

# Pesticide Contamination of Cultural Heritage Collections and Potential Human Health Risks

## An Introduction



Nancy Odegaard, PhD, FAIC  
Conservator Professor Emerita  
Arizona State Museum – University of  
Arizona

*The University of Arizona respectfully acknowledges the land and territories of Indigenous peoples. Today, Arizona is home to 22 federally recognized tribes, with Tucson being home to the O'odham and the Yaqui. Committed to diversity and inclusion, the University strives to build sustainable relationships with sovereign Native Nations and Indigenous communities through education offerings, partnerships, and community service.*

Connecting to  
Collections Care



foundation  
for advancement  
in conservation

**Protecting Cultural  
Heritage**

# MUSEUM OBJECTS TRANSFERRED TO NON-MUSEUM SETTINGS MAY BE CONTAMINATED WITH PESTICIDE RESIDUES

- **1. This is due to a lack of awareness because:**
  - Museum staff don't know how their collections were treated in the past
  - Museum staff are unaware of potential human health dangers from pesticides
  - Museum records and item histories are poor, non-existent, or not researched
  - Tribal representatives do not ask questions about pesticide residues or potential human health hazards
- **2. Research and testing have not been done by the museum due to:**
  - Inexperience or lack of equipment or supplies
  - Limited knowledge of the handling and disposal of toxins
  - An incomplete awareness of the toxicological properties of pesticide residues
- **3. Conflicting values and priorities**
  - By museums
  - By tribes

## Q: Why were pesticides used?

## A: To Prevent Biodeterioration

Biodeterioration is the process that involves the combination of:

- An organism (the **PEST**) especially Insects, Fungi, Rodents
- A food source (the **MUSEUM OBJECT**)
- A suitable environment (a **QUIET, DARK, COMFORTABLE PLACE**)



Insects of concern usually like materials such as Proteins: hair, fur, horn, quill, baleen, hoof, claw, feather, hide glues



Insects of concern also like materials such as Cellulose and Starch as in paper, sizing, pastes



An unprotected Object often becomes visibly infested



An unprotected object with no signs of infestation probably has been poisoned

Museums were built to collect and preserve cultural collections in perpetuity. Environmental concerns for environmental pesticide were raised in the 1960s. In the 1980s museum conservators became concerned with how pesticide treatments were altering the appearance of items, so some began compiling pesticide information files. In the 1990s human health risks became better known and Industrial Hygienists were consulted.

Archaeological repositories that offered curation for federally owned collections followed the The Code of Federal Regulations - CFR 36 part 79 requires that collections shall be cared for, maintained, and made accessible by professionals. This included the use of pesticides treatments.

Prior to NAGPRA most collectors and museums never considered that items would be returned to their communities. NAGPRA Section 10.10(e) required repositories to inform repatriation recipients of any presently known treatments including pesticides, preservatives, or other substances that represent a potential hazard to the object or to the person handling the objects.

In 2000 Alyce Sadongie and I testified that determining the hazard to NAGPRA objects or to persons handling potentially contaminated objects involves medical implications and these determinations cannot be made without testing and sampling. Sampling is a form of analysis and under the NAGPRA law it requires a tribal consultation, informed consent, and direct involvement by tribes in the process. The new Regulation revisions in 2024 include penalties.

## PESTICIDES CAN BE PLACED INTO CATEGORIES

- Contact or Dermal poisons penetrate the cuticle or body wall of the insect.
- Desiccants absorb part of the outer coating of the insect, causing dehydration.
- Stomach poisons enter the body by chewing.
- Fumigants are inhalation poisons that enter the insect's body wall or respiratory openings.
- Residuals are poisons that require a period of time to react.
- Persistent poisons are slow to break down, accumulate in the body, and remain.



## Era of Use

### Metals

Arsenic compounds 1700's - 1970's

Mercury compounds 1880's - 1940's

### Organophosphates & Organochlorines

Chlordane 1940's - Banned 1988

Chloropicrin 1920's - 1960's

Dichlorvos 1960's - 1980's

DDT 1940's - Banned 1972

Dieldrin 1950's - Banned 1987

Lindane 1940's - Banned 1988

### Volatile Fumes

Carbon disulfide 1880's - 1950's

Cyanide 1920's - Present (Limited use)

Ethylene oxide 1960's - Present

Methyl bromide 1960's - Banned 2001

Naphthalene 1880's - Present

Paradichlorobenzene 1940's - Present

Sulfuryl fluoride 1960's - 1980's

## COMMON PESTICIDE CATEGORIES

<i>Pesticide Group</i>	<i>Poisoning route of entry</i>			<i>Toxicity</i>	<i>Persistence</i>
	<i>Inhalation</i>	<i>Ingestion</i>	<i>Skin Absorption</i>		
Pyrethrins/Pyrethroids	x	x	x	slight	low-moderate
Organophosphates	x	x	varies	moderate to high	low
Carbamates	x	x	x	moderate	low-moderate
Fumigants	x	x	x	high at application	low-moderate
Organochlorines	x	x	x	moderate to high	high
Toxic metals	x	x	x	high	very high



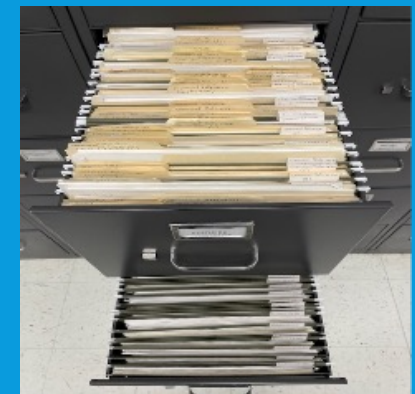
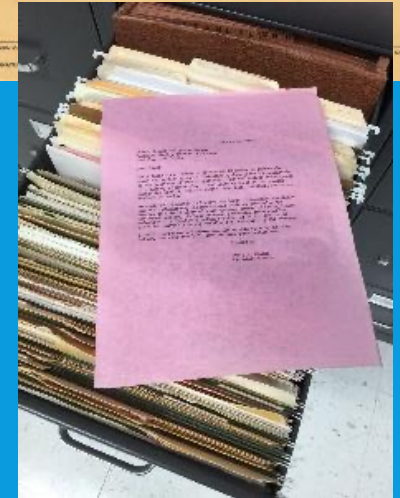
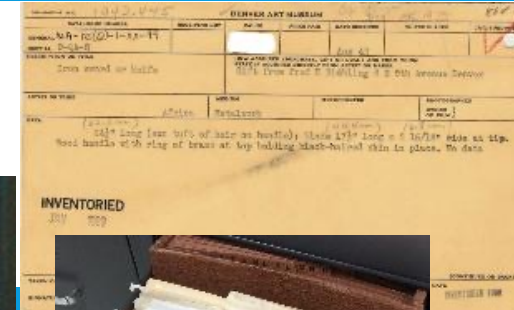
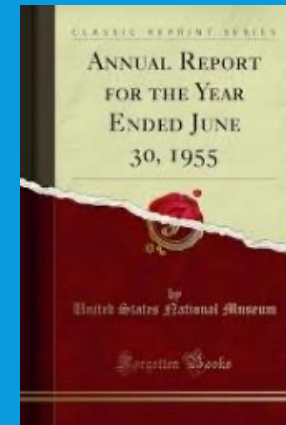
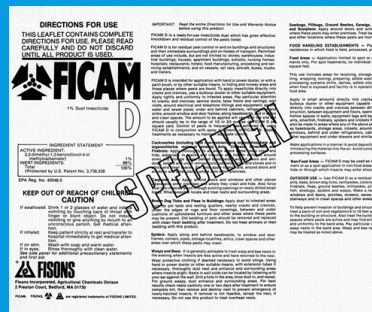
# COMPILE A HISTORY OF MUSEUM PESTICIDE USE

## Internal Information:

- Catalog cards, treatment reports, loan records
- Receipts and purchase orders for pesticides
- Contracts with extermination companies
- Published archaeological field notes
- Correspondence/ logbooks by staff members
- Annual reports done by the museum

## Information through interviews:

- With long-term and retired staff
- With pest control operators or extermination companies



## EVIDENCE ON THE COLLECTION

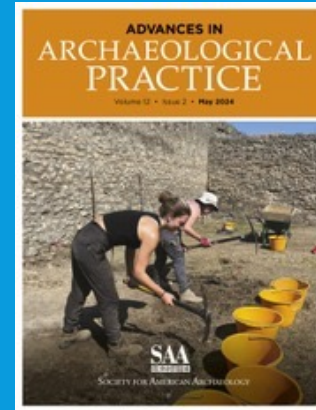
- Tags, labels, or marks on specimens
- Powder or crystalline residues on or around artifacts
- Persistent odors
- Old containers/ bags used to hold pesticides
- Old pesticide application equipment
- Old stocks of chemicals/pesticide products
- Old labels or copies of labels from pesticides



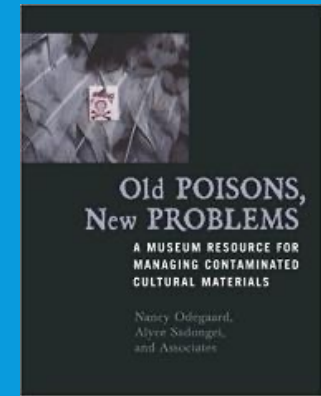
Old container labels - Old pesticide products - Old product instruction - Old containers or bags

## EXTERNAL INFORMATION

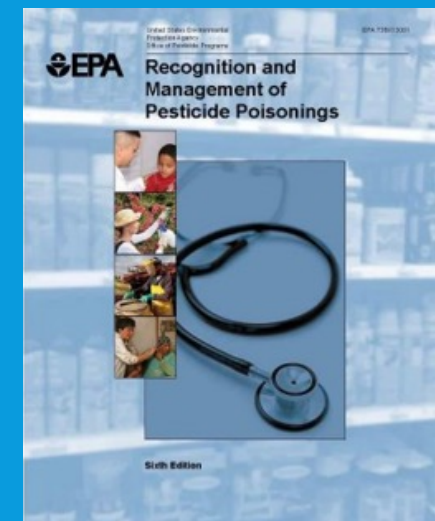
- Early pest control handbooks
- Professional pest control trade magazines
- Conservation literature
- Entomology literature
- Taxidermy manuals
- General museum literature - *Old Poisons, New Problems*
- Archaeological literature –*Advances in Archaeological Practice*
- Websites of medical toxicological databases – *EPA book*
- Websites and university agricultural department databases



[Advances in Archaeological Practice, Volume 7, Special issue 3: Archaeological Collections Care: Current Topics and Innovative Trends in the Repository, August 2019, online](#)  
Pesticide Contamination



2<sup>nd</sup> Edition coming in 2025



<https://www.epa.gov/pesticide-worker-safety/recognition-and-management-pesticide-poisonings>

**MuseumPests.net**  
<https://museumpests.net/>

**NEW SEARCHABLE DATABASE**

<https://museumpests.net/resources-2/pesticide-database/>

## PESTICIDE EXPOSURE MAY LEAD TO ADVERSE HEALTH CONDITIONS

An **exposure** is defined as taking a toxic substance into the body through:

Inhalation enters through breathing (dusts and fumes)

Ingestion enters through eating or drinking

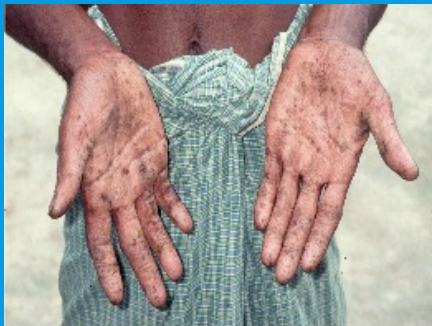
(can be a problem with items worn on the face/head or from containers during ceremonies)

Absorption enters through the skin (can be a problem when handling or if wearing items)

Exposure can also occur from:

- Items that were treated or have been cross contaminated by contact with other items
- Contaminants that are present in the storage area
- Using treated items through handling or as vessels for food or beverage

**Toxic metal pesticides are persistent and the most medically hazardous pesticides**



Arsenic



Mercury

### Human Health Hazards



Lead



Copper



Chrome

# GENERAL INFORMATION ABOUT SAFE HANDLING

## • Prevention of exposure depends on:

- Recognition and Risk assessment
  - Identification of the hazard(s)
  - Identification of people at risk
  - Evaluation of the extent of the risks taking past history into account
  - Evaluation of existing control measures
  - Determine the risk rating (severity of injury X likelihood of danger)
  - Recording of findings
  - Informing affected parties
  - Monitoring and evaluation



# RECOMMENDATIONS FOR HANDLING CONTAMINATED COLLECTIONS

1. Unless you can confirm that an object is safe, handle all museum objects as though they were treated with a toxic compound. This means that until confirmed, it is NOT advisable to:
  - Place objects in open or non-enclosed exhibit cases
  - Utilize objects in hands-on interpretation programs
  - Wear or perform objects
  - Place objects near food or other consumables
2. Examine potentially contaminated objects in a well-ventilated working environment. It may be advisable to USE a fume hood and to AVOID small rooms or closets that are not well ventilated.





## Handling Contaminated Collections

3. Handle contaminated objects as little as possible. Try to use their stands, mounts, or storage containers.
4. Ask about the use personal protective equipment. It is advisable to consider the following:
  - Disposable gloves (such as powder- free nitrile)
  - Disposable N-95 series particle respirator mask
  - Protective apron, smock, or lab coat
  - Goggles

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## Handling Contaminated Collections



5. Always dispose or care for protective equipment properly after working with objects. Do not reuse disposable items. ALWAYS wash hands that have handled objects, especially before eating and drinking.

6. Report and document any health irregularities that occur after examining, handling, or using contaminated objects.

# PPE: PERSONAL PROTECTIVE EQUIPMENT FOR HANDLING TOXIC ITEMS

GLOVES



Remove them without skin contact, dispose, and do not use again

PROTECTIVE GARMENTS



Launder separately from personal clothing

N-95 RESPIRATORS



Only for particles, not fumes

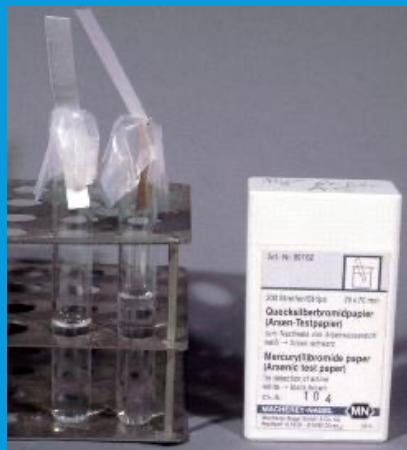
Dispose in regular trash in most cases

GOGGLES

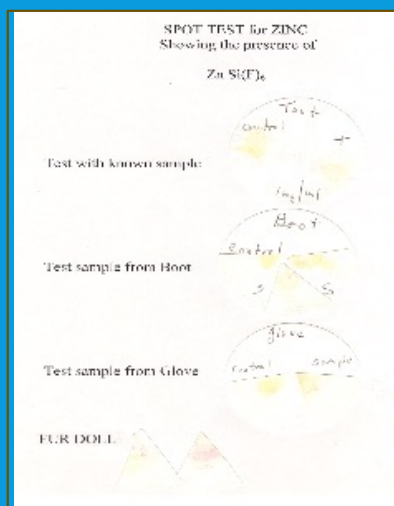


Wash thoroughly in warm water, rinse in fresh water, then clean with disinfectant wipes

## Recommendations for using Spot Tests to determine the presence of pesticides



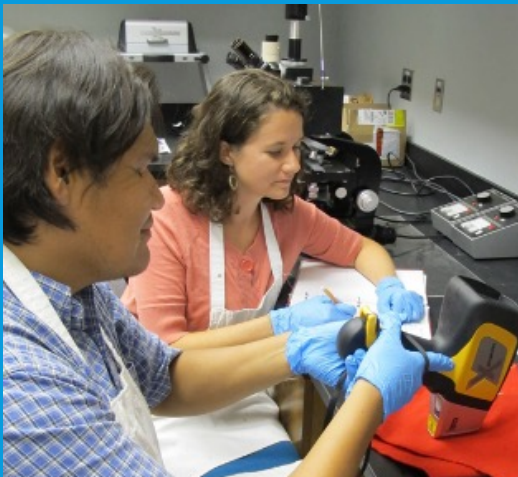
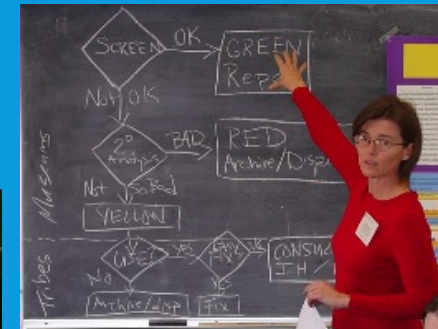
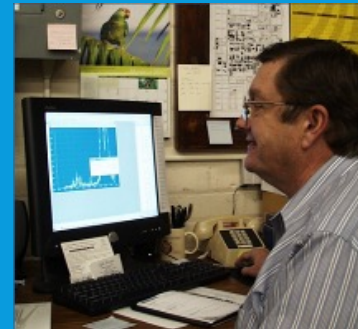
Spot test: arsenic



Spot test worksheet for Zinc

- Wear appropriate personal protective equipment -PPE
- Read test kit or test paper instructions prior to running the test
- Use fresh reagent solutions
- Hold test papers with tweezers
- Work in well-ventilated areas
- Test samples along with known positive and negative controls
- Make written notes of procedures used and results observed
- Prepare for proper disposal of test reagents and test material
- Maintain safety data sheets – SDS - for all chemicals

# Recommendations for using pXRF testing of toxic metal residues



## Best Practices:

- Provide safety training for instrument use
- Use calibration samples
- Develop and use of testing protocols
- Interpret the instrument spectra and data
- Develop a medical risk calibration program
- Develop containment strategies
- Complete and deliver helpful reports

### Arsenic:

RED= ≥ 5 mg  
YELLOW= 2-5 mg  
GREEN= none detected

### Lead:

RED= ≥ 100 mg  
YELLOW= 10 – 100 mg  
GREEN= <10 mg

### Mercury:

RED= ≥10 mg  
YELLOW= 1-10 mg  
GREEN= <1 mg

## BE PREPARED

- Develop clear labeling and handling procedures
- Practice good personal hygiene
- Wear appropriate Personal Protective Equipment - PPE
- Maintain SDS sheets on known pesticides
- Dispose of hazardous materials properly
- Seek professional advice and training

American Industrial Hygiene Association

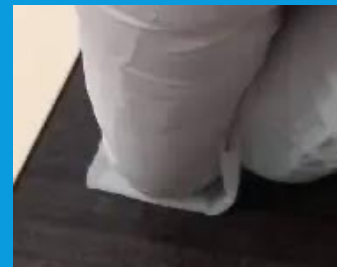
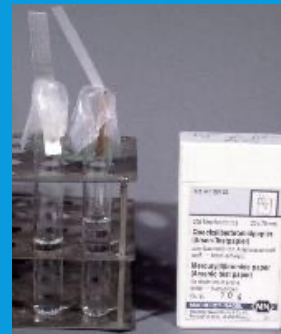


American Association of  
Poison Control Centers



# Collaborate

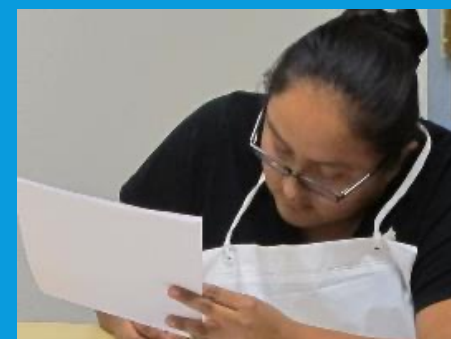
- Work as a team
- Select an appropriate testing program
- Investigate the human health hazard for the situation
- Consider options for mitigation (reduction), remediation (reversal), or removal
- Enforce regulations to limit individual and environmental exposures with PPE



# REMOVAL OF PESTICIDE RESIDUES FROM COLLECTIONS

Several actions must proceed any removal effort involving pesticides:

- Coordinate a team of specialists including tribal members, conservators, chemists, toxicologists and other stakeholders to consider and evaluate potential methods of testing and decontamination as they relate to a range of issues.
- Determine a probable pesticide presence through documentation or screening tests.
- Identify chemicals through qualitative and quantitative analytical techniques.
- Assess the potential human health risk through toxicological evaluation.



Thank you