), 1% w/v ethylenediaminetetraacetic acid plus 0.5% w/v pentasodium salt of diethylenetriaminepentaacetic acid, and 1% w/v ethylenediaminetetraacetic acid plus 10% w/v sodium hydrosulfite.

This project is one in a planned series that will deal with chemical treatments of metals.

The experimental work was carried out at Parks Canada because of specific issues about staining raised by archaeologists. Since the problem is general, it is thought that most archaeologists who deal with these materials will find the results from this work to be valuable.

Users who will benefit from this work are archaeological metal conservators.

**Dates:** 2006-2009

**CCI Project Leader:** Lyndsie Selwyn

**Project Team:** Cliff Cook, Tara Grant, Sherry Guild, Charlotte Newton, Season Tse, Jan Vuori

**Non-CCI Team Members:** Sylvie Labroche (Arc'Antique) and Ron Fairman

**Links/Partnerships:** Michael Eisen, Parks Canada

**Progress Summary:**

**Project Proposal** 2006-2007: Prior to 2006, experimental work was carried out by Sylvie Labroche and Ron Fairman during internships at Parks Canada under the supervision of Cliff Cook. It is proposed that work start in assessing and summarizing the results from this work into a manuscript suitable for submission to the *CAC Journal* or a paper at the next WOAM conference in 2008.

**Publications:**

**CCI Number:** 93854

## BASKETRY

**Project Title:** The Development of a Conservation Treatment for Waterlogged Basketry

**Project Description:** The purpose of this study is to develop a better method for the conservation of waterlogged North West coast basketry artifacts - together with a better understanding of the factors, which affect treatment. Current treatments lead to a material, which is either “damp” to the touch and with strong tendencies to dirt retention or dry brittle and fracturing. The main issue to be resolved seems to be to find a way to adjust the concentration of impregnant. Polyethylene glycol of molecular weight 200 (PEG 200) will be assessed for effectiveness in penetrating waterlogged archaeological basketry materials.

This research is important at present because waterlogged archaeological basketry provides a diagnostic tool that can be used to identify which aboriginal groups had been present in particular locations. This evidence may be helpful in resolving land claims issues. Aboriginal groups and archaeologists on the North West Coast are interested in this research and are providing sample material. On the successful outcome of the research a basketry workshop will be developed for interested participants

Users of the results of this research are conservators working with basketry artifacts. Most basketry found in Canada comes from aboriginal groups.

**Project Dates:** September 2005 to December 2007

**CCI Project Leader:** Malcolm Bilz

**Project Team:** Tara Grant, Charlotte Newton, Gregory Young

**Links/Partnerships:** Barbara Winter (Simon Fraser University), David Schaepe (Stó:l Nation Archaeologist), Ann Stevenson and Kathryn Bernick (University of British Columbia Museum of Anthropology),

**Progress Summary:** 2003-2004 The structure of intact western red cedar inner bark (a basketry material) has been found to present more resistance to PEG penetration than western red cedar wood. Microscopy has revealed that one source of this resistance is that inner bark has relatively thicker cell walls and smaller lumina for liquids to access the walls. Higher PEG concentrations are required for penetration into inner bark than into wood. The cobalt thiocyanate staining technique has been used to indicate the presence of PEG in the inner bark cell walls.

2004-2005 The project was delayed because of the temporary closure of the CCI laboratory during construction work.

2005-2006: **This project has been put on hold until CCI laboratories are operational again**

**Project Proposal:** 2006-2007: **When CCI laboratories are operational again; it is proposed to initiate the project to study the penetration of polyethylene glycol into actual archaeological basketry material.**

**Publications:** “Treating waterlogged basketry: a study of polyethylene glycol penetration into the inner bark of western red cedar”, Bilz, Malcolm, Tara Grant and Gregory

Young, Proceedings of the 7<sup>th</sup> ICOM-CC Working Group on Wet Organic  
Archaeological Materials conference, Grenoble, France, 1998, pp. 249-253

**CCI Number:** 69393

## COLLECTIONS - DISPLAY

<b>Project Title</b>	<b>The Development of a Low Cost Anoxic Enclosure for Display</b>
<b>Project Description</b>	<p>The purpose of the project is to develop a low-cost, easily maintained enclosure that will maintain an anoxic, dry environment for small sensitive objects. The approach will be to use existing technology of oxygen absorbers and barrier films to create an enclosure which satisfies the display criteria of being aesthetically acceptable, simple to monitor, and simple to maintain.</p> <p>This approach will be developed as an application to stabilize the Ferryland Cross, an inherently unstable artifact. Efforts to prevent corrosion of this iron/brass/gold-plated object by passive washing to remove salts and keeping it in dry atmosphere have failed. The Cross is needed for scholarly study as well as display at the Visitor Center at Ferryland, Newfoundland. The Cross will be documented, and put in its anoxic display environment, and then returned to the Colony of Avalon Interpretation Centre for long-term display and evaluation.</p> <p>The success of this approach will be evaluated by monitoring the condition of the Cross over the long term. In order to do this, it is necessary to record the present condition of the Cross. This will be done both by conventional photodocumentation, and also by using a laser scanner to capture a 3-dimensional image of the object. A replica of the Cross will also be produced to facilitate future comparison. The scanning will be done at the Canadian Museum of Nature, and the 3-D print will be made at the University of Alberta, where research is being done on this technique.</p>
<b>Users:</b>	The information will be used by conservators, curators, and archaeologists in Canada and abroad, who wish to develop anoxic storage enclosures that are cost-effective and easy to maintain
<b>Dates:</b>	2004 to 2005
<b>Team Leader:</b>	Judy Logan
<b>Team Members:</b>	Bob Barclay, Charlotte Newton, Lyndsie Selwyn, James A. Tuck (Memorial University of Newfoundland, Archaeology Unit)
<b>Links/Partnerships:</b>	Memorial University of Newfoundland, Province of Newfoundland and Labrador, Colony of Avalon Foundation, Canadian Museum of Nature, University of Alberta, Research Computing Support
<b>Progress Summary:</b>	2004 - 2005: The Cross has been laser-scanned at the Museum of Nature. We are waiting for the images (data being processed in January 2005).
<b>Publications:</b>	
<b>Project proposal:</b>	2005 - 2006: Send the data to the University of Alberta for the 3-D print. Create a dry, anoxic enclosure for storage/display. Return the Cross in its enclosure to the Colony of Avalon for display this coming summer. Evaluate the project, establish a monitoring program with Memorial University and the Colony of Avalon to evaluate the enclosure, prepare paper for publication.

## COLLECTIONS - RISK

**Project Title:** **Analysis of mammal storage-cabinet infestation severity through a ten-year annual regime of specimen inspections.**

**Project Purpose:** The goal of this project is to devise a visual inspection protocol, and treatment regime that allows collection staff to protect collections from pest damage despite the lack of in-cabinet chemical protectants. With the elimination of in-cabinet protectants through banning or removal of naphthalene, dichlorvos (DDVP), etc. millions of natural history specimens are becoming dependent on cabinet integrity and other layers of an integrated pest management (IPM) approach for protection. This project was developed as a long-term study in 1994 when the two researchers recognized the need to acquire and publish economic components to suggested practices in IPM. An intensity scale for appraising infestation levels in cabinets was developed, and within this scale an action level at which to treat infested material was set. The Mammalogy Division staff incorporated the inspection protocol into their annual work and participated in a ten-year study that recorded pest, location, severity, and time spent in carrying out the inspection. A database was developed to house the information and facilitate analysis of the results. One of the outcomes to date has been assessment of cabinet type against repetitive infestation frequency to demonstrate the need for replacing particular cabinet types as part of the Mammalogy collection rehousing plan. The extended cost of keeping ineffective cabinets in terms of cumulative specimen damage and staff effort in treating subsequent infestations could be quantified.

The targeted audience is anyone considering having staff visually inspect for pest problems in collections on a thorough annual basis, who needs information on time involved and efficacy of the process to decide if the measured benefit would justify applying our protocol to their situation.

**Project Date:** **2003 - 2007**

**CCI Project Leader:** Tom Strang

**Project Team:** Jeremy Jacobs (Smithsonian Institution)

**Links/Partnerships:** J. Jacobs, National Museum of Natural History, Smithsonian Institution, Mammals Division.

**Progress Summary:** 2003-2004: Ten years of data collected across three mammal ranges (study skins). Database constructed and populated with results.

The 2003-4 inspection results were obtained. Through on-site collaborative work in early 2004 the authors verified the database against primary records, filmed inspection processes, and photo-documented situations to illustrate their paper. The database has been populated with all summary data and preliminary analysis completed. Questions raised by this analysis are being addressed by further examination of our primary data sheets and spatial relationships in the storage range. Preliminary results of the work have been delivered in recent IPM workshops and meetings, in particular the joint workshop developed and delivered in 2004 by T. Strang and Dr. R. Kigawa of the National Research Institute for Cultural Property, Tokyo, Japan.

2005-2006: Additional 2005 inspection results obtained. Geo-referencing of



cabinets completed, before one specimen range was disassembled and moved to an improved local in the same building. An improved cabinet replacement policy has been developed as a result of the study. Results delivered in two one-day SPNHC workshops on IPM at the annual meeting at The Natural History Museum, London, June 2005.

- Project Proposal:** 2006-2007: Review technical considerations for migration of the inspection database to a GIS (Postgres/GRASS interfacing) Merge spatial data with inspection results. Write paper for publication. Jacobs may visit CCI to help accomplish latter
- Publications:** IPM workshops were delivered in with 2004 Dr. R. Kigawa of the National Research Institute for Cultural Property, Tokyo, Japan
- CCI Number:** 85852

## COLLECTIONS - RISK

**Project Title:** Collection Preservation Index Project

**Project Description:** To develop a tool that will help to assess the degree of preservation of collection for the Movable Cultural Property (MCP) Program and the Canada Travelling Exhibitions Indemnification Program. This model which will be provided "on line" will be based on actual knowledge on probability of event and rate of deterioration by various agents of deterioration.

The goal of this project is to replace the assessment forms presently used by MCP and Indemnification. The check list form will be transformed in an interactive self assessment on line model which will allow transparency, self evaluation of the preservation of the collection of the clients who want to apply for the two programs stated above. This will also allow CCI to retrieve reliable data for statistic purposes to determine the need of the cultural heritage community in Canada in terms of support or training.

The on line model will use concepts such as degree of preservation in terms of years without observing adverse effect on objects, values, and priority. For each agent of deterioration, users will be asked to select the condition (control strategies), which reflect the best of their situation. Automatically, results will be shown and users will see their strong and weak points related to the preservation of their collection. As much as possible proof of the control strategies in terms of policies, specifications or environmental performances will be requested to validate their assessment. Site visits will still be required as before for certain clients.

The primary clients will be MCP and Indemnification, but since it will be available from the CCI web site, many museums in Canada and around the world will have access to it. Preservation education programs could also benefit. Everyone who will have access to the forthcoming CCI Collection Preservation Management Book may have interest in the model.

**Project Dates:** July 2004 to April 2009

**CCI Project Leader:** Jean Tétreault

**Project Team:** Cliff Cook, Paul Marcon, Tom Strang, David Tremain, Deborah Stewart, Stefan Michalski, Siegfried Rempel, Bruce Gordon, Paul Baril (Fire Protection Consultant)

**Links/Partnerships:** Movable Cultural Property Program (MCP), Canada Travelling Exhibitions Indemnification Program.

**Progress Summary:** June 04 - March 05: developed the principles and mathematics; designed pilot model using an Excel spreadsheet; some data has been collected related to sensitivities of object to some agents, some degree of preservation against agents for a specific scenario, and some descriptions of scenario on possible control strategies. Control strategies for the pest control have been submitted as a peer review paper: Kigawa, R. and Strang, T. "Levels of IPM control. Matching conditions to performance and effort." Bunkazai Hozonshufuku gakkaiishi (submitted January 2005).  
April 05 - March 06: draft pilot model, Continue compiling data, do field test with different museums.

**Project Proposal:** 2006-2007: Project on hold while all the risk assessment projects are being re-evaluated.

**Publications:** Tétreault, J. "Preservation based on a risk management approach" Indoor Air Quality in Museums and Historic Properties. 6th International Conference, Padova, Italy, November 9 - 12, 2004.

**Proteus Number:** 87743

## COLLECTIONS - RISK

**Project Title:** Light Damage Calculator and Database

**Project Description:** The goal of this project is to develop a tool, which will allow the best available estimates of colour fading of museum artifacts via computer.

In 1989, the Canadian Conservation Institute produced 3,000 plastic slide rules called the Light Damage Calculator. By 2000, these had sold out. The replacement tool will be software. This will allow incorporation of a database, which addresses the greatest user complaint about the slide rule: how do I know what lightfastness rating, 1 to 8, to use on the blue wool scale? The database will incorporate various literature compilations of lightfastness ratings, as well as approximations about broad classes of objects. All primary literature sources of each piece of data will be available in the database. The software tool will also allow different fading curve shapes to be used for fading predictions, not just the simple linear curve of delta E over time used in the slide rule. Thus the issue of fading "slowing down" as the colour becomes more damaged can be illustrated directly on the display. The old technical difficulties of making accurate predictions of fading with lightfastness ratings remain unchanged, but for museum users, the intent of this advice has never been high precision, just useful, best available approximations. The software tool will allow a didactic help file explaining all these issues and more, with unlimited illustrations. The targeted audience is all museums, galleries, archives, and private collectors.

**Project Date:** 2004-2007

**CCI Project Leader:** Stefan Michalski

**Project Team:** -

**Links/Partnerships:**

**Progress Summary:** 1998 - 2004: The software interface, all forms, and colour fading calculator code, based on Microsoft Access, were developed to an early prototype stage by 2001, and the project then placed on hold. It has been reactivated for 2004-2005.

2004-2005: Data entry of colorants continued. "Help file" prototypes developed for the software product, which include didactic material on museum light damage issues. Presentation of the calculator prototype given at 2004 AIC annual conference, Research and Technical Studies Session. Strong support and many useful suggestions received and incorporated from potential users. Began conceptualization and development of forms and outputs for sets of artifacts, i.e., collections, with various distributions of sensitivities (as compared to the single colorant calculation of the prototype.)

We are interested in feedback and suggestions prior to finalization, both technical and user oriented. Any readers of this research summary are welcome to contact the author at [stefan\\_michalski@pch.gc.ca](mailto:stefan_michalski@pch.gc.ca) with suggestions.

2005-2006: Developed better user interface forms, incorporating suggestions from various presentations. In response to further suggestions during ICCROM-CCI 2005 course exercises on collections risk assessment, explored possible structure of outputs for light risk assessment of an entire collection with a distribution of light sensitivities, and how to present results. Refined table and

relationships structure for explanatory notes and literature references supporting all data entries. Continued entry of lightfastness data from standard texts on dyes and colorants, using the new notes/references forms.

**Project Proposal:**

2006-2007: In collaboration with CCI web master, explore possibilities and limitations of a web based version of the tool. Share a limited number of stand-alone CD-ROM versions of the tool with a selection of museums. From both web and CD-ROM tests, obtain user feedback and plan revisions accordingly.

**Publications:**

**CCI Number:** 865

## **LASER CLEANING**

**Project Title:** Nd:YAG laser cleaning of tarnished silver

**Project Description:** The purpose of this project is to investigate the potential of the Nd:YAG laser for tarnish removal from silver. Tests were carried out at various fluences and number of pulses to assess the cleaning efficiency of the Nd:YAG laser on tarnished silver. Some tests were carried out with or without flushing with nitrogen.

**Project Dates:** 1997 - 2006

**CCI Project Leader:** Carole Dignard

**Project Team:** Gregory Young, Nancy Binnie, Tom Stone, Paul Heinrichs

**Links/Partnerships:** National Research Council of Canada, Ottawa, Ontario

**Progress Summary:** 2003-2004: Tests have been completed at different cleaning parameters. Assessment is underway.

2004-2005: A poster of these results and selected samples were exhibited at the AIC Conference in Portland, Oregon, June 2004 within the Laser Cleaning Demo session of the Objects Speciality Group Session. No further progress has been made.

**Project Proposal:** On-hold

**CCI Number:** 77608

## LASER CLEANING

- Project Title:** Nd:YAG laser cleaning of soot from various organic materials
- Project Description:** The purpose of this project is to investigate the potential of the Nd:YAG laser for cleaning soot off of various organic materials. Tests were carried out at various fluences and number of pulses to assess the cleaning efficiency of the Nd: YAG laser on soot-covered organic materials, including various papers, cotton, linen, wool, silk, silk thread, leather, parchment, skin and feathers.
- Project Dates:** 1997 to 2005
- CCI Project Leader:** Carole Dignard
- Project Team:** Gregory Young, Nancy Binnie, Tom Stone, Paul Heinrichs
- Links/Partnerships:** National Research Council of Canada, Ottawa, Ontario
- Progress Summary:** 1997-2004: Tests have been completed at different cleaning parameters. Assessment is underway.
- 2004-2005: A poster of these results and selected samples were exhibited at the AIC Conference in Portland, Oregon, June 2004 with in the laser Cleaning Demo session of the Objects Speciality Group Session. Laser-irradiated samples have been assessed in terms of cleaning efficiency for the 4 groups of samples (paper, textiles, skin products, feathers). Colour assessment and analysis of samples is completed, and includes colormetric measurements for selected samples using the CIE L\*a\*b system. Selected materials have also been microphotographed or photographed by SEM to show cleaning efficiency and damage or lack of damage.
- Project Proposal:** 2005-2006: Submit article for publication.
- CCI Number:** 78441

## CLEANING

- Project Title:** **Mould Research Project: Initiatives in the removal of mould from organic substrates**
- Project Purpose** To determine the efficacy of treatment methodologies that remove mould growth and reduce mould spores from organic substrates such as painted canvas, paper, leather. The hazards of mould contaminating cultural artifacts is well understood- these objects can no longer be stored, displayed or handled without special precautions. Cleaning and other treatment guidelines for contaminated objects that explain methodologies and outcomes would be extremely beneficial to conservators and collections managers/curators. This project addresses an outstanding concern (how clean is an object after cleaning for mould?) that was raised by the conservation community during a CCI focus group meeting held in 1999 at the CAC conference. In addition, this project is a natural postscript to and builds upon the information amassed in TB 26 *Mould Prevention and Collection Recovery: Guidelines for Heritage Collections*. Because of the growing awareness of the hazards of exposure to this biological contaminant, the need for protocols and guidelines for conservation treatment is critical.
- Project Dates:** Project to begin 2006-2010
- CCI Project Leader:** Wendy Baker and Sherry Guild
- CCI Project Team:** other team members Jan Vuori, Renée Dancause and Janet Wagner, Tara Grant (?) Season Tse, Maureen MacDonald, Tom Strang
- Outside Team Members:** mycologist, and /or independent hygienist? with knowledge/experience in the field of mycology
- Project Description:** Initial phase for 2006-2007 will be a general review of literature concerned with the treatment of mould-contaminated artifacts to establish a baseline of treatment protocols/outcomes. A second activity for the 2006-2007 project will be the identification of a mycologist who can advise in subsequent phases of the overall project. Second phase (2007-2008) will be planning, design and experimental; it may also be possible, within this time frame to generate multi and diverse samples with specifically selected mould contaminants and to establish a spore counting protocol and experimental cleaning regimes. Third phase will be cleaning trials and determining effectiveness of cleaning methodologies. (2008-2010)  
Fourth phase will be compilation of data and generation of results from like samples (canvas/paper/leather) and producing report describing experimental process, results and conclusions. (2008-2010)
- Users:** Canadian and international collections (many collections in warmer climates- Central and South America, mould is a priority concern in archival as well as museum and gallery collections), guidelines for travelling collections, general public.
- Links/Partnerships:** Link with outside agencies specializing in mould remediation. Links with outside expert mycologist(s). **(Canadians)!!**
- Progress Summary:**
- Publications:**
- CCI Number:** **86046**



## LEATHER

**Project Title:** Comparison of PEG and Glycerol for the Treatment of Archaeological Leather

**Project Description:** The purpose of this work is to determine if polyethylene glycol of molecular weight 400 (PEG 400) is more suitable than glycerol for the conservation treatment of wet and deteriorated archaeological leather.

Leather samples tanned by various methods and impregnated with PEG 400 or glycerol will be evaluated. The shrinkage temperatures and energies required to cause denaturation in the samples will be measured to compare the effectiveness of the two treatment methods. These two parameters will be measured by Scanning Differential Calorimetry (DSC). Lower shrinkage temperature and lower denaturation energy indicate greater degradation.

Users of this information about the relative ability of PEG 400 and glycerol to help stabilize leather are conservators treating archaeological leather artifacts. This has application for the treatment of aboriginal untanned and semi-tanned skin artifacts.

**Dates:** February 2003 to December 2006

**CCI Project Leader:** Malcolm Bilz

**Project Team:** Charlotte Newton, Tara Grant, Gregory Young

**Links/Partnerships:** The comparison of the suitability of PEG 400 and glycerol for treating leather is of interest to conservators in and outside Canada, and has been raised at International conservation forums. The interaction of glycerol and collagen and the post-treatment behaviour of glycerol are research topics of interest to members of the Archaeological Leather Group.

**Progress Summary:** 2003-2004. Three types of leather were chosen; brain-tanned deer hide, vegetable-tanned cow hide and archaeological vegetable-tanned deer hide. Five samples were cut from each type. One was wet with water as a control and two were impregnated with PEG 400 at 25% or 100% and two were impregnated with glycerol at 25% or 100%. Initial runs have been carried out on the Differential Scanning Calorimeter to calibrate the instrument and to develop heating regimes for testing the samples. The shrinkage temperatures will be measured with dried samples and with samples in water.

Preliminary Differential Scanning Calorimetry tests on samples treated with 100% PEG 400 and 100% Glycerol showed lower shrinkage temperatures and required less energy to cause denaturation for the glycerol treated samples. It is thought that glycerol molecules (molecular weight 92), being smaller than PEG 400 molecules, infiltrate and swell the fibrillar and molecular structure of the collagen. This reduces the cooperative stability of the hydrogen bonding, making the glycerol treated samples less stable.

2004-2005 Limited progress due to other pressures. Samples from each of the 15 leather treatments have been prepared for analysis by wet and dry differential scanning calorimetry.

2005-2006: **Most of the analysis has been completed for three types of leather samples which were untreated or treated with either polyethylene glycol (PEG) 400 or**

**glycerol. This included differential scanning calorimetry (DSC) to determine denaturation onset temperatures and enthalpies, thermogravimetric analysis (TA) to determine moisture contents and thermal microscopy followed by image analysis to give more precise onsets and endpoints.**

**Project Proposal:**

**2006-2007: The data will be analyzed to compare the effect of PEG 400 and glycerol treatments on the three leather types both in the short term and in the long term. A paper will be written to describe the research and to make recommendations for using PEG 400 or glycerol for treating leather artifacts.**

**Publications:**

**CCI Number:**

74597

## LEATHER

**Project Title:** **Analytical Development: Image Analysis for Microscopical Shrinkage Temperature Measurements of Collagenous Fibers**

**Project Description:** The purpose of this study is to incorporate techniques of quantitative image analysis into the measurement technique to improve precision and accuracy. The new technology will improve the means with which CCI provides treatment support and conducts research of the preservation of collagenous materials in Canadian archival, archaeological, ethnographic, and natural history collections.

Shrinkage temperature measurements provide a straightforward, sensitive, full sample means of assessing the preservation of collagenous materials: skins, hides, leather, parchment, etc. The method is employed in support of treatments, research and collections monitoring. CCI introduced the method to conservation in 1987. It now has a small but international usage and continues to evolve. This project incorporates techniques of digital image capture and analysis for the first time to quantify the structural change of sample fibers during denaturation. Digital, time-lapse image capture permits the use of computer algorithms to quantify onset temperatures in an objective, reproducible manner.

The new technology dramatically improves CCI's research and conservation support functions in this field, providing CCI clientele with enhanced analytical service.

**Dates :** 2002 to 2006.

**CCI Project Leader:** Gregory Young,

**Project Team:**

**Links/Partnerships:** Walters Art Museum, Baltimore, MD National Archives and Records Administration, Washington, D.C.

**Progress Summary:** 2003-2004: Most of the developmental work is completed. This involved the establishment of three series comprised of multiple, reproducible processing steps aimed at isolating and quantifying even minute visible changes in samples during heating by thermal microscopy. The three series provide complementary numerical data on fiber denaturation. Sources of experimental error continue to be identified and corrected, including heating effects on the microscope, curve-fitting anomalies and sample movement unrelated to denaturation.

2004-2005: A great deal of progress was made during 2004 towards standardizing the many steps used to transform the video images of microscopical samples into the numerical data used to identify the onset temperature of denaturation (fiber shrinkage). Particular focus was given to just one of three methods developed, because it showed the best specificity to movement associated only with denaturation. This was used during the year to undertake client-based research on the state of preservation of several parchment documents of international renown.

2005 - 2006: The arrival of new instrumentation will, for the first time, allow accurate measurements below standard laboratory temperatures. Improvement in sample preparation is underway. The final step in this work is to institute as

much automation into the technique as possible. This will allow a broader user base to undertake measurements in support of treatment and research. The project will be completed during the first half of the year. Two publications are in preparation.

**Project Proposal:** 2006-2007: Developmental work complete – main objective for 06-07 is to write and submit a paper describing the image analysis method.

**Publications:** “Quantitative Image Analysis in Microscopical Thermal Stability Measurements” in *CCI Newsletter* No. 31 (June 2003, pp. 10–11).

“Preservation Study of the Declaration of Independence, Constitution and Bill of Rights” in *CCI Newsletter* No.33 (May 2004, pp. 15-16).

**CCI Number:** 81101

## METALS

**Project Title:** Archaeological Iron Treatments

**Project Description:** The purpose of this work is to publish a description of the treatment for archaeological iron developed in the early 1980s at CCI based on immersion in solutions of sodium hydroxide followed by ethylenediamine. This work will assess this treatment and explain the occasional observation of rapid iron corrosion of iron artifacts in ethylenediamine.

The first part of this project involves writing a paper that contains the details of the treatment for archaeological iron developed at CCI. The second part of this project involves the assessment of the treatment to answer the following questions:

1. How effective are the two solutions (sodium hydroxide and ethylenediamine) at removing chloride ions from archaeological iron?
2. Are any other metals being removed during immersion in these solutions?
3. Why does iron sometimes undergo rapid corrosion in ethylenediamine solutions?

Users are the Canadian and International archaeological conservation community.

**Dates:** 1994-2005 - **Project completed**

**CCI Project Leader:** Lyndsie Selwyn

**Project Team:** Vasilike Argyropoulos (Technological Educational Institution of Athens, Greece)

**Links/Partnerships:** Cathy Mathias, Archaeological Conservator, Memorial University, Newfoundland

**Progress Summary:** 2003-2004: A manuscript was written to summarize the results of the assessment part of this project and it was submitted to and accepted for publication in the journal *Studies in Conservation*.

2004-2005: An overview of the results from this project was presented at Metal 2004 in Canberra, Australia in October 2004 and published in the proceedings.

2005-2006: Carried out final steps required by *Studies in Conservation* for the publication of the paper "Removal of Chloride and Iron Ions from Archaeological Wrought Iron with Sodium Hydroxide and Ethylenediamine Solutions" by L.S. Selwyn and V. Argyropoulos. Paper was published. Presented a condensed version of the "Metal 2004" lecture at the CAC Annual Conference, Jasper, May 2005.

**Project Proposal:**

**Publications:** Argyropoulos, V., "Developing a Conservation Treatment using Ethylenediamine as a Corrosion inhibitor for Wrought Iron Objects found at Terrestrial Archaeological sites", presentation at Metal 95, ICOM-CC Metal Working Group Conference, September 25-28, 1995 in Semur en Auxois, France.

Argyropoulos, V., Selwyn, L.S., and Logan, J.A., "Developing a Conservation Treatment using Ethylenediamine as a Corrosion Inhibitor for Wrought Iron

Objects found at Terrestrial Archaeological Sites”, *Metal 95*, ed. I.D. MacLeod, S.L. Pennec, L. Robbiola, James & James Ltd., London, 1997, pp. 153-158.

Selwyn, L.S., “Active Corrosion on Archaeological Iron”, presentation at *Metal 98*, ICOM-CC Metal Working Group Conference, May 27-29, 1998, Draguignan, France.

Selwyn, L.S., “Active Corrosion on Archaeological Iron”, presentation at *CAC Conference*, May 23-25, 1999, Winnipeg, Manitoba.

Selwyn, L.S. “Corrosion of Archaeological Iron Before and After Excavation”, presentation at *NACE (National Association of Corrosion Engineers) Northern Area Eastern Conference*, October 24-27, 1999, Ottawa.

Selwyn, L.S. “Corrosion of Archaeological Iron Before and After Excavation” *NACE (National Association of Corrosion Engineers) Northern Area Eastern Conference and Exhibition*, Ottawa, Ontario, Canada, October 24-27, 1999, paper no. 2B.1, pp. 1-8.

Selwyn, L.S., P.J. Sirois, and V. Argyropoulos, “The Corrosion of Excavated Archaeological Iron with Details on Weeping and Akaganéite” *Studies in Conservation* Vol 44, 1999, pp. 217-232.

McNeil, M., and L.S. Selwyn. ‘Electrochemical Processes in Metallic Corrosion.’ pp. 605-614 in *Handbook of Archaeological Sciences* (edited by D.R. Brothwell and A.M. Pollard). Chichester, England: John Wiley & Sons, 2001.

Selwyn, L. “Analysis of the Chloride Ion Concentration in Aqueous Solutions by Potentiometric Titration”. CCI Research Report No. 2. Ottawa: Canadian Conservation Institute, 2001.

Selwyn, L.S., W.R. McKinnon, and V. Argyropoulos. “Models for Chloride Ion Diffusion in Archaeological Iron.” *Studies in Conservation* Vol. 46, 2001, pp. 109-120.

Selwyn, L.S., “Overview of Archaeological Iron: The Corrosion Problem, Key Factors Affecting Treatment, and Gaps in Current Knowledge”, presentation at *Metal 2004*, ICOM-CC Metal Working Group Conference, October 4-8, 2004, Canberra, Australia.

Selwyn, L.S. and V. Argyropoulos, “Removal of Chloride and Iron Ions from Archaeological Wrought Iron with Sodium Hydroxide and Ethylenediamine Solutions” accepted for publication in *Studies in Conservation*, 2004.

Selwyn, L.S. and V. Argyropoulos, “Removal of Chloride and Iron Ions from Archaeological Wrought Iron with Sodium Hydroxide and Ethylenediamine Solutions” *Studies in Conservation*, vol 50, no. 2, 2005, pp. 81-100.

Selwyn, L.S., “Overview of Archaeological Iron: The Corrosion Problem, Key Factors Affecting Treatment, and Gaps in Current Knowledge,” presented at the CAC Annual Conference, Jasper, May 2005.

**CCI Number:** 68874

## METALS

**Project Title:** Awareness of Lead in Conservation

**Project Description:** The purpose of this work is to collect information about lead for the purpose of being able to advise the conservation and museum community about the hazards of lead and how to maintain a safe working environment. Lead and lead compounds are ubiquitous in museum collections (e.g. as a pigment in paint, weights, stained glass, solder, toy soldiers, ornaments, etc.) and its presence, especially as fine dust, is a health hazard to museum staff.

During this project, a comprehensive literature review will be carried out. Information will be collected to answer the following questions:

1. What kinds of museum objects contain lead or lead compounds?
2. How can lead be identified?
3. How does lead corrode?
4. What are the health hazards associated with lead and lead compounds?
5. What precautions need to be taken when dealing with lead and lead compounds?

All conservators, curators, restorers, general public, collections researchers and interpreters will benefit from this work.

**Dates** 1997-2006 – **Project completed.**

**CCI Project Leader:** Lyndsie Selwyn

**Project Team:**

**Links/Partnerships:** Liz Croome, Senior Conservator, Parks Canada, Winnipeg

**Progress Summary:** 2004-2005: No progress

2005-2006: Completed manuscript for journal article and submitted it to J. CAC. Paper accepted and published. Completed manuscript for CCI Note and submitted it to CCI publishing.

**Project Proposal:**

**Publications:** Selwyn, L.S., "Lead in Conservation" presentation at CAC conference, Halifax, May 11-13, 2001.

Selwyn, L. "Health and Safety Concerns Relating to Lead and Lead Compounds in Conservation." *Journal of the Canadian Association for Conservation*, Vol 30 (2005) pp 18-37.

**CCI Number:** 68871

## METALS

**Project Title:** **An Investigation into the Causes of Indoor Bronze Sculpture Corrosion: A Case Study**

**Project Description:** The aim of the project is to investigate the causes of corrosion on indoor bronze sculptures at the National Gallery of Canada by analysing the metal alloys and samples of patina and corrosion from approximately forty bronze sculptures. This information, when combined with other studies, assists with assessing the cause of corrosion and in making conservation decisions, and is broadly applicable to other collections.

In 1997, conservators at the National Gallery of Canada started an investigation to determine the causes of corrosion on some of their indoor bronzes, in particular to determine whether the cause was environmental or an inherent feature of the type of patina applied to the sculpture. Between 1998- 2003, CCI and the National Gallery of Canada have been investigating the composition of patina and corrosion samples from about forty indoor bronze sculptures. Non-destructive, qualitative x-ray analysis of the metal alloys comprising the sculptures will be undertaken in 2003/04. The results from this investigation will be collected, interpreted and written up for publication.

Users of this project are curators, conservators, scientists, art historians, artists, collectors, and the general public in Canada and internationally.

**Project Dates:** April 2003 to April 2007

**CCI Project Leader:** Jane Sirois

**Project Team:** Elizabeth Moffatt, Lyndsie Selwyn, Nicolas Duxin and Doris Couture-Rigert (National Gallery of Canada, Project Co-Leader).

**Links/Partnerships:**

**Progress Summary:** 2003-2004: Samples of patina and corrosion have been analysed from thirty sculptures to date. Ten more sculptures were sampled in January 2003 and the analysis of the corrosion and patina samples will be completed by 31 March 2003.

2004-2005: Analysis of the corrosion and patina samples was completed for all forty sculptures. Metal edges on the base of nine sculptures were analysed non-destructively to obtain alloy compositions. The results from NGC's indoor air quality surveys and conservation surveys assessing the degree of corrosion on each sculpture, and results from the analysis of the sculptures analysed prior to 2004 were compiled.

2005-2006: Non-destructive x-ray fluorescence analysis of 40 sculptures was completed and all data compiled. Manuscript preparation was initiated.

**Project Proposal:** 2006-2007: A manuscript will be submitted for publication.

**Publications:** Couture-Rigert, D. and Graham, F., "An Investigation into the Causes of Bronze Corrosion at the National Gallery of Canada," presented at the 24<sup>th</sup> CAC Annual Conference, Whitehorse, May 1998 (lecture)

**CCI Number:** 83332 (68418, 69420, 73799, 83004)



## **METAL**

**Project Title:** Treatment of Corroded Lead using an Electrochemical Technique

**Project Description:** Cathodic reduction at constant potential has successfully been used to treat lead suffering from active corrosion. This project is intended to help CCI develop the technique for application here. It will also enable us to gain expertise using this electrochemical technique.

The main goal of this project is to set up the electrochemical equipment to treat corroding lead. This procedure is particularly effective when treating lead where corrosion has obscured any surface inscriptions. The procedure was demonstrated to Lyndsie Selwyn by Dr. C. Degriigny in Nantes, France in 2000 during a visit sponsored by the Canada-France Agreement. New equipment was purchased in 2001.

Users who will benefit from this project are metals conservators in Canada.

**Dates:** 2006-2009

**CCI Project Leader:** Lyndsie Selwyn

**Project Team:** Robert Barclay, Tom Stone

**Links/Partnerships:** Liz Croome, Senior Conservator, Parks Canada, Winnipeg

**Progress Summary:**

**Project Proposal:** 2006-2007: Set up the potentiostat after long-term storage, check the electrodes, and learn the software needed to run the electrochemical experiments. Once access to CCI's lab is restored, work will commence to restore the operational capacity of the equipment. This will be followed by initial experiments in electrochemical treatment of corroded lead samples.

**Publications:**

**CCI Number:** 93852

## MODERN MEDIA

**Title:** The Effect of Jewel Cases on the Longevity of CDs and DVDs.

**Project Description:** The purpose of this project is to examine the effect of jewel cases on the stability of optical discs.

Jewel cases are the recommended storage containers for CDs and DVDs and are effective in reducing the amount of physical damage that can occur. However, there has been some discussion in the literature that jewel cases are negatively affecting the chemical stability of the discs. It has been speculated that this is due to the portion of the jewel case that holds the disc in place (the holding tray). Consequently, recommendations have been made by some to replace standard trays with more expensive trays. Not much data are available to determine if there is a problem with jewel cases or not. Therefore, this project will investigate whether jewel cases are a threat to disc stability.

In this project a variety of different jewel cases will be examined. Jewel cases of different thicknesses and with different holding trays will be used and an analysis of the case composition will be performed. The effect of jewel cases on disc stability will be studied by inserting audio CDs and various types of recordable CDs into different jewel cases and subjecting the packages to accelerated aging. Discs will be analyzed for error rates and a variety of other properties before and after accelerated aging. Similar experiments will be repeated for DVD discs. The results of this research will be useful to any institution that uses and stores optical discs such as archives, libraries, museums, private institutions, as well as the general public.

**Dates** 2004 to 2007

**Team Leader** Joe Iraci

**Team Members** Scott Williams

### Links/Partnerships

**Progress Summary** 2004-2005: Four different types of jewel cases in combination with two different types of recordable CDs were examined in order to establish if any negative effects toward the discs were caused by the cases. In addition, some experiments performed focused on the effect that the paper enclosure materials had on disc stability.

**2005-2006:** A variety of jewel cases were tested in combination with several different types of CDs and CD-Rs. In addition, jewel case samples containing paper enclosure materials were prepared and tested in order to evaluate the effects such enclosures would have on CD and CD-R stability.

**Project proposal** 2006-2007: Data from all the experiments will be compiled. Depending on the results obtained, the effect of jewel cases on DVD discs may also be examined. A paper will be written describing the study and with recommendations on using jewel cases as storage containers.

**Publications:**

**CCI Number:** 88899

## MODERN MEDIA

**Project Title:** Remedies for Damaged Media

**Project Description:** The purpose of this study is to determine and test simple inexpensive techniques that can make deteriorated or damaged media playable. This is important because modern information carriers are machine-readable records. If the carriers cannot be read by the machine then the information is lost. Techniques need to be developed and compiled from the literature in order to allow archives, libraries, etc. to restore problematic information carriers.

For many modern information carriers, damage can lead to the loss of the whole record. Also, partial damage to a record can also lead to large losses of information. Archives and libraries need to have techniques available to them that can be used on modern information carriers to make them playable so that copies can be made and information can be accessed. In many cases, without such techniques, records would be forever lost.

Some suggestions for recovery or restoration techniques have been made in the literature, but there is little experience to verify whether these techniques are actually effective or not. Verifying their effectiveness will go a long way in providing archives and libraries some tools that can be used to extend the life of optical discs and magnetic media records.

The results will be combined with information from the literature and a CCI Technical Bulletin will be produced.

Any organization that may have modern records that store information such as archives, libraries, museums, galleries, government departments, private sector companies, etc., will benefit from this work.

**Dates:** 2004-2006 – **Project completed.**

**CCI Project Leader:** Joe Iraci

**Project Team:** Gilles St-Laurent (Library and Archives Canada)

**Links/Partnerships:** The Canadian Council of Archives has expressed interest in this work.

**Progress Summary:** 2003-2004: The literature has been studied and various small experiments have been conducted. The bulletin is being written and should be available late in 2004.

2004- 2005: Through the literature study and experimental work, it was discovered that a variety of remedies are available to possibly make damaged or degraded media playable. Scratched CDs or wrinkled tape can be restored. Therefore, deterioration will not always lead to complete loss of the media. However, many of the proposed remedies are high risk and should only be used as a last resort. A bulletin discussing common deterioration problems and possible remedies for these problems was written. It has been reviewed internally and externally and is slated for final edit.

2005-2006: Final editing changes were made on the draft version of the technical bulletin. Technical Bulletin No. 27 was published.

**Project Proposal:**

**Publications:** Iraci, J. Remedies for Deteriorated or Damaged Modern Information Carriers.  
CCI Technical Bulletin No. 27. Canadian Conservation Institute, Ottawa,  
Canada, 2005.

**CCI Number:** 78537

## MODERN MEDIA

**Project Title:** The Stability of Optical Discs and Magnetic Tapes

**Project Description:** Experiments on the disaster recovery of optical discs have indicated quite a bit of variability between different discs. This variability may also exist in terms of the longevity of discs. In this project, CDs will be tested according to standards to determine their variability in longevity and allow disc types to be ranked for relative stability. This will provide archives and libraries with an indication of which discs are good quality and will verify (to some degree) claims that manufacturers are making about their products. Similar experiments will also be performed on VHS tapes.

A variety of discs will be tested (audio CDs, CD\_Rs, CD\_RWs, DVDs, DVD-Rs, DVD-RWs). The discs will be aged at 80 degrees Celsius and 85% RH for intervals of 500, 1000, 1500, and 2000 hours. The Block Error Rate (BLER) as well as other key parameters will be monitored. This will allow the relative comparison of stabilities between different types of discs. Actual lifetime values will not be determined because this would require a much longer time frame to complete and require extensive resources.

Users are archives, libraries, museums or any institution that collects information on these information carriers.

**Dates** April 2003 to March 2007

**CCI Project Leader:** Joe Iraci

**Project Team:** Scott Williams

**Non-CCI Team Members:**

**Links/Partnerships:** The Canadian Council of Archives

**Progress Summary:** 2003-2004: A large number and variety of discs have been aged. More will be aged in 2004. As new products are introduced, more aging will be conducted. The tape aging experiments have not been started.  
2004 -2005: A variety of audio CDs, DVD movie discs, recordable CDs and DVDs, and erasable CDs and DVDs were aged in order to examine the stabilities of media currently being produced. The aging data obtained from these samples was compared to data from some older media that have been previously aged. It is becoming clear that the discs of choice for longevity are recordable CDs using the phthalocyanine dye and gold metal layer. Other recordable CDs using different dyes and other formats of discs do not compare favourably in terms of stability.  
No aging of VHS tapes was performed.  
2005-2006: Final editorial changes in consultation with the publisher were made on the paper - The Relative Stabilities of Optical Disc Formats. Some additional optical disc media was tested to determine their stabilities relative to previously tested discs.

**Project Proposal:** 2006-2007: There are no immediate plans to perform a similar study on VHS tapes or to conduct any further examination of optical discs.  
However, as new optical disc products are introduced, some additional experiments may be conducted to determine the relative longevity of the new materials.

**Publications:** Iraci, J. The Relative Stabilities of Optical Disc Formats.  
Restaurator 26, pp. 134-150, 2005.

**CCI Number:** 83365

## **PAINTINGS**

**Project Title:** **Analysis of Selected Materials from the Studio of Yves Gaucher (1934-2000)**

**Project Description:** The purpose of the project is to document and sample the materials remaining in Yves Gaucher's Montreal studio after his death in 2000. Approximately 375 samples were obtained and archived. 36 selected materials will be examined in this preliminary project. This could lead to a more extensive project on Gaucher's materials and techniques in the future.

The first step in the project was to gather documentary information, both from written sources and from discussions with his colleagues and family. The second step was to develop a database of the materials found in the studio. The final step of the project was the analysis of a selection of the paint materials.

By carrying out this project, we hope to contribute to the interpretation of Gaucher's painted oeuvre by understanding his materials and working methods. The research will also provide information that will assist in the conservation and display of his works and provide a basis for comparison for a future examination of Gaucher's paintings.

Users of the work are curators, conservators, scientists, art historians, artists, law enforcement agencies, collectors, and the general public in Canada and internationally.

Project results and information from the project will assist curators, conservators, and scientists by providing essential data on Gaucher's materials and techniques, which are used both in authenticity and attribution studies, and in evaluating the conservation requirements of his works.

**Project Dates:** 2002-2006 – **Project completed**

**CCI Project Leader:** Kate Helwig

**Project Team:** Marie-Chantale Poisson (Master of Art Conservation Programme, Queen's University)

**Links/Partnerships:**

**Progress Summary:** 2002-2003: Marie-Chantale Poisson visited the studio, documented the contents and took samples of approximately 375 materials. She has also obtained information from Gaucher's family and from a paint supplier (Chromatech) that Gaucher used. 36 samples were chosen and the analysis of these materials was begun.

2003-2004: Analysis of 36 samples completed and report written.

2004-2005: Draft manuscript in preparation.

2005-2006: The project was completed and an article published in *Journal of the Canadian Association for Conservation*.

**Project Proposal:**

**Publications:**

Helwig, K., and Poisson, M.-C., "The Characterization of Selected Materials from the Studio of Yves Gaucher", presented at the 29<sup>th</sup> CAC Annual Conference, Victoria, BC, May 2003. (lecture)

Helwig, K., and Poisson, M.-C., 'A Study of Painting Materials from the Studio of Yves Gaucher, *Journal of the Canadian Association for Conservation*, vol.29, 2004, p. 42-51.

**CCI Number:**

83110



## **PAINTINGS**

**Project Title:** CCI Lining Project; Phase III - Assessment of the Performance of Lining Supports on Model Paintings

**Project Description:** The Lining Project is a long-term project to study the behaviour of various lining systems lining systems and to investigate their ability to minimize defects in a painting. The previous research of Marion Mecklenburg and Gerry Hedley increased our understanding of the mechanicalbehaviour of paintings and lining supports and as a result, fabrics such as polyester, are being used as lining supports. Are these supports behaving as we think they are in supporting the stresses in a painting?

The purpose of the project is to assess the effectiveness of selected lining supports to dominate the stiffness in a painting and in so doing, to support the stresses in a painting in response to both short-term strain (shock) and long term strain (cupping and cracking, RH and T change). This will assist the conservator in making the most appropriate choice of lining fabric for a particular painting.

Development of a standard experimental procedure will allow comparative testing of additional lining supports as well as less interventive methods of structural stabilization.

The first phase of the project involved the measurement of the mechanical properties (tension and change in dimension (published), stress relaxation and modulus of elasticity (unpublished)) of modelpaintings under different conditions of relative humidity. The second phase investigated the bond strength of a BEVA 371 flocked adhesive and a wax-resin adhesive with different lining supports using 180 peel tests. In this final phase of the project, selected lining systems are being tested in terms of their ability to reduce cracking, delamination,cupping and sagging due to stretching, stress relaxation, and humidity and temperature fluctuations. Tension has been monitored continuously in uniaxial samples which have been exposed to 50%RH, 12%RH for several months and returned to 50%. Models used for analysis of the data have been taken from viscoelastic/plastic polymer mechanics. Initial results have been published. Equipment modifications are planned in order that testing can be continued at low temperature. Repetitive testing will be then be undertaken on additional samples to verify consistency of results. Future work will involve the testing of biaxial samples which have already been prepared.

**Project Dates:** 1993 - 2006

**CCI Project Leader:** Debra Daly Hartin

**Project Team** Stefan Michalski, Paul Heinrichs

**Links/Partnerships:** External linkages with other researchers working in the field, particularly ICOM-CC (Painting Group I).

**Progress Summary:** 1993-2003: Stress relaxation is an important criteria for lining supports. Viscoelastic polymer mechanics explains the rates of relaxation of the different layers of a lined painting. Lining with unimpregnated linen or a multifilament polyester fabric offered no significant support to the model paintings prepared with lead white oil grounds. A lining with unimpregnated polyester sailcloth showed high initial tension and much slower relaxation than the model oil

painting, so significant support was maintained. It can reduce cupping by stress alignment and can reduce cracking by some overstretching but at fast events like shock and after periods of low RH, the painting will carry the tension and will be vulnerable to defects. Several layers of sailcloth bonded together or a heavier weight cloth may extend support to these events as well. Impregnation can increase initial tension, slow subsequent relaxation and can slow the rate of response to change in RH; a size which does not saturate the fabric only influences tension a few days after an applied strain.

2004-2005: Investigated the replacement of environmental conditioning unit.

**Project Proposal:** 2006-2007: Install equipment to achieve testing. Reassemble testing equipment (jigs) and evaluate the data capture system software. Establishing test procedures and initiating tests with prefabricated samples may have to be scheduled for 2007-2008

**Publications:** S. Michalski, D. Daly Hartin, "CCI Lining Project: Preliminary Testing of Lined-Model Paintings", *Preprints 11th Triennial Meeting of the ICOM-CC*; Edinburgh, 1996

S. Michalski, D. Daly Hartin, "CCI Lining Project: Preliminary Testing of Lined-Model Paintings" poster at Conference on "Lining and Backing, The Support of Paintings, Paper and Textiles", UKIC, 1995

D. Daly Hartin, S. Michalski, "Ongoing Research in the CCI Lining Project: Peel Testing of BEVA 371 and Wax-resin Adhesives with Different Lining Supports" *Preprints of the 10th Triennial Meeting of the ICOM-CC*; Washington, 1993

D. Daly Hartin, S. Michalski "Lined Paintings - Research; Tests of Beva and Wax-Resin Linings", Gerry Hedley Memorial Forum: Mechanical Behaviour of Paintings - Experience and Theory; 1993

D. Daly Hartin, S. Michalski, C. Pacquet, "Ongoing Research in the CCI Lining Project: Peel Testing of BEVA 371 and Wax-Resin Adhesives with Different Lining Supports", *Preprints 8th Triennial Meeting of ICOM-CC*; Sydney, 1987.

**CCI Number:** 86055

## **PAINTINGS**

**Project Title:** **Technical and Scientific Examination of A.Y. Jackson's Paint Boxes**

**Project Description:** The purpose of the project is to document the painting materials contained in paint boxes that belonged to A.Y. Jackson, as well as the paint boxes' technology.

A.Y. Jackson (1882-1974) was a prominent Canadian artist. A member of the Group of Seven, he had a far-reaching impact on Canadian landscape painting. There are at least two paint boxes that belonged to A.Y. Jackson, one in the collection of the Ottawa Art Gallery, another which was acquired in 2004 by the Canadian Museum of Civilization with the collaboration of CCI. The study of the painting materials still contained in these paint boxes provides an ideal opportunity to study the materials of A.Y. Jackson without having to sample paintings. The study will also provide an opportunity to acquire information about the technology of these particular paint boxes and will contribute to a larger study on paint box technology undertaken by Professor Barbara Klempan at Queen's University.

Samples of the materials in the paint boxes will be removed and analysed using several techniques. The construction of the paint boxes will be documented as well as labels and markings that may help to link the boxes to a specific manufacturer.

The users of the results of this project are art historians, curators and conservators in Canada. Analysis of painting materials in paint boxes will provide reference data for paintings for which the attribution is uncertain.

**Project Dates:** April 2005 to March 2007

**Team Leader :** Marie-Claude Corbeil

**Team Members:** Jennifer Poulin and Barbara Klempan (Assistant Professor, Paintings Conservation, Queen's University)

**Links/Partnerships:** Ottawa Art Gallery, Canadian Museum of Civilization

**Progress Summary:** 2005-2006: The paint boxes were examined and analysis of samples of painting materials was completed.

**Progress Proposal** 2006-2007: A lecture on the project will be presented at the CAC Annual Conference in May 2006.

**CCI Number:** 89315

## PAINTINGS

**Project Title:** The Materials and Techniques of Cornelius Krieghoff (1815-1872)

**Project Description** The purpose of the project is to analyze the painting materials and document the techniques used by Cornelius Krieghoff in order to build a database, which will assist in devising treatments and selecting appropriate display and storage conditions. The project will provide reference analyses for paintings for which the attribution is uncertain.

The exhibition *Kriehoff: Images of Canada*, organized by the Art Gallery of Ontario and curator Dennis Reid, provided an excellent opportunity to study the works of the prolific nineteenth-century artist Cornelius Krieghoff. The exhibition, which opened in Toronto in November 1999, travelled to four other Canadian cities (Québec City, Ottawa, Vancouver and Montréal) before the end of 2001. Krieghoff's well know subject matters include autumn and winter landscapes and portrayals of natives and habitants.

Over 300 samples of paint and ground were collected from more than 50 works. Paintings from each stage of Krieghoff's career were selected for inclusion in the study - The Early Years 1841-1844, The Montréal Period 1846-1863, The Québec City Period 1853-1863, The European Period 1864-1870 and The Late Québec Period 1870-1872. Lenders who have agreed to participate in the analytical study are the Art Gallery of Ontario, Glenbow Museum, Kastel Gallery of Montréal, McCord Museum of Canadian History, Montréal Museum of Fine Arts, Musée du Château Ramezay, Musée national des beaux-arts du Québec, National Archives of Canada, National Gallery of Canada, Power Corporation, Royal Ontario Museum and the Thomson Collection.

The users of this work are curators, conservators, scientists, art historians, artists, law enforcement agencies, collectors, and the general public in Canada and internationally.

Project results and information from the project will assist curators, conservators, and scientists by providing essential data on Krieghoff's materials and techniques, which are used both in authenticity and attribution studies, and in evaluating the conservation requirements of his works.

**Project Dates:** January 2000 to March 2007

**CCI Project Leader:** Elizabeth Moffatt

**Project Team:** Marie-Claude Corbeil and Sandra Webster-Cook (Art Gallery of Ontario)

**Links/Partnerships:** Glenbow Museum; Library and Archives of Canada; McCord Museum of Canadian History; Musée des beaux-arts de Montréal; Musée du Château Ramezay; Musée national des beaux-arts du Québec; National Gallery of Canada; Royal Ontario Museum; Galerie Kastel Inc.; Power Corporation of Canada; Thomson Collection

**Progress Summary:** 2000-2004: Analysis of the paint samples began in 2000 and was completed during 2002. Data analysis and preparation of reports and a publication are in progress.

2004-2005: A comprehensive final report on the project was prepared for the Art Gallery of Ontario. The eleven other institutions and private collectors that

participated in the study received individual reports, which provided detailed analytical results for the paintings in their respective collections.

2005-2006: A draft manuscript was prepared.

**Project Proposal:** 2006-2007: An article will be submitted for publication.

**Publications:**

**CCI Number:** 74200

## PAINTINGS

**Project Title:** **The Materials and Techniques of David B. Milne (1882-1952)**

**Project Description:** The purpose of the project is to analyze the materials and document the techniques used by David Milne at different times in his career in order to build a database which will assist in devising treatments and selecting appropriate display and storage conditions. The project will provide reference analyses for paintings for which the attribution is uncertain.

Scientific research on David Milne's oil paintings was initiated when a large number of his paintings were assembled for a major Milne exhibition organized by the McMichael Canadian Collection and the Vancouver Art Gallery in 1991. The aim of this research is to determine the materials and techniques employed by Milne throughout his oil painting career. In collaboration with the conservation department of the McMichael Canadian Collection, over 280 samples were taken from a representative selection of thirty-seven oil paintings spanning Milne's career. These paintings came from the Milne Family Collection, the McMichael Canadian Art Collection, the Art Gallery of Ontario and the National Gallery of Canada.

The thirty-seven paintings were divided chronologically into four groups: group 1, 1911-1918; group 2, 1919-1928; group 3, 1929-1939 and group 4, 1939-1952. The first group represents some of Milne's early well-known paintings from New York City and Boston Corners, New York (1911- 1918). The paintings in the second group are from a period, which commenced in 1919, when Milne returned to Boston Corners after working as a war artist for a short time. During the years 1919-1928 Milne spent time in Boston Corners, N.Y., the Adirondacks, Mount Riga and Ottawa. The third group includes paintings from the years 1929-1939 when Milne returned to Ontario and the last group spans the period from 1939 until Milne's death in 1953, during which time Milne was in Toronto and then Uxbridge.

The users of the results of this project are curators, conservators, scientists, art historians, artists, law enforcement agencies, collectors, and the general public in Canada and internationally.

Project results and information from the project will assist curators, conservators, and scientists by providing essential data on Milne's materials and techniques, which are used both in authenticity and attribution studies, and in evaluating the conservation requirements of his works.

**Project Dates:** September 1991 to March 2007

**CCI Project Leader:** P. Jane Sirois

**Project Team:** Elizabeth A. Moffatt, Kate Helwig, Jeremy J. Powell, David Miller, Kristopher Legate (Young Canada Works in Science and Technology, Department of Canadian Heritage), and Annaïg Gautier (CCI intern)

**Links/Partnerships:** The McMichael Canadian Art Collection; National Gallery of Canada; the Art Gallery of Ontario; the Milne Family

**Progress Summary:** 1991-2004: Samples were taken from 37 paintings spanning David Milne's career from 1911 to 1946 belonging to The Milne Family collection, The National

Gallery of Canada, the McMichael Canadian Art Collection and the Art Gallery of Ontario. In addition to these, other samples have been taken from David Milne's palette and paintbox.

Several analytical techniques were employed on both cross-sections and samples of discrete layers to obtain detailed information on the composition of the pigments and media used: Fourier transform infrared spectroscopy, gas chromatography/mass-spectrometry, x-ray diffraction, x-ray microanalysis and scanning electron microscopy, light microscopy, fluorescence microscopy, and polarized light microscopy.

The analysis of all samples has been completed (SEM/XES, XRD, FTIR and polarized light microscopy). The project data has been reviewed and compiled and a publication is in progress.

2004-2005: A draft manuscript describing the project and results is in progress.

2005-2006: A lecture entitled "A Technical Study of David Milne's Oil Painting Materials and Techniques" was presented at the 31<sup>st</sup> CAC Annual Conference in May 2005. Preparation of a draft manuscript began.

**Project Proposal:**

2006-2007: A manuscript will be submitted for publication.

**Publications:**

Sirois, P.J., Moffatt, E.A., Miller, D., Helwig, K., "A Material and Technical Investigation of Early Oil Paintings by David Milne," presented at the 21<sup>st</sup> IIC-CG Annual Conference, Calgary, May 1995. (lecture)

Sirois, P.J., Gautier, A., Miller, D., Moffatt, E. A., and Powell, J.J., "A Scientific Investigation of the Paintboxes of Paul Kane and David Milne," presented at the 22<sup>nd</sup> IIC-CG annual conference, Montreal, May 1996. (poster)

Sirois, P.J., "Delving into the Paintboxes of Paul Kane and David Milne," *CCI Newsletter*, no. 19, March 1997, pp. 6-7.

Sirois, P.J., Stewart, C, Helwig, K, Moffatt, E.A., and Legate, K, "A Technical Study of David Milne's Oil Painting Materials and Techniques," presented at the 31<sup>st</sup> CAC Annual Conference, Jasper, May 2005. (lecture)

**CCI Number:**

55696

## PAINTINGS

**Project Title:** **The Material and Techniques of Jean-Antoine Aide-Créquy (1749-1780)**

**Project description:** The purpose of the project is to analyse the materials and document the techniques used by Jean-Antoine Aide-Créquy. Jean-Antoine Aide-Créquy is an important artist in the history of Canadian painting, as he created his works shortly after the English Conquest of 1759, during a transition period in which importing artwork from France was not possible; as a result, local painting emerged. A study of the materials and techniques used by Aide-Créquy will enhance our understanding of this important period in the history of Canadian art by identifying the materials available for the painting at the time.

There are only eight paintings left by this artist, most of them signed and dated. Two paintings have already been analyzed while they were being treated at the Centre de conservation du Québec. The other six paintings belong to parishes and religious communities in the regions of Québec and Charlevoix. They will be examined on site, and samples will be taken from them for analysis using various methods.

Users of the project are art historians, curators and conservators in Canada.

**Dates** April 2005 to March 2007

**Team Leader :** Marie-Claude Corbeil

**Project Team:** Elizabeth Moffatt and Elisabeth Forest (Centre de conservation du Québec)

**Links/Partnerships** Canadian institutions in which Aide-Créquy's work are conserved.

**Progress Summary:** 2005-2006: Four paintings were examined and sampled, and analysis began.

**Progress Proposal:** 2006-2007: The remaining paintings will be examined and sampled and analysis will be completed.

**CCI number:** 89313



## **PAINTINGS**

**Project Title:** **The Materials and Techniques of Jean-Paul Riopelle (1923-2002)**

**Project Description:** The purpose of the project is to analyse the materials and document the techniques used by Jean-Paul Riopelle in order to build a database, which will assist in devising treatments and selecting appropriate display and storage conditions. The project will provide reference analyses for paintings for which the attribution is questioned.

A number of paintings allegedly by Riopelle were examined in our laboratory, which turned out to be fakes. Riopelle is one of the most renowned 20<sup>th</sup> artists in Canada and internationally. His works, especially those of the 1950s, have reached high prices. It was recognized that we should build a database of his materials and techniques in order to assist curators and law enforcement agencies.

Users of the work are curators, conservators, scientists, art historians, artists, law enforcement agencies, collectors, and the general public in Canada and internationally.

Project results and information from the project will assist curators, conservators, and scientists by providing essential data on Riopelle's materials and techniques, which are used both in authenticity and attribution studies, and in evaluating the conservation requirements of his works.

**Project Dates:** December 2001 to December 2007

**CCI Project Leader:** Marie-Claude Corbeil

**Project Team:** Kate Helwig and Jennifer Poulin

**Links/Partnerships:** Montreal Museum of Fine Arts; Musée national des beaux-arts du Québec; Musée d'art contemporain de Montréal; Yseult Riopelle

**Progress Summary:** 2001-2003: Thirty-eight paintings were examined and sampled, and analysis of the samples began.

2003-2004: Analysis focussed on selected samples to address specific conservation issues. A manuscript was written on that body of data for IIC Bilbao 2004.

2004-2005: Analysis of all 300 samples by scanning electron microscopy/x-ray spectrometry, x-ray diffraction and polarized light microscopy was completed. Analysis by FTIR spectroscopy and GC-MS continued.

2005-2006: Analysis of samples from paintings was completed. A selection of painting materials from Riopelle's studio in France was obtained.

**Project Proposal:** 2006-2007: Analysis of painting materials from Riopelle's studio will be undertaken. An article will be written.

**Publications:** Corbeil, M.-C., "Discovering the Paintings of Jean-Paul Riopelle," *CCI Newsletter*, no. 32, November 2003, p. 9.

Corbeil, M.-C., "Considerations Regarding Riopelle's Pictorial Technique and Conservation," in *Jean Paul Riopelle - Catalogue raisonné*, vol. II, edited by Yseult Riopelle, Moudan, Acatos and Montréal, Hibou Éditeurs, 2004, pp. 19-25.

Corbeil, M.-C., "La technique picturale de Jean-Paul Riopelle: esthétique et conservation," presented at the 30<sup>th</sup> CAC Annual Conference, Québec City, May 2004. (lecture)

Corbeil, M.-C., Helwig, K., and Poulin, J., "Analysis of the Painted Œuvre of Jean-Paul Riopelle: From Oil to Mixed Media," in: *Modern Art, New Museums, Contributions to the Bilbao Congress*, Bilbao, 13-17 September 2004, edited by A. Roy and P. Smith, London, The International Institute for Conservation, 2004, pp. 170-173 + colour plates 61-62.

**CCI Number:** 77821

## **PAINTINGS**

**Project Title:** **The Materials and Techniques of Louis Dulongpré (1759-1843)**

**Project Description:** The purpose of the project is to develop a database of the materials, techniques and condition for a selected group of approximately fifteen to twenty oil paintings attributed to Dulongpré. This information will allow us to better understand the working methods of the artist and will also be a starting point to resolve problems of attribution.

The project will involve the examination of paintings from a number of museums. The work will include visual examination, technical photography, x-radiography and scientific analysis of the paint and ground layers. We expect that certain paintings will be sent to CCI for examination and that others will be examined on-site in the various participating museums.

Sampling and examination will take place in 2003-2005. Analysis and collation of results will be carried out in 2006-2008.

Users of the work are curators, conservators, scientists, art historians, artists, law enforcement agencies, collectors, and the general public in Canada and internationally.

Project results and information from the project will assist curators, conservators, and scientists by providing essential data on Dulongpré's materials and techniques, which are used both in authenticity and attribution studies, and in evaluating the conservation requirements of his works.

**Project Dates:** 2002-2008

**CCI Project Leader:** Kate Helwig

**Project Team:** Debra Daly Hartin, Jeremy Powell and Barbara Klempan (Art Conservation Programme, Queen's University)

**Links/Partnerships:** Gilbert Gignac (Library and Archives Canada); René Villeneuve (National Gallery of Canada); Conrad Graham (McCord Museum); Daniel Drouin (Musée national des beaux-arts du Québec) and others to be determined.

**Progress Summary:** 2002-2003: determined scope of project, contacted curators for advice about which paintings to examine, made final list of 20 paintings to be included in the study; developed a timeline for receiving paintings at CCI, contacted curators/museums to determine dates for loans, on-site visits.

2003-2004: examined and sampled three paintings from the McCord Museum in Montreal.

2004-2005: developed a condition report form and initiated cataloguing of photographic documentation; examined and sampled two paintings at the Library and Archives Canada.

2005-2006: No progress due to project leader's absence.

**Project Proposal:** 2006-2007: Analysis of samples from three paintings from the McCord Museum will be completed. Examination and sampling of paintings at the National Archives of Canada and the National Gallery of Canada will be undertaken.

**Publications:** Helwig, K., and Daly Hartin, D., "A Starch-based Ground Layer on a Painting Attributed to Louis Dulongpré," *Journal of the Canadian Association for Conservation*, vol. 24, 1999, pp. 23-28.

**CCI Number:** 82213

## **PAINTING**

**Project Title:** **The Materials and Techniques of Norval Morrisseau (1936-)**

**Project Description:** The purpose of the project is to analyze the painting materials and document the techniques used by Norval Morrisseau in order to build a database, which will assist in devising treatments and selecting appropriate display and storage conditions. The project will also provide reference analyses for paintings for which the attribution is uncertain.

Norval Morrisseau is one of Canada's best known First Nations' artists. A research project into Morrisseau's materials and techniques was first proposed in 2001 by Robert Arnold and Peter Vogel. The retrospective exhibition, "Norval Morrisseau: Shaman Artist", organized by Greg Hill, Assistant Curator of Contemporary Art, National Gallery of Canada, to be held February 3 to April 30, 2006, provides an excellent opportunity to initiate this research. The project would include examination, documentation and sampling a representative selection of Morrisseau's works, including paintings on birchbark, plywood and canvas. Analysis would include identification of the pigments and binding media in the paints and ground layers, and documentation of the artist's technique, supports, signatures, etc.

The project is also timely given recent media reports on the proliferation of Morrisseau forgeries and his family's attempt to find the source. A committee of Morrisseau experts has recently been established to create a central repository of Morrisseau archives and records, to prepare a catalogue raisonné, and to authenticate Morrisseau works.

The users of the results of this project are curators, conservators, scientists, art historians, artists, law enforcement agencies, collectors, and the general public in Canada and internationally.

Project results and information from the project will assist curators, conservators, and scientists by providing essential data on Morrisseau's materials and techniques, which are used both in authenticity and attribution studies, and in evaluating the conservation requirements of his works.

**Project Dates:** September 2005 to September 2009

**CCI Project Leader:** Elizabeth Moffatt

**Project Team:** Marie-Claude Corbeil and Robert Arnold

**Links/Partnerships:** National Gallery of Canada, Canadian Museum of Civilization, Canada Council Art Bank, other institutions to be determined

**Progress Summary:**

**Project Proposal:** Meet with Greg Hill in September 2005 to plan the project. In consultation with Mr. Hill, contact other institutions with Morrisseau collections, such as the Canadian Museum of Civilization and the Canada Council Art Bank, to ask them to allow examination and sampling of selected works.

**Publications:**

**CCI Number:** 92349

## PAPER

**Project Title:** **The Effect of Simmering on the Chemical and Mechanical Properties of Paper**

**Project Description:** The purpose of this project is to better understand how simmering affects the optical, chemical and mechanical properties of paper.

Simmering treatment for iron gall ink containing manuscripts has been used for over 30 years, and is one of several treatment options for iron gall ink corroded documents. The ability to remove large quantities of excess iron from the inks without causing ink migration, and the ability to cause weak and brittle papers to become more flexible, and therefore making these documents useable, are the main reasons why paper simmering is used. The nature of the treatment, subjecting paper to 90-95°C simmering water for 15 minutes, can be alarming because of the perceived risk to paper. This study looks into how simmering affects the chemical and mechanical properties of paper. The intent is not to advocate the use of simmering treatment for iron gall ink documents. Instead it is to provide an understanding into the impact of this controversial treatment for those who choose to use it.

Conservators who are considering paper simmering, as an option of treating iron gall ink corroded papers will benefit from this work.

**Dates:** 2001 – 2005 – **Project completed.**

**CCI Project Leader:** Season Tse

**Project Team:** Paul Bégin, Jane Sirois, Elizabeth Moffatt

**Team Members:** Heather Hendry; Yale Centre for British Art, 1080 Chapel St., New Haven, CT 06513 USA  
Maria Bedynski; Library and Archives of Canada (LAC - Gatineau Preservation Center)

**Links/Partnerships:** Library and Archives of Canada (LAC), and also the Canadian Council of Archives has expressed interest in this work.

**Progress Summary:** Two papers, a linen rag book paper (c.1758) and Whatman #40 filter paper, were simmered in alkaline water (pH 8.5; calcium hydroxide) for 15 minutes. The simmered papers, along with untreated controls and alkaline water wash controls, were artificially aged (thermal) in sealed tubes. Degree of polymerization, moisture content, pH, fold endurance, tear strength, and colour of all the treated papers and controls were measured before and after aging. The papers were also examined by x-ray microanalysis (SEM/EDS). Some of the wash water samples were analyzed by inductively-coupled plasma atomic emission spectroscopy (ICP/AES) and Fourier transform infrared spectroscopy (FTIR). The results showed that 15 minutes of simmering does not cause damage to the two papers, chemically and mechanically. In addition, both room temperature washing and simmering greatly benefitted the papers during thermal aging. The benefit was greater for the new paper. The softening and improved flexibility of old and brittle papers, commonly observed after simmering, can be attributed to the removal of water soluble sizes and fillers. A paper has been submitted for publication.

**Project Proposal:** 2005-2006: The project is complete - there is no proposal to continue work at present

**Publications:** S.Tse, H. Hendry P. Bégin M. Trojan-Bedynski P. J. Sirois. "The Effect of Simmering on the Chemical and Mechanical Properties of Paper." *Restaurator* 26 (2005): 14-35.

Trojan-Bedynski, Maria Kalbfleisch Frieda Tse Season Sirois P. Jane. "The Use of Simmering Water in the Treatment of a Nineteenth Century Sketchbook of Iron Gall Ink Drawings by James G. Mackay." *J.CAC* 28 (2003): 3-15.

**CCI Number:** 77816



## PAPER

**Project Title:** Monitoring of mass deacidified samples treated in 1993 (Phase III)

**Project Description:** To test paper samples deacidified in the early 90s to determine what kind of changes have occurred since their treatment and to use this natural aging data to better understand the relationship between natural and accelerated aging.

The long-term effects of various treatments such as mass deacidification are typically predicted using accelerated aging techniques. With increasing recognition of the limitations of artificial aging methods, monitoring change (degradation) in treated objects over long periods of time (natural aging) is the most reliable way of measuring the long-term impact of treatments. This project provides a unique opportunity to collect natural aging data on well defined samples whose original properties were carefully measured.

In the early 1990s, CCI carried out a comprehensive evaluation of three mass deacidification systems, "Evaluation of Commercial Mass Deacidification Processes: AKZO-DEZ, Wei T'o and FMC-MG3". The study was divided into three phases. Phase II examined the effect of treatment on new and artificially aged modern papers, while Phase III evaluated the effect of treatment on media, bindings, and special papers. The impact of treatment on these materials was documented in 1993. Ten years later, some treated materials have shown changes that were not seen in the initial evaluation.

Even though two of the three methods no longer exist, the information gathered on the naturally aged samples could be used to determine the actual effectiveness of mass deacidification, to assist in the evaluation of existing and new mass deacidification processes, and to refine artificial aging protocols. The best way to study the stability of a material is to measure the changes over time at various intervals to determine the rate of change. Therefore, this would be the first testing interval for these samples with others to follow in the future.

There are two aspects to the project. First is migration of data from Phase III, recorded in 1993, from WordPerfect into a flexible database, follow by visual evaluation of the treated samples twelve years after treatment. Re-evaluation of these samples is not labour intensive and can be ongoing, particularly suitable when lab facilities are not available. Visual re-evaluation is also an excellent training opportunity for interns or conservators in training. The second aspect of the project is to evaluate the chemical and mechanical properties of the Phase II papers to determine if the buffer added as part of the treatment is still effective in slowing the acid breakdown of the paper

Users are archives and libraries that require information and advice on the selection of suitable deacidification processes for their collections.

**Dates:** April 2004 to March 2008

**CCI Project Leader:** Paul Bégin, Season Tse

**Project Team:** Sherry Guild

**Links/Partnerships:** The Canadian Council of Archives has expressed interest in this work.

**Progress Summary:** A database has been created to record data collected from Phase III in 1993, and those that will be collected this year.

2005-2006: Due to lack of lab space, and help from intern/fellow, this project is on hold until resources are available possibly in 2007.

**Project Proposal:** 2006-2007 Continuing delays in lab construction the plan is to start as soon as the lab is accessible.

**Publications:**

**CCI Number:** 86434

## PAPER

**Project Title:** Preservation of Works on Paper with Iron Gall Ink in Canadian Collections – Research into Aqueous Treatment Methods

**Project Description:** The purpose of this project is to evaluate the effects of eight conservation treatments on original iron gall ink documents.

Five iron gall ink documents, dating from the mid to late 19th century, donated by Archives nationales du Québec, were used for in this experiment. Each document was treated with eight separate conservation treatments. The documents were treated by Valeria Orlandini, an intern at the Gatineau Preservation Center, Library and Archives of Canada, in July 2002. The five sets of treated samples were artificially aged using heat (80°C, 65% RH) light (fluorescent light bank without UV filter) and humidity (22°C, 85% RH). Quantitative colour monitoring was carried out with the Minolta 2022 spectrophotometer. Changes in the appearance of the documents will be evaluated visually by a panel. Imaging methods such as the MuSIS camera, flatbed scanners, and conventional UV-fluorescence and IR photography will also be used. The methods of imaging will also be compared according to their accuracy in documenting colour and physical changes to the ink and the paper. The treated and aged samples will also be monitored for colour change every five years while stored in temperature and RH controlled laboratory environments.

Users are conservators and custodians of iron gall ink collections in archives, libraries and galleries interested in knowing the impact some of the conservation treatments may have on iron gall ink documents in their collection.

**Dates:** 2003 to June 2007

**CCI Project Leader:** Season Tse

**Project Team:** Sherry Guild, Scott Williams, Carl Bigras, Maria Bedynski; Library and Archives of Canada (LAC)

**Links/Partnerships:** Valeria Orlandini (McKay Lodge Fine Arts Conservation Laboratory, Oberlin, Ohio); Harold Holland, Council of Archives of New Brunswick (CANB)

**Progress Summary:** 2003-2004: The treated and artificially aged samples have been mounted for evaluation.

2004 - 2005: Photo-documentation and MuSIS imaging of each sample were completed. The presence of Fe(II) ions in the treated and aged samples were tested using bathophenanthroline test. The aged samples visually evaluated by paper conservators attending the Iron Gall Ink workshop (February 21-23, 2005).

2005-2006: FTIR analyses and surface pH using a microprobe was carried out on selected treated aged samples. A summary of the research findings to date was presented in the 2<sup>nd</sup> Iron Gall Ink Meeting and Final Conference for Metals in Paper Research Group, on January 24-27, 2006, in Newcastle upon Tyne, UK. The results to date were summarized and published in the pre-conference publication (extended abstract), and was submitted to be published in the post conference proceedings.

**Project Proposal:** 2006-2007: Complete FTIR and pH measurements of the samples, prepare publication to be submitted to JCAC. An update of the research and progress of the overall program will be presented in the annual CAC conference in Toronto, May 17-19, 2006

**Publications:** Tse, S. Guild S. Trojan-Bedynski M. Orlandini V. "Effect of Aqueous Treatments on 19th Century Iron Gall Ink Documents: Part 2: Artificial Aging by Heat, Humidity and Light." Second Iron Gall Ink Meeting and Final Meeting for Metals in Paper European Thematic Network, January 24-27, 2006, Newcastle upon Tyne, UK, Pre Conference publication 2006. p.p. **(Missing info.)**

Tse, Season. "Preservation of Works on Paper With Iron Gall Ink in Canadian Collections." CCI Newsletter, Fall 2005 p.p.**(Missing info.)**

**CCI Number:** **92399**

## PAPER

**Project Title:** Preservation of Works on Paper with Iron Gall Ink in Canadian Collections – Collection Survey

**Project Description:** To design and develop a simple, possibly web based, survey tool to assess the extent and condition of iron gall ink material in Canadian collections.

Iron gall ink threatens to destroy collections in museums, galleries and archives all over the world. While the problem is acknowledged and there is active research and treatment development in Europe, there is little awareness of its problem in Canadian collections. Since many documents, critical to understanding the history of Canada were written with iron gall ink, and because of the inherent instability of these ink, resulting either in corrosion of paper or fading of the ink, it is important that institutions are aware of the urgent need to preserve them. The need to assess the extent of iron gall ink in Canadian collections was again identified as a CCI research priority in a focus group meeting, hosted by CCI, during the CAC conference in 2000. The survey tool serves two purposes, first it is a means to provide Canadian institutions with a self-assessment and bench-marking tool to determine the condition and quantify the risks of losing these historical documents or works of art in their collection. Secondly, with the use of the on-line survey by Canadian conservators and collection managers, we can have an accurate idea of the distribution of iron gall ink collections across Canada, monitor their conditions and suggest necessary strategies to preserve these collections for future generations. Users of this work include archives, libraries and galleries responsible for the preservation and care of collections of historic documents and works of art on paper containing gall ink.

**Project Dates:** 2003 - 2007

**CCI Project Leader:** Season Tse

**CCI Project Team:** Sherry Guild, Bruce Gordon, Rob Waller (Museum of Nature), Maria Bedynski (Library and Archives of Canada), Harold Holland (Council of Archives of New Brunswick)

**Links/Partnerships:** Library and Archives of Canada (LAC)

**Progress Summary:** 2004-2005: A risk model has been created for works of paper containing iron gall ink. The survey, based on the risk model is being designed and a draft version was introduced and evaluated during the Iron Gall Ink Workshop, to be held at the LAC-GPC in February 21-23, 2005.

2005-2006: The risk model and risk assessment survey form was developed, modified, and presented as a poster at the 2<sup>nd</sup> Iron Gall Ink Meeting and Final Conference for Metals in Paper Research Group, on January 24-27, 2006, in Newcastle upon Tyne, UK. The results to date were summarized and published in the pre-conference publication.

Progress of the risk assessment survey will be presented in the annual CAC conference in Toronto, May 17-19, 2006, where Canadian conservators will be made aware of the diagnostic tool and the assessment survey colleagues. They will be invited to take part in assessing the condition of their iron gall ink collections.

**Project Proposal;** 2006-2007: Pilot surveys will be conducted in a national archive and a smaller provincial museum archive. The design of the survey will be modified based on the pilot surveys, and will be sent to colleagues in Canada and outside of Canada for critical review. A survey kit will be developed for and sent to institutions who are interested in participating in the survey. An on-line survey will be designed and made available to our clients to encourage assessment of their collection. The results of the survey will also be published in professional journals as a means of education and creating awareness. The risk model, after peer reviewed, will be submitted for presentation presented in the Iron Gall Ink meeting in 2006.

**Publications:**

**CCI Number:** 90967

## PAPER

<b>Project Title</b>	<b>Study on the Effectiveness of Bookkeeper Deacidification Technology Using the Arrhenius Relationship</b>
<b>Project Description</b>	<p>The purpose of the project is to evaluate the long-term effectiveness of Bookkeeper Deacidification on paper.</p> <p>Deacidification involves the introduction of a material into paper to neutralize acids and provide a buffer to protect the paper from further attack. The deacidification agent is typically a dissolved compound in solution. The Bookkeeper method differs in that the chemical is not dissolved, but rather in the form of submicron particles suspended in a carrier. The library and archive community would like to know if this has an impact on the effectiveness of a deacidification treatment.</p> <p>This study will apply the Arrhenius relationship between the rate constant of a reaction and the reaction temperature to estimate the effect of Bookkeeper deacidification on the rate of paper degradation at ambient conditions. The samples (untreated and deacidified) will be aged at five temperatures (between 50 and 90°C) and the rate constants of depolymerization of cellulose will be determined for an acidic paper and the same paper deacidified by the Bookkeeper process. Other tests such as folding endurance, pH, alkaline reserve, and measurement of optical properties will be carried out. This is a long-term project (4 years) due to the length of time required for the lower temperature accelerated aging. Users are archives, libraries, museums or other institutions that collect and store paper based materials and require information or advice on the deacidification of these materials.</p>
<b>Dates</b>	2006 to 2010
<b>Team Leader</b>	Paul Bégin
<b>Team Members</b>	Season Tse
<b>Links/Partnerships</b>	
<b>Progress Summary</b>	<b>2005-2006</b> On hold due to pending move of CCI's Tunney's Pasture laboratory and equipment to the main CCI building to be able to start the long-term accelerated aging experiments.
<b>Project Proposal</b>	2006-2007: Finalize planning and project outline. Prepare samples for deacidification and begin the accelerated aging experiments
<b>Publications</b>	
<b>CCI Number:</b>	75369

## PESTICIDES:

**Project Title:** Collections contaminated by Pesticides

**Project Description:** The purposes of this project are:  
to provide clients in Canadian museums and Aboriginal cultural centres with information on the health hazards associated with contaminated collections;  
to further develop analytical methods, such as GC/MS and portable XRF for detection of a wider range of pesticides, and to improve the existing methods of analysis to provide quantitative data.  
to participate in developing standardized analytical methods within the museum community to ensure all institutions are reporting analyses which are comparable, and  
to develop and evaluate pesticide mitigation procedures

Preliminary results have shown that many natural history specimens and Aboriginal artifacts have been treated with a variety of pesticide residues. Identification of these residues, safer handling protocols and health hazard information is needed by museums and Aboriginal communities caring for these objects to ensure the caretakers' safety. Techniques to remove pesticides from artifacts should be investigated in order to make these artifacts as safe as possible so that they may be used and handled.

The users of this work are Canadian and American museums, Aboriginal cultural centers, members of Aboriginal communities with contaminated objects in their possession from, for example, repatriation.

**Project Dates:** 2005-2009

**CCI Project Leader:** Jane Sirois

**Project Team:** Jane Sirois, Jennifer Poulin, Malcolm Bilz, Tom Stone

**Links/Partnerships:** Health Canada, informal partnerships only with museums.

**Progress Summary:** 2005-2006: Discussed with Health Canada how to provide clients with hazard information. A strategy to prepare pesticide fact sheets was developed.

**Project Proposal:** 2006-2007: Determination of the hazards relating to specific pesticides and development of safety guidelines  
- Preparation of pesticide fact sheets to outline hazards of pesticides identified in collections and to describe measures to be taken to minimize exposure to these pesticides. (Jane Sirois, Jennifer Poulin ARL)

**2007-2008: Preparation and analysis of experimental material for XRF calibration and pesticide mitigation studies (ARL and CR).**  
- start evaluation of pesticide removal techniques and guidelines for mitigation (OIAF and CR)

**2008-2009: Continue evaluation of pesticide removal techniques techniques and guidelines for mitigation (OIAF and CR)**



**Publications:**           **None relating to this specific project to date.**

**CCI Number:**           **94075**

## PIGMENTS

**Project Title:** Iron Oxide Pigments: Natural and Synthetic

**Project Description:** The purpose of the project is to undertake research on the history and characteristics of the iron oxide pigments and to prepare a manuscript "Iron Oxide Pigments: Natural and Synthetic," for inclusion in *Artists' Pigments: A Handbook of their History and Characteristics*, vol. 4, Barbara H. Berrie, Editor, to be published by the National Gallery of Art, Washington.

Colored iron oxides are widespread in nature and have long attracted the attention of artists and craftsmen. There is archeological evidence that iron earths were collected and transported more than three hundred thousand years ago. Processing could include washing the earth to remove quartz and hard impurities, heating yellow ochre to create red iron oxide, and mixing different earths together to produce a desired color. Methods to make synthetic iron oxides were known early, but were not employed on a large scale until the development of mars colors in the latter part of the eighteenth century. Both natural and synthetic iron oxides remain important artists' pigments.

The provisional section headings for the Chapter, subject to modification or omission, are as follows: *Introduction* (pigment definition; current terminology); *History* (archaic and historical names; history of use; dates of use); *General Pigment Properties* (colour and spectral reflectance; optical properties; permanence; chemical properties; compatibility; oil absorption and grinding properties; toxicity); *Composition* (chemical composition; sources; preparation; adulteration and sophistication); *Identification and Characterization* (optical and chemical microscopy; chemical identification; instrumental methods of analysis, e.g. x-ray powder diffraction, infrared spectroscopy; spectrochemical analysis; criteria for identification); *Occurrences*.

The users of this work are the National Gallery of Art, Washington (publisher); curators, conservators, scientists, art historians, artists and the general public in Canada and internationally.

**Project Dates:** June 1994 to September 2006

**CCI Project Leader:** Kate Helwig

**Project Team:**

**Links/Partnerships:** National Gallery of Art (Washington); pigment manufacturers; CCI Library; Material Technology Laboratory, Natural Resources Canada; Surface Science Western; Nancy Binnie, Conservation Processes and Materials Research, CCI (colour measurement studies).

**Progress Summary:** 1994-1996: literature search completed. References imported into "Reference Manager" software for ease of retrieval and production of a bibliography. Collection of reference materials was completed although samples of particular interest are still being solicited. Analysis of reference materials by FTIR, SEM/XES, PLM and XRD was initiated.

1997-1999: A draft manuscript of all sections, excluding *Identification and Characterization*, was completed. Analysis of standard samples continued.

The completed manuscript with illustrations and references was sent to the National Gallery of Art in Washington.

2002-2003: a revised manuscript was sent to the National Gallery of Art in Washington. Editing at the National Gallery to begin shortly.

2004-2005: Revision from the copy editor received and revised manuscript returned to the National Gallery of Art.

2005-2006: Corrections to the first set of proofs of the chapter were made.

**Project Proposal:** 2006-2007: Corrections to final proofs of chapter prior to publication will be made.

**Publications:** Helwig, K., "A Note on Burnt Yellow Earth Pigments: Documentary Sources and Scientific Analysis," *Studies in Conservation*, vol. 42, no. 3, 1997, pp. 181-188.

Helwig, K., "Characterisation of the Iron Earth Pigments Using Infrared Spectroscopy," *Postprints of the Infrared Users Group Meeting*, Victoria & Albert Museum, London, September 12-13, 1995 (1998).

Helwig, K., "Pigment Research at CCI: From Titanium Whites to Iron Oxides," *CCI Newsletter*, No. 21, March 1998, p. 5.

Helwig, K., "Mars Colours: Preparation Methods and Chemical Composition," *Poster Summary Booklet, Preprints of Painting Techniques: History, Materials and Studio Practice*, 17th IIC Congress, Dublin, Ireland, 1998.

Helwig, K., "Characterization of the Iron Oxide Pigments Using Physical and Chemical Analysis," presented at the AGPIC 1998 Student Conference, Queen's University, Kingston, Ontario, 2 May 1998. (lecture)

Helwig, K., "The Iron Oxide Pigments: From Red Earth to Mars Colours," presented at the 44th International Conference on Analytical Sciences and Spectroscopy at Queen's University, Kingston, Ontario, 9 August 1998. (lecture)

**CCI Number:** 69576

## STONE

**Project Title:** **Characterization of Imitation Stone in Outdoor Monuments and Sculpture**

**Project Description:** The number of exterior imitation stone monuments and sculptures requiring conservation treatment has been growing. Knowledge of the materials used in these monuments is important in determining the proper conservation treatment. As the composition of imitation stone varies greatly, identification can be difficult without analytical support. Little information is available in the literature on imitation stones used in outdoor religious sculptures and monuments. The purpose of this project is to provide knowledge about these materials. The project goals are to identify the types of "imitation stone", to document existing stones to act as reference materials for future analyses and to develop an analytical protocol to more easily categorize these types of materials. Knowledge of the different imitation stones mixtures used by various studios at different times and their characteristics may provide enough information to make conservation decisions without needing analysis for each sculpture. This knowledge can also assist with provenance when little information is available on a particular artifact.

Typical samples of imitation stone will be characterized by combining existing provenance information such as the date and studio where the sculpture was made, information on what materials may have been incorporated into certain types of stone, photo documentation of the artifact materials, and analysis. The project will start with literature research, assembling well-documented imitation stone sample and determining the major categories of imitation stone to be analyzed. Appropriate strategies will then be determined for efficient analysis of the material. Other expertise may be sought during the project to assist with some analytical aspects such as petrographic thin section preparation and interpretation, and atomic absorption spectrophotometry or ICP analysis.

The users of the results of this project are conservators, architectural historians, curators and art historians in Canada.

**Dates** April 2005 to March 2007

**Team Leader** Jane Sirois

**Team Members** Elizabeth Moffatt and Isabelle Paradis (Centre de conservation du Québec)

### Links/Partnerships

**Progress Summary** 2004: Six samples of imitation stone from religious monuments were collected by Isabelle Paradis, CCQ and submitted to CCI as examples. Analyses of several different types of imitation stone samples have been undertaken by ARL as service requests in the past. Information on outdoor religious sculptures and the studios, which provided these sculptures, has been collected by Isabelle Paradis (CCQ).

2005-2006: 15 samples of imitation stone were gathered, as well as articles from the literature. Thin sections, petrographic analysis, elemental analysis and photography of the samples were completed.

**Progress Proposal** 2006-2007: Investigation into analytical protocol of imitation stone samples will continue.

**CCI Number**

## TEXTILES

- Project Title:** **The Effectiveness of Bathophenanthroline Test Strips for identifying Iron Ions on Textiles.**
- Project Description:** The purpose of this project is to determine if iron (II) test strips, originally developed for identifying iron (II) and iron (III) ions in iron gall ink on manuscripts, can also be used to identify iron (ii) on a variety of textiles.
- Dr. Han Neevel and Birgit Reissland at the Netherlands Institute for Cultural Heritage developed the non-bleeding bathophenanthroline test strips for identifying iron (II) and iron (III) ions in iron gall ink containing papers. The test strips were introduced to textile conservation for use on cellulosic textiles by Katherine Barker (NATCC 2002). This research will determine if the test strips can also be used on other types of fibres. If the test strips are effective and reliable, they would: provide a low tech means of confirming if brown/rust coloured stains on textiles contain iron; provide a means of monitoring the effectiveness of treatments to remove or chemically stabilize iron stains on textiles; and provide a means of identifying residual iron in printed or dyed textiles which were not adequately rinsed during manufacture. Testing will be carried out on fabric samples stained with iron in the lab as well as on textiles from museum collections. The research project will benefit textile conservators and other conservators treating textiles which may contain iron, textile researchers, collection managers, and anyone caring for textiles
- Project Dates:** 2003 - 2006
- CCI Project Leader:** Jan Vuori
- Project Team:** Season Tse, Kate Barker (Textile conservation workshop, New York)
- Links/Partnerships:** Jim Donnelly (Canadian Museum of Civilization), Christine Grant (Parks Canada), Anne MacKay (McCord Museum of Canadian History), Shirley Ellis (Royal Ontario Museum), Lucie Thivierge (Parks Canada), Colleen Wilson and Kjerstin Mackie (Royal British Columbia Museum), Joan Marshall (private practice), Mary Frame (textile researcher), Doris and Bill Hoag (textile researchers), Chris Paulocik (Metropolitan Museum of Art)
- Progress Summary:** 2003-2004: To date some preliminary tests confirmed that the strips may be used to indicate the presence of iron (II) on cellulosic textiles. The results also indicated that the strips may be used on silk although the method must be altered slightly from that recommended for paper (i.e., more pressure and longer contact time is required). More testing is required to determine if the strips can be used on wool and on other fibre types.
- 2004-2005: Bathophenanthroline Fe (III) ion test strips were used on a variety of textiles in Canadian museum collections suspected of containing iron ions. For selected samples, results obtained with the test strips were compared to those obtained by instrumental analysis. Test kits were also prepared and sent to a number of textile conservators in Canada. Guidelines for using the test strips on textiles were developed based on our own experience and those reported by others using the kit. The results were summarized in a paper submitted to ICOM-CC 2005.

2005-2006: The results of the study to date were presented at the 14<sup>th</sup> Triennial meeting of the International Council of Museums Committee for Conservation, The Hague, September 2005.

2005-2006: No further experimental work was carried out due to lack of laboratory facilities. Work will resume once appropriate facilities are available.

**Project Proposal:** 2006-2007: Once laboratory facilities are available, - testing and analysis on additional samples, particularly wool and Prussian Blue dyed or painted samples, if obtainable, will be carried out. Some samples of iron-containing wool or Prussian blue dyed or painted textiles will be aged by light an/or heat to determine of this releases sufficient Fe(II) to be detectable with the strips.

**Completion date: 2007/08**

**Publications:** Vuori, J. and Tse, S. 2005. "A preliminary study of the use of bathophenanthroline iron test strips on textiles" in *Preprints of the 14<sup>th</sup> Triennial Meeting of the ICOM Committee for Conservation*, The Hague, ICOM-CC, 989-995.

**CCI Number:** 88301

## TEXTILES

**Project Title:** Evaluation of Treatments for Stabilization of Iron Containing Textiles

**Project Description:** The purpose of this project is to determine if calcium phytate and newly developed antioxidants are effective in textiles that are either stained with iron or contain iron due to a manufacturing process such as iron mordanted dyes. Calcium phytate and tetra butylammonium bromide (TBAB) has been used successfully on iron gall ink containing paper - this project addresses the question as to whether it is also suitable for textiles.

The presence of iron, especially iron (II) ions, and other transition metal ions are known to catalyse oxidation and is therefore detrimental to organic substrates such as textiles and paper. Textiles containing iron as a mordant, for instant, often deteriorate to the extent that the fibres simply disintegrate. The results from a related project, "The effectiveness of iron ion test strips for identifying iron (II) and iron (III) on textiles" (83041), indicate that iron (II) ions are present in many textiles. Some of these textiles are already suffering from deterioration as a result of iron-catalysed oxidation, but others have not yet shown symptoms of deterioration. The question that conservators ask is, "now we know the cause of the problem, what is the solution?". A treatment to prevent or to mitigate the problem is required.

The effectiveness of calcium phytate in stabilizing papers containing iron gall ink has been thoroughly tested and found to be effective. In the presence of water, calcium phytate complexes iron (II) ions without removing them. Preliminary work by Vincent Daniels at the British Museum, found that sodium phytate was effective in stabilizing black-dyed New Zealand flax but the effectiveness of calcium phytate to complex iron on other fibres types as well as its effect on dyes and finishes has yet to be established. The purpose of this research is to determine if calcium phytate is also effective in complexing iron (II) and iron (III) ions in textiles that are either stained with iron or contain iron from a manufacturing process such as mordanting. A new compound, TBAB, has been identified by two European thematic research networks (InkCor and MIP) as effective in stabilizing iron gall ink paper. The advantage of this peroxide inhibitor is its solubility both in water and in organic solvents, and is therefore can be used for treatment of objects that cannot be subjected to water. The long-term effects of the phytate and TBAB treatment will be compared to rust removal treatments such as dithionite, oxalic and hydrofluoric acids.

Users are textile, upholstery, and object conservators treating iron stained or iron containing textiles and fibres, paintings conservators dealing with corroded tacking margins.

**Project Date:**

**CCI Project Leader:** Season Tse

**Project Team:** Jan Vuori

**Links/Partnerships:** Iron test kits will be prepared and introduced to textile conservators and collectors in Canada, the US and the UK to assess the condition of textiles containing iron. Partnerships and collaborative efforts will be established as conservators and collectors become aware of the extent that their collection is being affected by iron.

**Progress Summary:** No progress in phytate treatment research in 2004 due to lack of lab facilities.

**Project Proposal:** Project will resume when laboratory reopens.

**Publications:**

**CCI Number:** 83037



## TEXTILES

**Project Title:** **Setting Fugitive Dyes on Cotton and Silk Textiles: Adding Salts, Vinegar, and Using Cyclododecane and Different Drying Methods**

**Project Description:** The purpose of this research is to verify the effectiveness of 'traditional' washing methods (ie. addition of salts and vinegar to the wash water), and to evaluate new techniques (application of cyclododecane consolidant prior to washing) and drying methods (ie. use of suction devices, drying cloths and freeze drying) that can prevent or reduce migration of fugitive dyes in textiles during wet cleaning. Ultimately, the goal is to develop new treatment options that minimize the risks involved in wet treatments to dyed textiles.

Conservators often encounter historic textiles that are dyed or that incorporate coloured threads, often embellishment, that require treatment. Periodically, these textiles need further intervention than simply mechanical surface cleaning in order to improve their aesthetic qualities and inherent stability. However, wet or dry cleaning treatments are often not an option because of the known fugitiveness of the dye and the probability of loss of dye including other effects to the textile associated with this phenomenon. Various traditional methods, not adopted by the textile conservation field, have been used over the years to set fugitive dyes, including the use of various types and concentrations of salts in the wash bath and even vinegar. This research project will examine several of these traditional fixative methods, some in combination with various drying techniques in the hope that they will give results that could be translated to the conservation of historic textiles.

Silk and cotton yarns and fabrics will be custom-dyed in our laboratory with Solophenyl (a direct dye), which is a known fugitive dye. A series of experiments using the above methods will be carried out to ascertain the effect on the fugitive colourant of samples of white fabric stitched with the dyed thread, and to the dyed fabric. A comparison of the results will assist in determining the effectiveness of these wash bath additives and drying techniques to control dye migration in coloured yarns.

The research project will be of benefit to textile conservators who need to carry out immersion or local wet cleaning on coloured textiles.

**Project Dates:** 2002 - 2007

**CCI Project Leader:** Renée Dancause

**Project Team:** Season Tse, Jan Vuori, Sherry Guild

**Links/Partnerships:**

**Progress Summary:** 2002-2003: The research plan for the project was formulated and materials were purchased, including silk and cotton yarn and fabric. Several trial dyebaths were carried out to determine an appropriate depth of shade to use for dyeing the test yarn and fabric. The silk and cotton yarn and fabric was over-dyed (excess dye used in the dyebath) and used to make machine and hand-stitched test samples representative of artifacts with coloured components. The samples will aid in determining the efficacy of various techniques for controlling dye movement during wet treatments. Solophenyl dyes with poor washfastness were chosen for the dyeing.  
2004-2005: No progress was made in 2004 due to lab closure.

2005-2006: No progress was made in 2005 due to lab closure

**Project Proposal:** 2006-2007: When the Textile Lab is open and functional, it is planned that the following will be completed: washing methods practical research including deionized water, tap water, salts, vinegar; drying methods practical research including suction, drying cloth, freeze drying; consolidation practical research with use of cyclododecane.

**Publications:**

**CCI Number:** 80340

## UNDERWATER COLLECTION

**Project Title:** Collection and documentation of deteriorated of materials from heritage aircraft wrecks in fresh water

**Project Purpose:** The purpose of the project is to document the condition of materials derived from the wrecks of historic aircraft in fresh water. This is to prepare for the likely recovery of the Avro Arrow model and other significant aircraft.

The restoration project being carried out on the WW2 Halifax bomber at RCAF Memorial Museum Trenton offers an opportunity to collect unique and rare reference samples for conservation research from a heritage aircraft wreck that was submerged in a freshwater lake for 50 years (recovered in 1995). As the restoration is carried out, many deteriorated materials from the interior fittings, as well as structural and exterior cladding are being discarded. Collection of materials from the Halifax bomber, a fragment of a Velvet Glove missile recovered from Lake Ontario, and a Beechcraft Staggerwing float plane, would provide CCI with a reference collection to carry out research into the condition of these materials. Research on the condition of these materials and their conservation treatment is required to aid in predicting the condition and stability of materials from other Canadian heritage aircraft wrecks which may potentially be recovered (such as the 1/8 scale Avro Arrow air plane models which have been a search target for several avocational groups and the Canadian Navy in 2004), and in stabilizing aircraft wreckage already present in Canadian collections.

The recovered aircraft wreckage is not stable in its present form because the construction materials have changed during their ~50 year underwater exposure. These materials are obviously deteriorated, and metals are corroding. An understanding of the condition of these materials would enable us to determine if treatments developed by US and Australian researchers for recovered aircraft from saltwater environments are suitable for aircraft recovered from fresh water locations. Stabilization of these important artifacts from Canada's past will ensure they are accessible to future researchers and for public viewing in a museum environment.

Materials which may be collected for research include cladding alloys, wood, plywood, synthetic laminates (wood substitutes), insulation (foam), Plexiglas, Bakelite, rivets, and paint. Sampling and description of the components being examined will be guided by the team carrying out the restoration project, and construction drawings and specifications for the Halifax bomber are available.

**Project Dates:** 2005-2006 (for collection of samples).

**CCI Project Leader:** Nancy Binnie

**CCI Project Team:** Scott Williams

**Project Description:** Submerged wreckage materials, currently in danger of being discarded, will be collected for research purposes

Collected materials will be characterized by physical condition and chemical analysis where appropriate.

Suitability of current conservation treatments applied to saltwater wreckage will be evaluated and new treatments will be developed where necessary for freshwater wreckage.

Source material which may be examined is located at the following locations: RCAF Memorial Museum, Trenton, Ontario (Halifax bomber, Velvet Glove missile); Centennial Museum, in Shequiandah, Manitoulin Island, Ontario (Beechcraft Staggerwing UC-43B "Traveller").

- Users:** Cultural Resource Managers, Underwater Archaeologists, Conservation Scientists and Conservators, Aircraft restoration specialists, Industrial Objects Conservators. Licensed groups interested in recovery of Avro Arrow models from Lake Ontario.
- Links/Partnerships:** RCAF Memorial Museum Trenton  
Centennial Museum, in Shequiandah, Manitoulin Island  
Licensed Archaeological Groups wishing to retrieve Avro Arrow models from Lake Ontario.
- Progress Summary:** August 2004 - carried out site visit to RCAF Memorial Museum Trenton to view wreckage; collected photographs to illustrate materials and condition (for use in planning project).
- 2005-2006: March 2006 - A limited literature survey has been carried out and no sampling has yet been done. This work has been postponed pending re-opening of the CCI laboratories.
- Publications:**
- Project Proposal:** 2006-2007: **Phase 1:** Travel to museum(s) and other locations to make observations and collect research materials.
- CCI has been invited to assist the Western Canada Aviation Museum (WCAM) with the recovery of a Fokker Universal sea plane from Charron Lake in July 2006. Participation in this project would allow samples to be obtained from the wreckage prior to any conservation treatment and after minimal alteration in the burial (lake bed) environment. The museum has requested the following:
    - 1) conservation recovery plan (pre-recovery)
    - 2) conservation staff for field work assistance during recovery (possibly 2-3 weeks). See CCI request #93769 for full details. Activities would include working with the WCAM museum technician on-site and Recovery Team, and would include
      - Documentation (inventory) of each recovered item - photography, condition report, sketches.
      - Condition assessment - wood, iron tubing of airframe, cargo, furnishings inside plane, control panel, etc.
      - Emergency stabilization of specialized items at risk - log books, cargo, unstable metals.
      - Preparation of aircraft/fragments for shipping - may involve dismantling wings, removal of fragile components (textile).
- Phase 2:** Characterize materials by physical condition and chemical analysis.
- Phase 3:** Determine if previously developed conservation treatments for aircraft wreckage from saltwater (US and Australian researchers) will be suitable for use on aircraft wreckage recovered from fresh water. This will be done through a search of literature reporting on aircraft recoveries, condition assessment, and conservation treatment, as well as consulting with other conservation and aircraft restoration professionals.

***If needed -- Phase 4:*** Develop conservation treatments for submerged wreckage materials if suitable conservation treatments do not already exist (this research is not part of the current proposal, it would require experimental trials)

**CCI Number:** 74557

## UNDERWATER COLLECTION

**Project Title:** Erosion of Wood in Freshwater Shipwrecks

**Project Description:** The purpose of this study is to obtain a quantitative measure of the rate of wood erosion for deteriorated, waterlogged wood samples on a typical freshwater shipwreck site where surfaces are covered with zebra mussels (*dreissena polymorpha*), and where recreational divers remove mussels from timbers. Loss rates can be used as a damage indicator for survival of wood in similar environments.

As part of a study to assess the impact of fresh water zebra mussels on the materials composing shipwrecks, two large wood plank samples from the *Princess Charlotte* (sunk in the 1840's near Kingston in Deadman Bay, Lake Ontario, were recovered from the site in November 1996 and characterized by methods which included: 1) studio photography; 2) 3-dimensional moulding, with casting of replica surfaces; 3) 3-D laser scans of the surface at the National Research Council of Canada; 4) pilodyn measurements; 5) wood species identification and wood loss estimated with a weighing technique; and 6) installation of erosion pin markers used as reference standards on other underwater sites to assess wood loss on surfaces. The samples were reinstalled on the site in December 1996 and left to undergo natural ageing. After an extended period of natural ageing (5-10 years), the plan is to recover the samples and reassess to determine changes. Between June 15-25, 2004, a team from Parks Canada/Underwater Archaeological Services Unit will be working nearby and the wood samples can be recovered during that period.

Users are underwater archaeologists, cultural resource managers, and conservators.

**Project Dates:** 1996 - 2010

**CCI Project Leader:** Nancy Binnie

**Project Team:** Jonathan Moore and Willis Stevens (Underwater Archaeologists, Underwater Archaeological Services/Parks Canada)  
Rejean Baribeau (Research Officer, Photometry and Radiometry, National Research Council of Canada)

**Links/Partnerships:** Parks Canada, Natural Research Council of Canada.

**Progress Summary:** Samples will have undergone 7.5 years of natural underwater exposure as of summer 2004.

1996-1997 – Wood samples selected, characterized & reinstalled on site for long-term exposure.

2005-2006: No progress - unable to arrange for reinstallation of wood samples on site in 2005. Samples are stored in walk-in fridge at Walkley Rd and are checked regularly and water changed. Samples to be installed early spring 2006.

**Project Proposal:** 2006-2007: Parks Canada underwater archaeologists will be working at the Deadman Bay site in May 2006 and will be able to carry out the following activities:

1) re-install wood samples (\*)

- 2) determine wood loss *in situ* by measuring timber separations (\*)(\*\*)
- 3) collate all project records and data and prepare a technical note
- 4) communicate results.

\* Note that 1 and 2 may be carried out in the absence of N. Binnie due to a scheduling conflict with the CMA Risk Assessment Workshop (Saint Johns, NB) the same week. If Parks changes the dates planned for their Kingston site work, it may be possible to be present in person for this work.

\*\* There may also be an opportunity to look at wood erosion rates on the Sitka spruce wings of the Fokker Universal aircraft that will be recovered from 120 ft deep in Lake Charron in July 2006 by the Western Canada Aviation Museum. CCI has also been asked to assist with project (see CCI 93769)

**Publications:**

Nancy E. Binnie, Peter Engelbert, Lorne D. Murdock and Jonathan Moore, September 2000, *Shipwrecks, Archaeology and Zebra Mussels: Is Mussel Attachment a Threat to Our Submerged Cultural Resources*, in Proceedings of the 10<sup>th</sup> International Aquatic Nuisance Species and Zebra Mussel Conference, hosted by the Department of Fisheries and Oceans, February 13 to 17, 2000, pp. 121-131.

**CCI Number:**

74557

## UNDERWATER COLLECTIONS

**Project Title:** Corrosion Rates for Iron Components of Shipwrecks at Fathom Five National Marine Park

**Project Description:** A key issue in the management of underwater heritage is to understand the natural rates of decay. This project is a service provided to Parks Canada in which the aim is to find out what the natural rate of corrosion of iron in the freshwater Great Lakes environment.

This work is being carried out in Georgian Bay at Fathom Five National Marine Park, and rates will be determined using standard iron coupons installed on underwater test racks. A multi- year exposure is necessary as the corrosion rate is initially high, but eventually reaches a steady state rate after 5-8 years. Extrapolation of the steady state corrosion rate can be used to estimate the condition of fasteners and structural components on heritage shipwrecks, and will be used to predict the lifetime of the collection of 21 sail and steam vessels dating from the mid-19<sup>th</sup> to 20<sup>th</sup> centuries within Canada's first National Marine Conservation Area.

Samples are removed every year from shallow and deep-water stations. This is done regularly in the first few years, and then whenever convenient. Corrosion rates are established using the mass loss.

In August 2005, samples in the 1994 test station will have been in place for 11 years. Shallow and deep samples be recovered for analysis. Mini-test samples installed in October 1999 will have been in place for nearly 6 years and may also be recovered. Laboratory work will be carried out to establish corrosion rates. A final report and/or technical note will be prepared to describe the corrosion studies.

Users are cultural resources managers, underwater archaeologists, and conservation scientists.

**Project Dates:**

**CCI Project Leader:** Nancy Binnie

**Project Team:** Parks Canada - marine archaeologists from the Underwater Archaeological Services Unit, and John Stewart (Conservation Scientist); and members from Fathom Five National Marine Park

**Links/Partnerships:** Fathom Five National Marine Park, Parks Canada Ontario Service Centre and Underwater Archaeological Services Unit

**Progress Summary:** **1994-2006** Samples were installed in August 1994, August 1996, and September 1999. Recovery was carried out annually between 1994-1999, and in 2001.

**Samples** were analyzed and summary reports prepared (internal) for CCI and Parks Canada.

2004- 2005: No progress was made this year as FFNMP did not have a dive team available, and the UAS team was not working at FFNMP that year.



2005-2006: Samples were recovered from mini-test racks at most locations in 2006 by Jim Ringer, Underwater Archaeologist at Parks Canada. Samples were returned to CCI for analysis, but have been frozen in lake water and transferred to a freezer at Parks/1800 Walkley Road to await analysis when the CCI laboratory construction is complete

**Project Proposal:** 2006-2007: 1) Analysis of samples recovered in 2006 (pending laboratory completion).  
2) Compile and collate all experimental data accumulated; prepare a new report to summarize findings.  
3) No new samples will be recovered in 2006 unless the Underwater Archaeological Services Unit of Parks Canada carries out field work at this location. If field work is carried out, priority will be given to recovering samples from the Russel Island (30 ft) and King test racks (105 ft) that were not sampled in 2006. The data logger on the deep location will also be recovered.

**Publications:** Stewart, J., Murdock, L.D., and Binnie, N., *The Design of a Monitoring Program for Iron Alloys on Underwater Historic Shipwrecks in Fathom Five National Marine Park, Ontario, Canada,* Materials Research Society Symposium Proceedings, The Materials Research Society, vol. 462, pp. 359-368, 1997.  
- Stewart, J. and Argyropoulos, V., *The Corrosion of Ferrous-Metal at Fathom Five National Marine Park,* Historic Resource Conservation Branch, National Historic Sites, Parks Canada Report 20 February, 1994.  
- Binnie, Nancy E., *Corrosion Rate Monitoring of Submerged Cultural Resources at Fathom Five National Marine Park, A report on the 1994 field trip,* CCI Service Request CPR Report No. 656, October 6, 1995.;  
- Binnie N.E., *Corrosion Rate Monitoring of Submerged Cultural Resources at Fathom Five National Marine Park, A report on the 1995 field trip,* CCI Service Request CPR Report No. 657, June 19, 1996;  
- Binnie N.E., *Corrosion Rate Monitoring of Submerged Cultural Resources at Fathom Five National Marine Park, A report on the 1996 field trip,* CCI Service Request CPR Report No. 695, November 6, 1996.  
- Binnie N.E., *Corrosion Rate Monitoring on Station 161 (38MRD-1) and Station 180 (38MRD-2), Shipwreck Monitoring Program at Fathom Five National Marine Park,* CPMR Report No. 749, December 19, 1997.

**CCI Number:** 74557