Safe Access: Exposure Assessment of Residual Legacy Pesticides on Anthropology Collections

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AIHA-WCG-SI Professional Development Seminar
November 8, 2016

Anchorage Loan Conservation Project

- Nat Museum of Natural History ~400 Alaskan Native artifacts, loaned to Anchorage Museum at Rasmuson Center.
- 2007-2010 collaboration: conservators, curators and Alaskan Native Communities.
- Innovative floor-to-ceiling glass display cases now house the objects of these Native communities, many of which have returned to Alaska for the first time since they were collected, some over 125 years ago

Living Our Cultures, Sharing Our Heritage: The First Peoples of Alaska. (exhibit May 2010).

Credit: Chuck Choa, Smithsonian

Anchorage Loan Conservation Project

A combination of case design features, specialized staff training, and a Cultural Resource Room for receiving objects enable them to be made available for hands-on examination and dialogue by elders, artists, and scholars. These innovations make the exhibit a model for continued dialogue between community members and museum professionals.

Photos by Wayde Carroll.

Alaska Native artists Elaine Kingeekuk and Mary Tunuchuk at the 2014 Sewing Gut residency at the Anchorage Museum/ NMNH Arctic Studies Center.

This three year project was opportunity to monitor for potential heath risks for those in contact with collections from past pesticide applications and inherent hazardous components. Past Pesticide treatments were generally documented in archival records.

Nelson's Alaska collection is in the process of being poisoned.
1882 Curatorial Annual Reports

Arsenic, camphor, fumigating tobacco, and mercuric chloride was purchased for the "further care and preservation of specimens brought home by the U.S. Exploring Expedition"
John Varden, Curator, 1843-1865

1 pt. saturated solution of arsenic acid and alcohol, 25 drops strong carbolic acid, 20 grains strychnine, 1 qt. strong alcohol, and 1 pt. naphtha.
"most satisfactory for poisoning nearly every kind of specimen"
W.A.M. Hough 1889:553

Poison Tags

Tags attached to objects also indicated early applications of pesticides

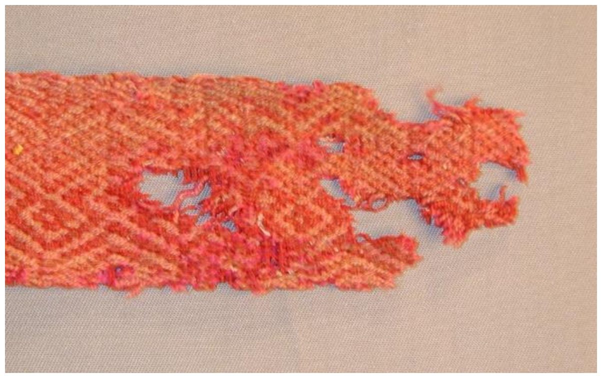
T. W. Sweeny, preparator of the department of ethnology, is detailed to do the poisonings. Collections are sent to a "poisoning room" in the Castle. 1884 Curatorial Reports

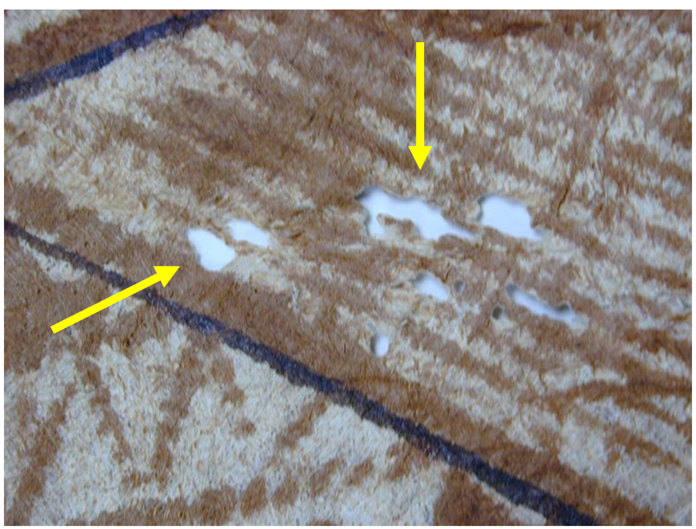
Historic Record of NMNH Pest Control Measures researched by Lisa Goldberg include:

- Inorganic arsenic compounds, mercuric chloride
- DDT, sulphur, strychnine, camphor
- Naphthalene, p-dichlorobenzene, ethylene oxide, dimethyl formamide, sulfuryl fluoride (Vikane)
- Phenol, pentachlorophenol, ethylene dichloride/carbon tetrachloride (Dowfume), ethylene dibromide, methyl bromide, carbon disulphide
- Dichlorvos (DDVP or vapona strips)

Goldberg, L. 1996. A history of pest control measures in the anthropology collections, National Museum of Natural History, Smithsonian Institution. JAIC 35 (1996):74-75
http://cool.conservation-us.org/coolaic/jaic/articles/jaic35-01-003_2.html

Applying pesticides was a well intentioned reaction to significant loss of objects and associated documentation to museum pests.





NMNH Statement on Pesticide Treatments

National Museum of Natural History
Statement on Pesticide Treatments

Beginning in the late 1800s, many organic objects in the anthropological collections of the National Museum of Natural History (NMNH) were treated with a wide variety of pesticide chemicals, including arsenic, mercuric chloride, strychnine, DDT, ethylene dichloride, methyl bromide, ethylene oxide, sulfuryl flouride, and others. Collectors often subjected these objects to pesticide treatments at the time of acquisition. Subsequently, upon their transfer to museums, these objects were treated with chemicals by museum staff as a routine and accepted method of preventing infestation by harmful insects on susceptible objects such as basketry, feathers, textiles, leather or other animal hide. Because the treatments were customary, no records were kept as to what treatments were applied to specific objects. As a result, the museum does not know the pesticide history for each object.

In recent decades, the harmful effects of highly poisonous pesticide chemicals on humans became better known. Therefore, the NMNH and other museums have discontinued their widespread use. However, many of the pesticides that were used on the objects leave behind *known* residual contaminants that are poisonous and possibly carcinogenic. In addition, there may also be *unknown* chemical interactions with pesticides that produce poisonous contaminants depending on the materials used to make museum objects, and the ways in which the objects have been used, cared for, conserved, preserved, or otherwise handled. When people come into contact with these objects, the chemicals can be inhaled, swallowed, or absorbed through the skin, depending upon the nature of the bodily contact. Researchers, tribal representatives, and others should be aware that the long-term health effects from continued close contact with these pesticide chemicals are simply not know at this time.

Within the museum community, analytical techniques are currently being explored to test for the presence of pesticide chemicals. So far, surface testing of objects has identified the presence of arsenic and mercury in areas on many ethnographic objects in a number of museums, including the NMNH. It is important to understand, however, that how and where samples are taken on an object can affect test results. Spot testing only reveals the presence or absence of a pesticide in a specific spot; a negative test result in one spot does not necessarily mean the whole object is free from pesticide contamination. Testing for chemicals other than arsenic and mercury has not been actively pursued. Such testing is complicated and remains inconclusive. Furthermore, it has not been determined how specific levels of pesticide contamination are related to health risks. Nor does information exist to determine the effect of body heat and perspiration on pesticide-treated objects when they are in intimate body contact, or the effect of hazardous dusts that may be released from handling, wearing, or using flexible materials such as skins, feathers, and fabrics.

For these reasons, all NMNH ethnographic objects that are encountered during consultation and/or repatriation must be regarded as hazardous and must be handled with caution using standard techniques for the handling of potentially hazardous materials.

These precautions include:

- The wearing of disposable latex gloves at all times while handling the objects. Gloves should be used only one time and then discarded.
- Exposed skin should be washed with soap and water after contact. Hands should also be washed with soap and water after the gloves have been removed.
- Objects should not be tried on or worn in any way.
- Children, persons with weakened immune systems, pregnant women, and the elderly should not handle objects.
- Objects should be stored in a secure area or container separated from eating utensils, food supplies, clothing, or other items which may be ingested or worn.

If objects are to be interred in the process of repatriation, the precautions described above should be followed.

For more information on the chemicals involved, precautions, and remediation, please see the bibliography provided:

Bibliography

Goldberg, L.
1996 "A History of Pest Control Measures in the Anthropology Collections, National Museum of Natural History, Smithsonian Institution." *Journal of the American Institute for Conservation* 35: 23-43.

Hawks, C. A. and K. A. Makos
2000 "Inherent and Acquired Hazards in Museum Objects." *Cultural Resource Management* 23(5): 31-37.

Johnson, J.
1999 "Masked Hazard." *Common Ground*, Fall: 26-31.

Odegaard, N.
2000 "Collections Conservation: Some Current Issues and Trends." *Cultural Resource Management* 23(5):38-41.

Webster, L.
1990 "Altered States: Documenting Changes in Anthropology Research Collections." *Curator* 33(2):146-151.

http://anthropology.si.edu/cm/NMNH_Potential_Hazards_Disclosure_Statement_2010.pdf

Use of Portable XRF to determine presence of heavy metals and to try to understand its source as inherent or applied is an established protocol in the Department of Anthropology

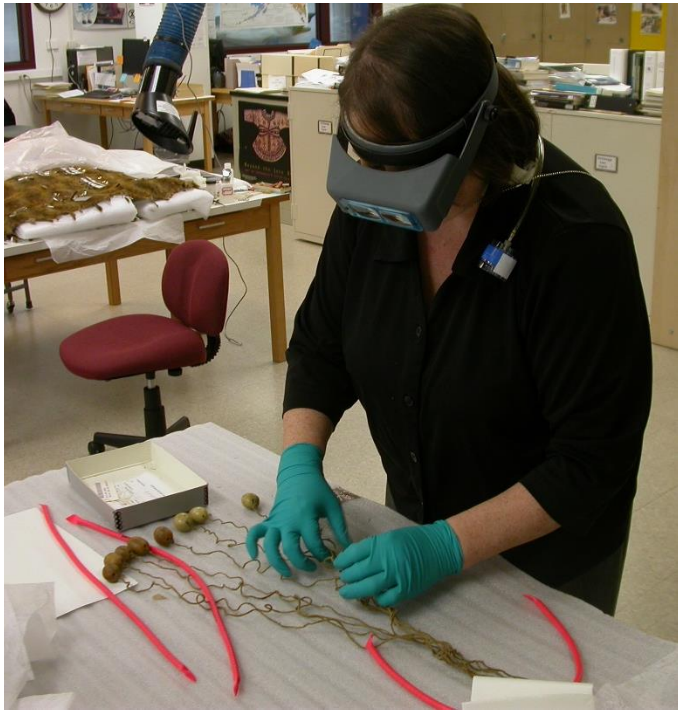
- Inherent (beads, pigments, dyes or minerals).
- Acquired (past heavy metal + OC pesticides, preservatives, cons. treatments).
- Records: Hg most commonly applied.

Eric Hollinger, NMNH Repatriation Office

NMNH Anthropology + SI OSHEM Anchorage Project Health Study Objectives (2007-2010)

A long-term opportunity to adequately sample and assess the risk both for staff at NMNH and source communities and staff at the Anchorage Museum, by:

- Identifying hazardous agents present on or within.
- Determining staff exposure levels from these agents while conducting typical tasks.
- Against the results, evaluating effectiveness of Department existing safe work practices.
- Providing hazard information data to loan recipients.



Sampling strategy

- As, Pb, Hg (particulate & vapor).
- Inhalation/BZ + biological monitoring.
- Verification via dermal/glove wipes.
- One similar exposure group to account for high intra-worker variability, task frequency, duration.
- Random sampling over course of study.
- Calculated full shift 8-hr TWA samples.

Tasks typical of major loan preparation

- Conservation:
  - treatments
  - damage/deterioration mitigation
  - object handling
- Collections management:
  - case access
  - object retrieval/handling
  - XRF measurements
  - documentation/photography/cataloguing for exhibit
- Mount making & object handling

Occupational Exposure Sampling

82 Airborne/Breathing Zone samples

As & Pb particulate: 0.8 u MCEF filters, NIOSH 7901M/7082.
Hg particulate: 0.8 u MCEF, OSHA ID 145 CVAA.
Hg vapor: SKC Carulite sorbent tubes, NIOSH 6009 CVAA.

20 Dermal/skin Wipe Samples

Ghostwipes, analysis as above.

31 Biological Samples

Inorganic Arsenic-in-urine; Inorganic Hg-in-urine; per ACGIH BEI-established protocols.

Inhalation Exposure Data

	Inorganic As	Inorganic Pb	Elem/Inorganic Hg	
N	**12**	9	**61**	
< LOQ	10	6	51	
Detects	2	3	3 (vapor)	7 (partic)
µg/M3	**0.036, 0.051**	**0.050, 0.10, 0.36**	**2.12, 3.45,3.51**	**(Range) 0.03-0.21**
ACGIH TLV	**10.0 µg/M3**	**50.0 µg/M3**	**25.0 µg/M3**	
OSHA PEL	**10.0 µg/M3**	**50.0 µg/M3**	**100.0 µg/M3**	
OSHA AL	**5.0 µg/M3**	**30.0 µg/M3**		

TLV=Threshold Limit Value, 8-hr Time Weighted Average
PEL=Permissible Exposure Limit, 8-hr Time Weighted Average
AL=Action Level, 8-hr Time Weighted Average

Discussion

- Inorganic Arsenic and Lead particulate samples:
  - non-detects or significantly below (< 10%) current Occupational Exposure Levels.

- Inorganic Hg:
  - Most non-detects or significantly below conservative OEL.
  - 4 < 25% of OEL.
  - Statistical analysis needed: 61 Hg 8-hr TWA samples.

- Kaplan Meyer Product Limit Estimate indicates with 95% confidence, that fewer than 4.8% of any Hg exposures in similar tasks might exceed largest detectable number of 3.51 μg/M3.

Results: Dermal / Glove Wipes

- 20 sets of wipe samples (30 sec; NIOSH)
  - on clean hands pre-task
  - on gloves prior to removal
  - then on skin immediately after glove removal

- As, Pb, Hg detected on 19 glove sets.
- Metals detected on 7 post-glove wipes (hands, forearms, face or neck).

Data confirm hazard presence + suggest added risk via ingestion/inhalation.

Results: Biological Monitoring

- N = 31
- As-in-urine and Hg-in-urine within clinically normal ranges, and
- Did not exceed the respective ACGIH Biological Exposure Indices established for these metals.

Data (normal biological dose) suggest total exposure through all routes of entry was minimized.

Smithsonian Safety Directives

- *Smithsonian Safety Manual*

http://www.sifacilities.si.edu/safety_health/Safety_manual/safety_manual_toc.asp

- *Ch. 24 "Collections-Based Hazards*:

"The safety of collections and the persons handling them is part of an overall collections management policy. Ensuring that collection access is not restricted due to unsafe conditions is a facility safety and collection care joint responsibility."

- Incorporated into Dept. of Anthropology Lab Safety Plans; hazard communication for staff, visiting researchers, on shipping/receiving paperwork.

Local ventilation, Hazard removal, Dust suppression

- When treating, conserving, examining, transporting object/specimens w/residual.
- Lab hoods; slot, downdraft, trunk capture hoods.
- HEPA vacuums for removing toxic particulates, insect eggs, detritus.
- Closed containers, archival sheeting/bags for short-distance transport.

Storage + Work Area Contaminant Control

- Prevent cross-contamination: Store contaminated collections in separate cabinets than non-hazardous items.

- Dedicate a HEPA vacuums for storage and work areas.

- Always decontaminate storage units prior to re-use.
  - HEPA-vacuum or wet methods for particulates; solvent cleaners for organic liquids).

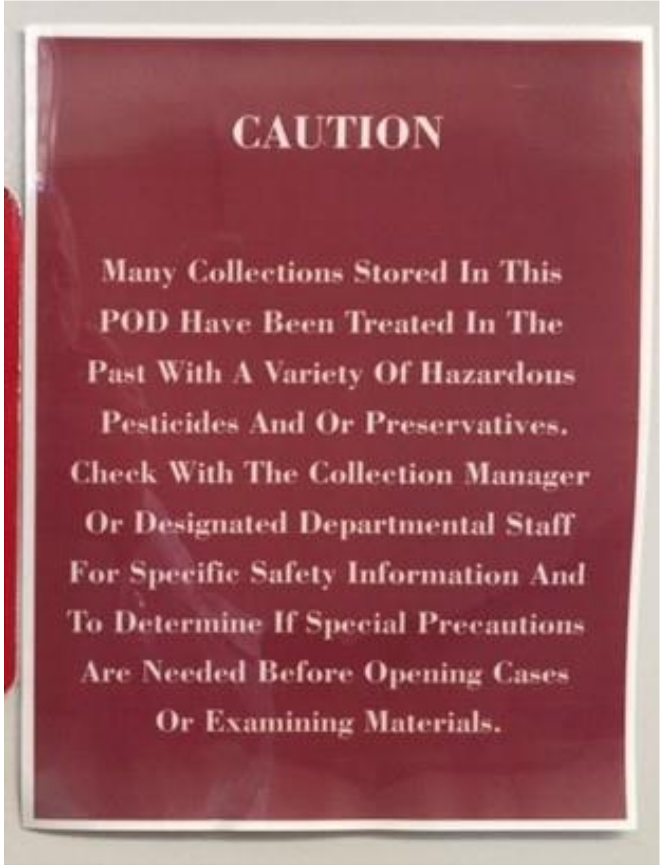
- Water-trap vacuum cleaners discouraged: effluent may be regulated waste, cannot be disposed down the sewer.

- Break & food storage areas segregated from work, storage
- Periodic HEPA/wet wiping of break tables, telephones.

Personal Protection

- Respirators based on employee exposure monitoring.
- Disposable exam gloves (vinyl or nitrile) when handling contaminated collections, storage cases, work surfaces.
- Available to visiting researchers throughout study/storage areas.
- Frequent glove change (remove inside out) before breaks or phone.
- Mid-arm gloves/lab coats worn during rigorous handling, retrieval, moving over-sized objects.
- Frequent washing, exposed skin, eyeglasses.

Collections-based Hazard Communication



- Included in GHS/Lab Safety Training.
- Object/shelf labelling + storage area signage; access restrictions.
- Fact sheets, gloves, for visiting researchers, interns.
- Disclosure fact sheets on line and on site for short-term visiting researchers.
- Accession/catalogue records, collection information system.

Hazard Disclosure in Shipping and Receiving

- SHIPPING DOCUMENTATION for loans, deaccessions with known/suspect hazardous materials or preservative fluids.
- RECEIVING DOCUMENTATION in loan or acquisition paper work on past pesticide or customs fumigations to prevent or prepare for receipt of a potentially toxic shipping crate and/or object.
- Supervisors must communicate hazards and precautions to their staff prior to arrival of the item.

<u>Special training for Registrars responsible for shipping</u>

- Department of Transportation Hazardous Materials Transport
- International Air Transport Association Dangerous Goods Training

Hazardous Waste

- Concentrated contaminated waste assumed as Hazardous Waste
  - HEPA vacuum bags & filters

- TCLP for miscellaneous work materials
  - contaminated gloves
  - interleaving papers
  - swabs or other conservation materials
  - potentially contaminated storage materials and drawers

TCLP: Toxicity Characteristic Leaching Procedure

Listed Metal Waste	Bulk sample of gloves from week-long conservation work	Bulk composite sample of waste materials associated with work on objects (e.g., gloves, blotters, application tips, sheeting and acid-free paper)	Regulatory Level (mg/L) USEPA 40 CFR 261.24 Table 1
	Results (milligrams per liter, mg/L)		
Arsenic	< RL of 0.500	< RL of 0.500	5.0
Barium	< RL of 10.0	< RL of 10.0	100
Cadmium	< RL of 0.100	< RL of 0.100	1.0
Chromium	< RL of 0.500	< RL of 0.500	5.0
Lead	< RL of 0.500	< RL of 0.500	5.0
Mercury	0.00263	< RL of 0.00200	0.2
Selenium	< RL of 0.100	< RL of 0.100	1.0
Silver	< RL of 0.500	< RL of 0.500	5.0

Conclusion

- Health risk from hazardous materials present in collections care tasks was controlled to within occupational exposure limits.
- Assessment suggests the effectiveness of Department-established safe work practices.

Grateful appreciation to

Greta Hansen

(Ret) Conservation Manager

Anthropology Conservation Laboratory

Museum Support Center

National Museum of Natural History

Suitland MD; Washington DC

Iňupiag artist Sylvester Ayek interprets pieces bound for Smithsonian Arctic Studies Center

Photo credit : Smithsonian Institution, published Washington Post May 9, 2010