

Arsenic, mercury, and lead: Inorganic pesticide residues in museum collections



Pests like dermestid beetles and clothes moths have long threatened biological and ethnographic collections. In the past, people used pesticides containing arsenic, mercury, and lead, to protect collections from biological attack. Residues from these early pesticides can still be found on collections. These residues can impact the health of those handling affected objects, long after the chemicals were applied. Handling these collections, cleaning them, or otherwise raising dust, pose a risk. Good handling procedures reduce the risk.

Organic and inorganic pesticides

This tip sheet describes how to handle collections that have in the past been treated with inorganic pesticides: pesticides that contain arsenic, mercury, and lead. It is important to note, though, that other pesticides (known as “organic” because their chemical formulas contain carbon) were also once

commonly used in museums. They include substances like naphthalene and paradichlorobenzene (mothballs), and previously common but now prohibited chemicals like DDT and methyl bromide. The procedures here can apply to both kinds of pesticide residues, but the background information provided is limited to arsenic, mercury and lead. Links with more information about the uses and lingering risks of organic pesticides are

provided at the end of this document.

Especially in a museum environment, both inorganic and organic pesticides can leave persistent, harmful residues. For this reason, museums today opt for pest control methods that are chemical-free.

Arsenic, mercury and lead

Arsenic, mercury, and lead are toxic chemicals that can enter the body through skin contact, ingestion, or by breathing in dusts. At room temperature, mercury compounds can emit harmful vapours. Long-term exposure to low dosages, or short-term exposure to large dosages can result in serious illness or death. It is important for adults to avoid exposure but children are especially vulnerable. While mercury is often reported as having been phased out some time ago, compounds such as mercuric chloride may have actually been used more recently than arsenic, so should not be discounted.

Arsenic, mercury, and lead each affect many different organs and body

systems. All three affect the nervous and digestive systems. Lead and mercury can also cause developmental effects; lead affects the reproductive system as well. Arsenic is a known human carcinogen, and lead is suspected to be carcinogenicⁱ. The *Agency for Toxic Substances and Disease Registry* fully describes the health impacts and symptoms for each, and links to this information can be found at the end of this document.

Inorganic pesticides in collections

Pesticide surveys of Canadian museum collections, conducted by the Canadian Conservation Institute, found arsenic most frequently in collections of birds, followed by mammals, then ethnographic, education and other collectionsⁱⁱ.

Ethnographic collections generally consist of human-made objects composed of natural materials like hide, hair, wool, grasses, bark and feathers. Education collections are often museum objects designated for use in interpretation activities with the public. The other collections in the surveys included fish, reptiles and mollusks. While surveying its own collection, the Royal Saskatchewan Museum (RSM) also found arsenic on bone.

Overall, mercury and bromine, a residue from brominated organic pesticides like methyl bromide, were found less frequently than arsenicⁱⁱ. However, they can be prevalent in specific individual collectionsⁱⁱ.

Mercuric chloride is also known to have been used with older herbarium specimens.

Inorganic pesticides and taxidermy

Arsenic and mercury in taxidermy dates back to the 18th century and continued through part of the 20th centuryⁱⁱⁱ. Lead was used in combination with arsenic in the form of lead arsenate or arsenic acid-lead salt^{iv}.

When this practice stopped depends on the collector, taxidermist, and caretakers. The US National Parks Service Conserve-O-Gram entitled “Arsenic Health and Safety Update” advises caution when handling specimens prior to 1980^v.



A conservator cleaning a bird study skin that tested positive for arsenic.

It was common to apply arsenic compounds to the inside of taxidermy and study skinsⁱⁱⁱ. However, arsenic could also be applied to the outside^{vi}. Compounds initially applied on the inside can work their way to the surface, especially near openings like the eyes, ears, seams, and tails.

Inorganic pesticides and ethnographic collections

Some ethnographic material may have been treated with pesticides after it was collected^{vii}. As with taxidermy techniques, pest control methods have varied widely among museums, and are often not documented.

How do I know if there is arsenic, mercury and lead on my collection?

There is *no safe, consistent way of telling whether something has arsenic, mercury, or lead on it just by looking at it.*

Often there is nothing to indicate the presence of pesticides. If you do see white powder or crystals on or around a specimen, it must be treated with caution. While it could be boric acid or borax, a less toxic substance used in taxidermy, there is no way to tell just by looking at it.

Infestation does not rule out pesticides either. The RSM has observed pieces with infestation that also tested positive for pesticides.

Testing for inorganic pesticides is



Swabs taken of the outside of this Black-headed Grosbeak tested positive for arsenic; those taken from the break in the neck were especially high.

possible, but there is often an expense involved. More information about testing can be obtained from organizations like the RSM and the Canadian Conservation Institute.

Handling suspect collections

The only way to reduce risks of inorganic pesticide residues is to use good handling procedures. Most of these points could be adopted for all collections, not just those suspected of residues.

- Do not eat or drink around collections.



Gloves and lab coat for collection handling.

- Do not use objects you are uncertain of for hands-on interpretation (ie. education events where the public can touch the object).
- Wear powder-free nitrile gloves and a smock or lab coat when handling objects.



Wear an N95 mask while inspecting for pests.

Pesticide Testing Case Study

The RSM surveyed its taxidermy collection using portable x-ray fluorescence (XRF), a non-destructive technique used to identify chemical elements. After finding specimens that tested positive for arsenic and lead, an industrial hygienist was hired to monitor air quality. Tests were taken in the worker's breathing zone while handling specimens for analysis, inspecting for pests, and while cleaning. The results showed that staff were taking adequate precautions, wearing gloves and a lab coat while generally handling specimens, and at minimum an N95 mask when working closely with them. Additional precautions and equipment are used when engaging in activities that might raise dust, like cleaning the specimens or the area they are stored.



A Bald Eagle is tested for arsenic using XRF.

- Allow cupboards and cabinets to air several minutes before working in them. Work with objects in a well ventilated area.
- If working closely, wear an N-95 dust mask.
- It is possible more stringent respiratory protection, like a fit-tested P-100 half mask respirator, may be required. Talk to an occupational hygienist to assess the risk and the appropriate steps to take.
- Be hygienic. Do not spread

- residues by first touching a suspect object and then clean surfaces with the same gloves. This includes not touching your eyes, face, mouth, and glasses. Use gloves if touching other contaminated surfaces and again, do not touch your face area.
- Remove gloves without touching the outside of them with your bare hands. See the link from the Centre for Disease Control, listed at the end of this document, to see how.
- Wash hands directly after removing gloves. Put on new gloves and wash surfaces and tools that have contacted the specimen or contaminated gloves.
- Launder lab coats or smocks separately from other laundry. Disposable lab coats might be a more appropriate option if on-site laundry is not available.



An "Arsenic Suspected" tag attached to a Sandhill Crane.

- Label suspect objects so they are easily identified. Contact the Museums Association of Saskatchewan for techniques appropriate for museum collections.
- Do not attempt to clean suspect objects without first talking with a knowledgeable conservator and an Occupational Health and Safety (OHS) professional. Safe cleaning involves special equipment, specific procedures, and set up.
- Do not sweep or vacuum within 60 cm of suspect objects – this could make residual pesticides airborne and therefore breathable.
- Clean the immediate area (typically 60 cm around the object would be appropriate, or any surface that you may be resting hands/arms) around suspect objects using wet methods. Wear a lab coat, nitrile gloves, and at least an N-95 mask while cleaning. Wash cloths and mops, separately, afterwards.

Storage and display of suspect collections

- Keep objects that are on display out of public reach and keep them away from fans and air vents that might disturb their surfaces and make residues airborne.
- Consider building a case for display objects. This will help keep them clean, and could also help keep them pest-free too. Contact the Museums Association of Saskatchewan for more information about museum quality cases.
- Suspect objects could be bagged in clear polyethylene plastic, but talk to the Museums Association of

Saskatchewan before proceeding. Under certain circumstances, bagging can lead to mould, or otherwise damage the object.

Disposal of suspect objects may require special arrangements for hazardous materials. Contact the Saskatchewan Government Occupational Hygiene Unit for guidance.

While pesticide residues command respect, handled properly, contaminated collections can be safely stored and exhibited.

By Alyssa Becker- Burns and Timothy Greening, March 2016.

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More Information

Pesticides in Museum Collections

National Park Service Conserve O Grams
http://www.nps.gov/museum/publications/consveogram/cons_toc.html

Hawks, C. (Ed.). (2010). Health and Safety for Museum Professionals. New York, NY: Society for the Preservation of Natural History Collections.

Links to Agency for Toxic Substances and Disease Registry pages for Toxicity of Arsenic, Mercury and Lead

Arsenic
<http://www.atsdr.cdc.gov/substances/toxsubstance.asp?toxid=3>

Mercury
<http://www.atsdr.cdc.gov/substances/toxsubstance.asp?toxid=24>

Lead
<http://www.atsdr.cdc.gov/substances/toxsubstance.asp?toxid=22>

Health Canada Reference on Lead

<http://www.hc-sc.gc.ca/ewh-semt/contaminants/lead-plomb/index-eng.php>

Handling Taxidermy

Care of Mounted Specimens and Pelts – Canadian Conservation Institute (CCI)
 Notes 8/3
<http://canada.pch.gc.ca/eng/1439925170320>

Donning and Removing Personal Protective Equipment (PPE)

Centers for Disease Control and Prevention PPE Poster

<http://www.cdc.gov/HAI/pdfs/ppe/ppeposter148.pdf>

Contacts

Government of Saskatchewan

Occupational Health and Safety Division

www.saskatchewan.ca/work

T | 306-787-4496

F | 306-787-2208

Royal Saskatchewan Museum

Conservation

E | info@royalsaskmuseum.ca

T | 306-787-2667

F | 306-787-2645

Canadian Conservation Institute

<http://canada.pch.gc.ca/eng/1454704828075>

T | 613-998-3721

T | 1-866-998-3721 (toll-free)

F | 613-998-4721

TTY | 819-997-3123

Museums Association of Saskatchewan

<http://saskmuseums.org/>

E | mas@saskmuseums.org

T | (306) 780-9279

T | 1-866-568-7386 (toll-free in Saskatchewan)

F | (306) 780-9463

ii Sirois, P. J., Poulin J., & Stone, T. (2010). Detecting pesticide residues on museum objects in Canadian collections – a summary of surveys spanning a twenty-year period. *Collection Forum* 24 (1-2), 28-45.

iii Hawks, C.A. and S.L. Williams.(1986). Arsenic in natural history collections. *Leather Conservation News* 2,1-4.

iv Babin, A., Hinkamp, D., Makos, K, McCann, M., & Pool, M. (2010). Chemical Hazards. In C. Hawks (Ed.), *Health and Safety for Museum Professionals*. (pp. 227-349). New York: Society for the Preservation of Natural History Collections.

v Knapp, A. (2000). Arsenic Health and Safety Update. *National Park Service Conserv-o-Gram* 2(3). Retrieved from <http://www.nps.gov/museum/publications/conservoogram/02-03.pdf>

vi Sirois, P. J. (2001). Analysis of objects for arsenic and mercury. *Collection Forum* 16 (1-2), 65-75.

vii Goldberg, L. (1996). A history of pest control measures in the anthropology collections, National Museum of Natural History, Smithsonian Institution. *Journal of the American Institution for Conservation* 35 (1), 23-43.

References

i Agency for Toxic Substances and Disease Registry (2014, May 23). *ASTDR Toxic Substances Portal*. Retrieved from <http://www.atsdr.cdc.gov/substances/index.asp>