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POISONOUS HERITAGE: PESTICIDES IN MUSEUM COLLECTIONS

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by

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Abstract

The use of pesticides in museums began in the eighteenth century and continued until about fifty years ago. Indeed, there is evidence that some institutions were using substances like arsenic as late as the 1960s. Today, though most museum professionals are aware of the danger of these toxins, not all institutions are properly equipped or have procedures in place to ensure the safety of their staff, interns, volunteers, or whoever else may come into contact with these objects. Additionally, objects contaminated with pesticides have been returned to Native American tribes in the wake of the Native American Grave Protection and Repatriation Act. This raises concerns about the risks posed to human health and museums' liability in the event of sickness resulting from pesticide residues. Museum professionals need to know what objects have been treated, and with what. To what pesticides may they be exposed? What are the health risks associated with the most persistent and troubling pesticides, those containing arsenic and mercury? Are there effective means for detecting and mitigating these toxins? How do these poisonous residues affect the fulfillment of NAGPRA? In order to shed some light on these questions, a short survey was created and distributed through the Registrar's Committee of the American Association of Museums. The survey respondents in general supported the idea that even if the institution does not have any evidence of pesticide contamination, it is good practice to treat the objects as if they were. The risks to human health posed by the formerly widespread practice of pesticide use is simply too great to ignore. Though this survey may not represent a sample with statistical significance, it does provide a basic understanding of the inconsistency of museum practices across the board.

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Introduction

A graduate student finds herself on the first day of a new internship. She has the privilege of working in one of the best-known and most prestigious natural history museums in the world. On this first day, all the new interns and volunteers are asked to attend an object-handling course, which is necessary. Not everyone, especially college students and volunteers, has the appropriate experience handling objects. Some of what is discussed during this informal class turns out to be surprising, if not a bit frightening and overwhelming. This group of students and volunteers has committed their time to this institution to learn how museum professionals protect the artifacts placed in their care, not necessarily how to protect *themselves* from these very objects.

"Of course you should always wear your gloves when handling artifacts, with the exception of a few types of objects," asserts the conservator leading the class. This is nothing new to most in the group, many of whom have worked in museums prior to this experience. The conservator continues, "This is for the safety of the objects, but more importantly, it is for your safety. Many of these objects have been in our collection for over a hundred years, and many have had a variety of pesticide treatments done to them. We mostly don't know what has and what hasn't been treated. Some of the chemicals to which you will potentially be exposed include arsenic, mercury, and lead, to name a few. Thus, you must wear gloves at all times when handling all objects and wash your hands frequently. Since we don't know what has been treated and in what manner, treat every object with suspicion."

Objects contaminated by poisonous residues are not a totally new or unusual problem for museums and the warning provided by this example is probably better than most heard by new staff, if they receive any warning at all. All museum collections that include objects containing organic materials (such as wood, leather, feathers, plant material, etc.) and that have been in the possession of a museum or collector for a significant length of time will more than likely have been contaminated by hazardous or poisonous materials and there have been cases in which individuals were unknowingly and directly exposed to pesticides found on museum objects.

Only relatively recently has the use of pesticides fallen out of favor in museums. There is some evidence that some institutions were using arsenic as late as the 1960s, but the cutoff date differs from institution to institution. It is also possible that some less scrupulous private collectors still use hazardous chemicals to protect their precious collections. In fact, poisonous residues can be found on many objects in museum collections, some plausible, others unexpected. While one would readily assume that biological specimens, such as preserved plants and animals, contain harmful compounds, one does not so readily expect them in archaeological and ethnographic material. But they, too, are often composed of organic material susceptible to pest attack.

Today, though most museum professionals are aware of the danger of these toxins, not all institutions are properly equipped or have procedures in place to ensure the safety of their staff, interns, volunteers, or whoever else may come into contact with these objects. It is the fear of this author that in small museums or small heritage sites such as historic homes, the staff may not even be aware of the issue of toxins and the fact that they are at risk.

Pesticide residues are even a greater concern when it comes to the disposal of collections. As an example, in the past the process used in taxidermy was incredibly toxic, involving the heavy use of chemicals such as arsenic. Disposal of these contaminated objects can be incredibly complicated. They are often considered hazardous materials, which fall under the control of the EPA (Environmental Protection Agency). There may be no safe and effective way to dispose of them. In addition, highly contaminated objects, such as taxidermic specimens, do not just pose a threat to those handling them. Entire displays can become contaminated with their residues. Depending on the chemical used, pesticide residues may become powder, evaporate, off-gas, or spread, often to the detriment of the surrounding objects or display materials.

Not all toxicity in museums collections stems from historic pesticide use. A collection object can pose a danger because of an inherent hazardous material. Fossils can emit radiation. Objects, although perfectly safe when created, can become dangerous over time due to decay and aging. Cellulose nitrate film, for example emits nitrogen oxide gases when breaking down. A cellulose nitrate fire releases carbon monoxide, nitrogen peroxide and other very toxic chemicals. Lead corrodes rapidly into a fine white powder that is easily inhaled, ingested, or trapped in clothing.[1] Some collection objects may have been intentionally created to be hazardous, such as arrows tips that have been dipped in poison. Moreover, many substances once considered to be safe can prove to be hazardous today, such as the asbestos used as a reinforcing fiber in modeling material.[2] In these examples, the collections objects are inherently hazardous; however, this hazard is not due to the intervention of collectors or museum staff.

Unfortunately, contaminated objects have also become the concern of groups outside the museum profession. With the passage of the Native American Graves Protection and Repatriation Act (NAGPRA), the relationship between American Indian tribes and museums was

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[1] (Hazadous Materials in Your Collection 1998)

[2] (Hawks and Makos, Inherent and Acquired Hazards in Museum Objects 2000, 31)

redefined. The law requires museums to return human remains, funerary objects, sacred objects, and objects of cultural patrimony to the tribes. In recent years, issues have arisen about the possible hazard posed by these objects for the tribes to which they are returned. The presence of pesticide residue and other chemicals on NAGPRA-related objects poses a serious threat to health. This has even led to changes in legislation. In 1996, the following section was added to the NAGPRA legislation to address this issue:

> *The museum official or Federal agency official must inform the recipients of repatriations of any presently known treatment of the human remains, funerary objects, sacred objects, or objects of cultural patrimony with pesticides, preservatives, or other substances that represent a potential hazard to the objects or person handling the objects.*[3]

However, does this small amendment to NAGPRA ultimately solve any of the issues surrounding the repatriation of toxic objects? Is it ethical to just inform a tribe that the sacred object may be contaminated and walk away from the problem? No. Objects that are reclaimed under NAGPRA are often reincorporated into religious ceremonies or reinterred in the ground. This poses a threat to not only the people handling these toxic objects, but the environment as well. The ethical responsibilities may depend on the situation and the institution involved. However, when returning a sacred object, stating an object is contaminated and walking away is simply not acceptable.

Conservators are keenly aware of the issues surrounding museum objects that have been made toxic, but there are currently very few, if any, effective techniques for eliminating the toxicity of an object. Museum professionals need to know what objects have been treated, and with what. What pesticides are they possibly being exposing themselves to? What are the health

[3] Native American Graves Protection and Repatriation Regulations, 43 CFR Part 10, Sub Part B §10.10 [e]

risks associated with the most persistent and troubling pesticides, those containing arsenic and mercury? Are there effective means for detecting and mitigating these toxins? Can these objects be disposed of? How do these poisonous residues affect the fulfillment of NAGPRA? In this paper I intend to answer these and other questions and I will discuss some practical solutions that museums have adopted to tackle the many problems related to toxicity of museum objects.

The Historic Use of Pesticides in Museums

Many museum objects are made of organic materials such as fur, feather, textile, and leather, to name a few. These materials are prone to deterioration from pests, including but not limited to mold, bacteria, rodents, and insects. To control these and other pests, the vast majority of museums today use what is called "Integrated Pest Management," which focuses on prevention rather than treatment. Integrated pest management is the combination of good housekeeping policies and the selection of appropriate treatments in the event of an infestation. A good IMP policy includes a thorough and stringent food and beverage policy with guidelines both for staff and for special events at the museum. Additionally, museums often include in their IMP policy guidelines for incoming object processing, inspection, housekeeping, monitoring, and treatment.[4] If an infestation is discovered, there are a variety of non-toxic treatments that are commonly utilized, including isolating and bagging, low temperatures/freezing, nitrogen and argon, carbon dioxide, oxygen scavengers, and heat treatments. Some pesticides and fumigants are still used, but only under the supervised care of a professional and after informed consideration of all the options available.[5]

Museums' recent understanding of the importance of pest prevention through cleanliness and appropriate environmental conditions has grown from entomological research into the habitat requirements of pest, as well as from concerns regarding the physical effects of pesticide treatments on collections.[6] Certain pesticides have been known to affect the aesthetics of objects, for example, by causing colors to fade. Current thinking about pest management

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[4] (MuseumPests.net n.d.)
[5] (MuseumPests.net n.d.)
[6] (Hawks, Historical Survey of the Sources of Contamination of Ethographic Materials in Museum Collections 2001, 5)

recognizes the negative effects of past pesticide use on personnel and collections. Nowadays, the use of many fumigants and pesticides requires specific licensing and, in the United States, registration with the Environmental Protection Agency.[7] For a while it was incredibly popular to routinely fumigate large collection in airtight chambers. Many of the chemicals used in fumigation have now been take off the market for health and environmental concerns.[8]

Until recently, the main means to prevent as well as to destroy pests were chemicals, the workings of which were not thoroughly understood. In fact, many of the chemicals used in museums and collections were considered safe to humans and were often used indiscriminately. Starting in the late 18th century and until relatively recently, the use of pesticides was perceived as the only effective means of preventing the loss of collections to various pests.[9] In 1748, a French naturalist lamented that collectors watched daily as their collections were consumed and destroyed by voracious insects.[10] Beginning in the late 1800s, many objects with organic materials were treated with a wide variety of pesticide treatments including arsenic, mercuric chloride, strychnine, DDT, ethylene dichloride, methyl bromide, ethylene oxide, sulfuryl fluoride, and numerous others. Museums were not always the ones responsible for treating objects with these chemicals. Collectors often subjected objects to pesticide treatments long before museums acquired them. Consequently, the institution in which an object currently resides may not have applied the pesticides of which residues remain. Such treatments were rarely documented and institutions may have inherited problems they may not know about.[11]

[7] (Goldberg 1996, 23)
[8] (Pool, Odegaard and Huber 2005, 12)
[9] (Hawks and Makos, Inherent and Acquired Hazards in Museum Objects 2000, 32)
[10] (Hawks and Makos, Inherent and Acquired Hazards in Museum Objects 2000, 33)
[11] (Hawks and Makos, Inherent and Acquired Hazards in Museum Objects 2000, 32)

Making matters worse, objects treated with pesticides by collectors at the time of acquisition or their collection from the field, upon transfer to museums, would often be treated again with chemicals by museum staff as a routine and accepted method of preventing infestation by harmful insects on susceptible objects. These treatments were customary and, as is often the case with routine work, no records were kept as to what treatments were applied to specific objects. As a result, many museums do not know the pesticide history for specific objects and individual objects may have a variety of pesticide residues on them.[12]

This is indeed the case at the National Museum of Natural History. Through historic documentation and word of mouth accounts, Lisa Goldberg was able to partially construct historical pesticide treatments within that institution. In the second half of the 19th and the early years of the 20th century, both field collectors and museum staff treated the National Museum's collections. Evidence collected suggests that many field collectors, such as Captain Charles Wilkes, regularly applied poisons to their anthropological and biological specimens to ensure their survival en route to the museum. Other collectors used whatever pest control measures they happened to have on hand with them. On June 18, 1893, one field collector described a field preservation technique as follows, "I have thrown tobacco among the articles and hope that it will keep until the collections can be unpacked in Washington."[13] According to the National Museum of Natural History's records, field collectors often employed a wide range of chemicals to reduce pest damage in transit. Their documentation indicates that fumigating tobacco, camphor, flour of sulphur, arsenic, and corrosive sublimate (mercuric chloride) were regularly purchased to aid in the preservation of specimens during field collecting expeditions. As with

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[12] (National Museum of Natural History n.d.)
[13] (Goldberg 1996, 28)

pesticide treatments completed in-house in museums, the care objects received while in the field was rarely documented.[14]

With the formalization of museum practices around the start of the 19th century, museums relied heavily on chemical pesticides to prevent infestations. As collection grew to include a much greater number of objects, large buildings were dedicated for the sole purpose of display. Professionals had little understanding of insect life cycles and as a consequence buildings were not designed with pest control in mind. A poorly designed building can and will serve as a habitat for scores of pests.[15] Additionally, collections tended to be enclosed in cabinets, which were often constructed of wood. These cabinets made objects not readily visible to staff and they were harbingers of pests as they were rarely sealed sufficiently to exclude pests. Conveniently for the time, however, cabinets did allow for fumigating on cabinet-by-cabinet basis.

Some museums created fumigation chambers where they could treat large numbers of incoming objects and infestations using highly toxic gasses. As a fumigant, the synthetic organic chemical naphthalene was first described in 1821 and was eventually used as a pesticide by 1889 by the Smithsonian. Naphthalene and the closely related compound paradichlorobenzene have both been used as cabinet fumigants in museums through much of the 1900s and are still actively used in some museums today.[16]

Arsenic and mercury were among the most popular materials used by natural scientists that valued the preservation of their collections. In an early Smithsonian publication, arsenic was listed as an essential supply for collections. In 1887, Dr. Walter Hugh, head curator of the

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[14] (Goldberg 1996, 28)
[15] (Hawks, Historical Survey of the Sources of Contamination of Ethographic Materials in Museum Collections 2001, 4)
[16] (Hawks, Historical Survey of the Sources of Contamination of Ethographic Materials in Museum Collections 2001, 4)

Anthropology Department described several concoctions for the preservation of anthropological specimens. One of his recipes, for what he describes as a general insecticide, is as follows: "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, crude or refined."[17] This solution was described as "most satisfactory for poisoning nearly every kind of specimen.... The use of strychnine is not absolutely necessary; but it is a very good agent and adds much to the value of the solution."[18] Later in 1940, a museum memorandum noted that specimens preserved with arsenic very rarely were the subject of new infestations.[19] They were correct that this was effective in killing nearly every possible pest, including humans.

The National Park Service compiled a history of pesticide use in their collections. The use of arsenic is first recorded in 1941. Arsenic continued to be used periodically through 1976! This record includes only what could be officially documented. It is plausible there were additional treatments for which no record exists.[20] Besides arsenic, mercury was also commonly used in pesticide formulas. In the early 1900s, objects could be either dipped in or painted with a mercuric solution. The National Museum of Natural History confirmed in its records that objects were protected by scattering crystalline mercuric chloride in the corners of closed drawers and even over some objects, such as textiles.[21] The National Park Service has also constructed a record of the use of mercuric chloride in their collections. It is first recorded in 1941 and though it seems to have fallen in and out of use over the years, it continued to be used through 1980.[22]

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[17] (Goldberg 1996, 30)
[18] (Goldberg 1996, 30)
[19] (Goldberg 1996, 30)
[20] (Chronology Of Pesticides Used On National Park Service Collections 2001)
[21] (Goldberg 1996, 31)
[22] (Chronology Of Pesticides Used On National Park Service Collections 2001) The park service has created an entire table of pesticides used over the years, including fungicides and microbiocides. The dates included represent published recommendations for the use of pesticides. It also refers to conservation treatment reports and other file

Arsenic compounds have been used as therapeutic agents since the 5th century BC, when arsenic sulfide was recommended as a treatment for ulcerated abscesses. From the 18th century and until the 19th century arsenic was prescribed for disorders, such as tuberculosis, rheumatism, and syphilis. Arsenic is mainly found in two forms: organic (when associated with carbon and hydrogen) and inorganic (combined with sulfur and chlorine), with the inorganic form being more toxic. When exposed to humid air, arsenic tarnishes into diarsenic, a very toxic powder associated with rat poison.[23]

Museum staff should not criticize the past actions of their predecessors. They did the best they could with the limited tools and knowledge of the day. Museums are the result of possibly one of the oldest instincts of mankind, collecting. It wasn't until fairly recently that long-surviving collections (those enduring for over a hundred years) of organic material could even exist and certainly pesticides have played a role in that longevity.[24] One can also reflect on the use of pesticides when it comes to repatriation decisions. Many tribes are justifiably outraged that many of their sacred objects were treated with chemicals but they don't always see that the reason there can be talk of repatriation today is that there is something to repatriate. It is no coincidence that these objects were able to survive such a test of time. It is unlikely that many of the objects that tribes wish to have repatriated would have survived in a pristine state.[25] It can also be argued, of course, that some Native American objects were not meant to be preserved but were intended to be interred or to be left to decay naturally. But that is a different matter altogether.

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notations that confirm the use of pesticides on specific objects or collections. The table may omit some of the years pesticides were used, considering some may have been used earlier, but where no records exist.

23 (Marte, Pequignot and Von Endt 2006, 144)

24 (Hawks, Historical Survey of the Sources of Contamination of Ethographic Materials in Museum Collections 2001, 2)

25 (Hawks, Historical Survey of the Sources of Contamination of Ethographic Materials in Museum Collections 2001, 8)

It is likely that museums will continue to find toxins, poisons, and hazards in structures or storage furniture that was once considered to be safe. The good news is that the conservation community has recognized this issue and is constantly evaluating and testing new materials before they are incorporated into use at museums. Maybe this way we will be able to avoid further unpleasant surprises that museum work may produce in the future.[26]

This short survey of historic pest control techniques clearly raises concerns about the risks museum objects present to human health and provides a basis for further investigations. It should be noted, however, that not all historic pesticide treatments pose a risk to workers today. Some pesticides become harmless relatively quickly, only being highly toxic during the initial application. However, arsenic and mercury based pesticides pose a major risk to human health even many years after their first application. Both have been used ubiquitously and for a long time on organic material, such as leather and feathers, in amounts that are generally capable of producing human toxicity. Also, the formulations favored by museums were particularly toxic. Once applied, arsenic and mercury tend to remain on the treated objects as they leave high levels of residues. Also of concern is the fact that in many cases the degradation of a pesticide does not lead to less toxicity but only to a different route of exposure (ex. from ingestion to inhalation) and changes the spectrum of toxicity. Exposure is difficult to detect. Often it occurs in small amounts over time, and signs of toxicity can be subtle and difficult to diagnose. Finally, arsenic and mercury are elements. They are environmentally permanent and can create contaminations in the soil, air, and groundwater.[27] This paper will generally deal with pesticides that included these two toxins in their formulations as they pose the greatest and most urgent risk to museum professionals and human health in general.

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[26] (Hawks, Historical Survey of the Sources of Contamination of Ethographic Materials in Museum Collections 2001, 7)

[27] (Boyer, et al. 2005, 75)

Upon examining the history of pesticide use in their institutions, museums can begin to take positive steps towards making the best of the legacy that was left to them.

Pests Found in Museum Collections

Why are pesticides so effective in destroying pests and why were they heavily relied upon? Biodeterioration is the process that results from the combination of an organism (the pest), a food source (a museum object), and a suitable environment (the dark, quiet, comfortable space found in most museum storage areas). The primary pests that threaten museum objects include fungi, bacteria, rodents, insects, and people. Of all the pests found in museum collections, insects are generally the number one worry. Pesticides used to be the primary way of combating the effect of insect attacks on museum collections and, for the most part, they are harmful not only to pests but to humans as well.[28]

Insects pose a great risk to museum collections. They are resilient, numerous, and persistent. Where humans go, insects are sure to follow. The only organism that is more destructive to museum collections is people. The good news for museum professionals is that only a relatively small group of insect species can survive in the museum collections areas. The insects most commonly found in museum collections include clothes moths, carpet beetles, furniture beetles or woodborers, silverfish, firebrats, odd beetles, crickets, cockroaches, and book lice. The reason these species are able to flourish on museum objects is because both the food source (the museum object) and the environment (the storage room) are very favorable to their

[28] (Pool, Odegaard and Huber 2005, 5)

propagation and survival and these organisms can do a wide array of damage, ranging from the disfiguring of an objects surface to the total destruction of its structure.[29]

It is important for museum professionals to have at least a basic understanding of the pests that threaten their collections. Insects can be divided into two groups, those that undergo an incomplete metamorphosis, such as silverfish, crickets, and cockroaches and those that go through a complete metamorphosis, such as moths and beetles. The difference is that an insect undergoing an incomplete metamorphosis will go through the stages of egg, nymph, and adult while a complete metamorphosis includes egg, larvae, pupa, and adult.[30]

A clothes moths infestation can wreak havoc on a museum collection. There are two types of moths that are commonly found in museum collections. They include the common or webbing clothes moth (*Tineola bisselliella)* and the case-making moth (*Tinea pellionella)*.[31] The first indication of an infestation is usually the discovery of adults; unfortunately, adults are not responsible for the damage to collection objects, as adult moths do not feed. Larvae are the culprits responsible for the mayhem wrought on collections. The larvae will feed on animal products commonly found in museum collections, including fur, hair, woolens, quill, horn, and other protein-based material. It is unlikely an infestation will be revealed through the discovery of eggs. The eggs of moths can be incredibly small and are often hidden in hard to see areas, such as the seams of textiles. The life cycle of many moth species is approximately two months, but can be prolonged up to two years due to dormancy.[32] The good news, if it can be considered as such, is that infestations tend to be localized to one area.

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[29] (Pool, Odegaard and Huber 2005, 5)
[30] (Pool, Odegaard and Huber 2005, 5-6)
[31] (Pesticides n.d.)
[32] (Pool, Odegaard and Huber 2005, 7)

The carpet beetle is another dangerous insect to a museum object. The name "carpet beetle" encompasses several species that can be potentially found in collections. The species to blame for the majority of damage inflicted on museum objects includes the common carpet beetle (*Anthrenus scrophulariae*), the black carpet beetle (*Attagenus piceus)*, the varied carpet beetle (*Anthrenus verbasci*), and the furniture carpet beetle (*Anthrenus flavipes*).[33] The larvae molt several times during their development. The shed skins are a usual sign of an infestation. It can take up to three years for a carpet beetle to complete its life cycle, and there can be a new generation every year. The eggs are very difficult to see and the larvae have worm-like bodies that vary in size and color according to their species. Unlike the clothes moths, carpet beetles tend to move around the collection area meaning damage tends not to be localized to one particular area. The larvae feed on animal products and other protein-based material. They will also attack silk, linen, rayon, and woods with animal glue.[34]

Wood boring beetles are also particularly harmful to museum collections. "Wood boring beetle" encompasses a variety of species, but the most common include the powder-post beetle (Lyctid family), the false powder-post beetle (Bostrichid family), and the furniture beetle (Anobid family). The larvae will consume the wood, while traveling up and down inside the piece with the grain of the wood. These tunnels become filled with wood dust and fecal pellets. The fully developed adult beetle will chew a flight hole in the wood that has the potential to be used as a place to deposit a new set of eggs. The presence of these holes only indicates that there was an infestation at one time. It does not necessarily indicate an active infestation.[35]

Silverfish (*Lepisma saccharina*), and firebrats (*Thermobia domestica*), do comparatively less damage to museum collections. They lay only a few eggs, or even one at a time. Both the

[33] (Pesticides n.d.)
[34] (Pool, Odegaard and Huber 2005, 7-8)
[35] (Pesticides n.d.)

nymphs and adults cause damage by feeding on the starch, sugar and proteins that are found in textiles, paper, books, and paintings. The firebrat prefers drier environs so they tend to favor the Southwest. Book lice are often found as swarms among pages of books where they will cause damage to old-protein based glues, starch pastes, and paper bindings. They will also feed on mold damage.[36]

How do pesticides work and why are they so effective? Pesticides are poisons that kill pests by entering the organism through a variety or combination of ways including through their shell or skin (dermal), the mouth (oral), or inhaled (respiratory). Dermal poisons penetrate the cuticle or body wall of the pest. Pesticides that act as desiccants (i.e., cause dehydration and death) can also be dermal or contact poisons. Oral poisons are normally eaten and inhalation poisons generally enter through a respiratory opening. All poisons can be placed into one of these categories, but some may be effective in more than one way.[37] Pesticides can also be applied in wide variety of ways, including spraying, aerosol, bombing, fogging, dusting, or fumigating. Approaches have changed widely as formulations methods, the chemicals available, and application techniques have changed over time.[38]

[36] (Pesticides n.d.)
[37] (Pool, Odegaard and Huber 2005, 10-11)
[38] (Pool, Odegaard and Huber 2005, 12)

Taxidermy and Museum Collections

A historical review of taxidermy shows wide use of hazardous ingredients. By the 18th century, collectors of natural history specimens were experiencing problems with preserving their collections. At the time, specimens were commonly dried and preserved with salt, herbs, alum, spices, and tobacco. However, these treatments did not last very long. These treatments were replaced, therefore, by very strong and effective techniques, most commonly involving arsenic.[39] Arsenic was a vital ingredient since the 18th century onward for the preservation and conservation of animal specimens. In 1925, John Rowley describes his recipe for "poisonous materials used to protect dry skins from insect pests." His recipe includes "flowers of sulfur," arsenic sulfide, sodium arsenite solution, and gum arabic.[40] Rowley also provides a recipe for a solution to spray on the outside of specimens that have already suffered insect infestation.

> *Formula 4 [the aforementioned recipe] may also be used to poison the exterior of mounted specimens that are infected with moths or dermestes. Such specimens should first be sprayed or painted with gasoline to kill any insect life that may exist in the hair. When this has evaporated, spray or paint with Formula 4 diluted with water. Bichloride of mercury solution, as follows, is also used to spray infested mounted heads or entire specimens, after gasoline treatment. Water (1 gallon), citric acid, dry (2 ounces), bichloride mercury (4 ounces)"*

In an even earlier book, *The Taxidermist's Manual* by Thomas Brown, 1785-1862, a recipe is provided for a "solution of corrosive sublimate" used for the preservation of the skin.

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[39] (Marte, Pequignot and Von Endt 2006, 143-144)
[40] (Rowley 1925, 19)

The ingredients included arsenic, camphor, white soap, salt of tartar, and powered lime.[41] Nearly all the recommended treatments for the preservation of the specimens included the use of arsenic.

Another technique involved covering the animal skins with a terebenthine and camphor tarnish. At the time of mounting, the interior of the skins would then be covered with a mixture and arsenic and aloe. During the stuffing of the specimen, a dry mixture of corrosive sublimate, arsenic, alum, camphor, and sometime cinnamon (to create a pleasant smell) was used. Arsenic was considered to be a tanning agent, but also served as a powerful insecticide.

In taxidermy, arsenic is probably best known for the preservative arsenical soap, which was invented by the Frenchman Jean-Baptiste Bécoeur (1718–1777). During his lifetime, he kept the recipe a strict secret. The recipe was not uncovered until 1800. In its day it was considered a miracle preservative and contained camphor, arsenic oxide, carbonate of potash, soap and lime powder. The composition has remained basically the same over centuries. Bécoeur's recipe was used by different museums around the world until the 1980s. Fortunately, because of its extreme toxicity, the museum community now prohibits the use of arsenic.[42]

Today, museum staff members are left to deal with the hazardous effects of these chemicals. This brief history shows that most of the specimens found in museums pose a serious hazard. It is vitally important to know which specimens are contaminated so measures can be taken to protect the health of individuals who come into contact with them, as well as to prevent contamination of other, unaffected specimens within the collection.[43] One anecdotal account from a natural history museum tells of a stuffed polar specimen that used to be incredibly popular in the museum. Though behind a barrier, it was extremely common for children to go up

[41] (Brown n.d., 106)
[42] (Marte, Pequignot and Von Endt 2006, 144-145)
[43] (Marte, Pequignot and Von Endt 2006, 145)

to polar bear and hug it. When the museum built newer facilities and began the process of transferring their collections, they learned the polar bear was preserved with arsenic. Needless to say, the polar bear is no longer in a position where the public can touch it. The fact so many children touched it is troubling to say the least. A better understanding of what is in museum collections could have prevented this to begin with.

Detecting Arsenic Contamination in Taxidermy

The process of detecting arsenic contamination in a taxidermy collection should begin with a visual inspection. A white powder may be present on the surface of the specimens. This powdery or crystalline deposit, normally found in the base of feathers and hairs, around eyes, in or on the base of ears, around bills or mouths, and on footpads is characteristic of white arsenic dust. In addition to this visual examination, it is extremely helpful to check to see if a record exists regarding who created the specimen, when it was created, and what process they used. If a date exists, it may be possible to rule out that arsenic was used.[44]

It still may be necessary to test a specimen for the presence of arsenic, for the absence of the tell tale white powder does not indicate an absence of arsenic. There are several available techniques available to museums for this purpose. Because the vast majority of museums do not have access to high technology for sophisticated tests, spots tests are a reasonable option. There are two spot tests that are commonly used within museums today, the Weber's test and the *Arsenic Paper Test* kit manufactured by the Macherey-Nagel Corporation. Both tests will detect arsenic at concentration of 200 ppm (parts per million). In other words, both tests are very

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[44] (Marte, Pequignot and Von Endt 2006, 145)

sensitive and are suitable for detecting arsenic contamination in museum collections. From a practical point of view, both tests have their advantages as well as drawbacks. The Weber's test requires previous training with the chemical compounds involved, but provides very quick tests results. The *Arsenic Paper Test* is easier to use, but requires a 30 minute waiting time before the results may be read. The *Arsenic Paper* Test is also a commercially available kit, which costs approximately $25 for 200 paper strips. For both tests, it is essential to take multiple samples from various locations on a single specimen, as it is possible to obtain negative results from certain parts of a contaminated specimen.

My Museum Has Contaminated Taxidermy, What Now?

When a museum collection does indeed contain specimens contaminated by arsenic, an appropriate level of management needs to be taken. This includes the documentation that accompanies the specimens. It is important for institutions to create a written protocol for handling arsenic-contaminated specimens not just for museum staff, but also for visitors, researchers, and volunteers. This paper includes examples of written protocols in Appendix C. Specimens that are known, or even suspected to be contaminated should never be handled without appropriate protection. Nitrile gloves, a smock or apron and even a respirator should be worn at all times when handling specimens. The supplies used during handling should be disposed of in a manner similar to the disposal of hazardous materials. Specimens that test positive must have "Arsenic Contaminated" clearly visible on their label. This information must be added to the specimen's paper and/or computer catalog record. It should also be noted that objects that tested negative could still contain arsenic. These objects should be continuously tested every two or three years, as arsenic may migrate from the interior of the specimen to the exterior. Every test result, whether it is positive or negative, should be recorded in the specimen's catalog record. Contaminated objects should also be stored separately whenever possible. Contaminated objects should be displayed in appropriate conditions and/or decontaminated to reduce the risk of exposure. Contaminated specimens can be cleaned with a HEPA filter vacuum, though this method may have restricted application with taxidermy because arsenic was usually applied on the interior side of the specimen's skin.[45]

[45] (Marte, Pequignot and Von Endt 2006, 147-148)

Arsenic and Mercury Health Risks

The health risks associated with taxidermy are startling to say the least. The effects of arsenic, the primary poison used in taxidermy, are cumulative. In the early 19th century Charles Willson Peale kept a diary documenting the symptoms of his son, artist and taxidermist Raphaelle Peale. Raphaelle suffered from violent tremors and severe abdominal pain, both of which are symptoms of arsenic and mercury poisoning. In addition to the tremors, the symptoms included attacks of excruciating pain, hair and teeth loss, weakness, loss of appetite and, finally, gangrene. He also suffered from bouts of depression during which he would threaten suicide and, his father wrote, he seemed to be going insane. Raphaelle died in 1825 at age 51. The cause of death was listed as "consumption," a lung ailment that some today believe was the result of a lifetime of breathing the poisonous solution he made as a preservative for his taxidermic animals.[46]

Of course this is an extreme example. This story represents a lifetime of exposure to heavy concentrations of arsenic. Even in the worst scenarios found in museums, it is unlikely that such concentrations will be encountered. It is unlikely that museum employees will find themselves suffering from "Mad Hatter Disease," the ailment traditionally associated with hatters who used mercury in the hat making process. The question is then, at what point do arsenic and mercury become dangerous and what are the symptoms associated with lower levels of exposure?

[46] (Reinert 1999)

According to the CDC, ingesting or breathing in low levels of inorganic arsenic over a long time can cause the darkening of the skin and the appearance of "warts" or "corns" on the palms, soles, and torso. Skin contact with inorganic arsenic can cause redness and swelling. Several studies have shown that exposure to arsenic can increase the risk of skin cancer and the inhalation of inorganic arsenic may increase the risk of lung cancer. The Department of Health and Human Services and the Environmental Protection Agency have identified inorganic arsenic as a human carcinogen. There is evidence that inhaled or ingested inorganic arsenic can injure pregnant woman or their unborn babies. Arsenic can cross the placenta and has been found in fetal tissue.[47] Arsenic may impair nail development in the fetus or lead to nail deformities in the newborn, and cause changes in gene expression.[48] Arsenic can even be found in low levels in breast milk if the mother has been exposed.

The acute or short term, effects of arsenic include weakness, headache, gastro-intestinal discomfort, changes in skin and nail texture and pigmentation, respiratory problems, coughing, irregular heartbeat, breathing difficulty, and chest pain. Chronic, or long term, effects include general abnormalities to the pigmentation of the skin as well as abnormalities to nails and skin on the palms of the hands and soles of the feet. Arsenic is also linked to nonmalignant respiratory diseases, numerous diseases of the nervous system, emphysema, kidney disease, and many heart diseases.[49] Unfortunately, it has not been definitively determined how much exposure an individual can tolerate before they begin to suffer the effects of arsenic poisoning.[50]

Mercury can be just as harmful to human health. The nervous system is very sensitive to all forms of mercury. Exposure to high levels of metallic, inorganic, and organic mercury can

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[47] (ToxFAQs for Arsenic 2010)
[48] (Arsenic Health and Safety Update 2000)
[49] (Arsenic Health and Safety Update 2000)
[50] (ToxFAQs for Arsenic 2010)

permanently damage the brain, kidneys, and developing fetuses. The effects mercury has on the brain can include irritability, shyness, tremors, changes in vision or hearing, as well as memory problems. There are inadequate data for all forms of mercury, but the EPA had determined mercuric chloride and methyl mercury are possible human carcinogens.

Very young children are more sensitive to mercury. Mercury from the mother's body may be passed to the fetus and may accumulate. The effects that may be passed to the fetus include brain damage, mental retardation, loss of coordination, blindness, seizures, and the inability to speak. Most health providers can determine the level of exposure. Tests, using blood, urine, or hair can be taken and sent to a lab for testing.[51]

[51] (ToxFAQs for Mercury 2010)

Contaminated Culture: Repatriated Objects Found Contaminated with Pesticides

In 1997, several museums repatriated sacred objects known as Katcina Friends to the Hopi Tribe. After they had been in the Hopi Tribe's possession for six months, the tribe decided to test three Katcina Friends for arsenic contamination. Test results revealed that all three of the Katcina Friends had heavy concentrations of arsenic residue. In the six months prior, numerous community members including tribal staff and religious leaders handled the Katcina Friends. A number of the dolls had been stored in their traditional manner, for example, in the family's corn supply. Following these findings, all subsequent repatriations were called to a halt. It was decided that the tribes would retain title of certain objects, but museums would continue holding them until they could be safely restored to the tribe.[52]

The return of the Katcina Friends represents one example of the difficulties surrounding the repatriation of contaminated objects, especially when they are not transferred to museum type settings. The handling and care these objects will receive post repatriation will depart significantly from accepted museum procedures. They are sacred objects and are frequently reintroduced into ceremonial use. An understanding of how objects may be used after repatriation is critical to the conversation concerning contaminated objects.

Native American Use of the Sacred

It is vital for museum professionals to be aware of how repatriated objects may be used before they complete the process of repatriation. Contaminated objects pose a serious threat to

[52] (Davis and Caldararo, The Repatriation Dilemma: Museum Objects are Contaminated with Pesticides 2000)

human health as well as the environment. Understanding how an object's meaning and function will change after it leaves the museum should be a condition of all repatriations. Museums, in general, place a great deal of value and importance on objects possessing a clearly documented provenance. An object linked to the Lewis and Clark Expedition, for example, is judged significant because it documents and confirms an important facet of American history. The role of museums is to preserve these objects into perpetuity in order to maintain their integrity. To accomplish this, museums limit handling and viewing in order to minimize the risk of damage. Pesticides used in the past helped museums achieve this goal by preserving the objects in their care.[53]

Tribal nations will use objects based on their understanding of, and their current relationship with, their traditions and ceremonial practice. For example, one tribe may open a museum or cultural center in which they may choose to display an object for the community or keep it safe in storage. Another tribe may wish to reactive the objects through a ceremony. "Reactivation" refers to the need complete a ceremony before an object can be put back into ceremonial use. Additionally, some objects may need to be ceremonial retired before they may be removed from ceremonial use. Anticipation of these possible scenarios will have an impact on the assessment of the potential cultural and physical risk a repatriated object may bring to a community.[54]

In her article *American Indian Concepts of Object Use*, Alyce Sadongei creates three broad terms to describe the possible ways in which repatriated objects may be used in tribal cultural practices. Though not conclusive, the terms serve as a way to understand the abstract

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[53] (Sadongei 2001, 113)
[54] (Odegaard and Alyce 2005, xx -xxi)

constructs involved in the American Indian religious worldview. The three terms she proposes are "Physical Use," "Symbolic Use," and "Life Ending Use."

"Physical Use" arises when tribal cultural practitioners come into direct contact with a sacred object. Obviously, this type of contact carries a great amount of risk. Contact with sacred or ceremonial objects is not arbitrary. Commonly, only religious leaders or individuals with special knowledge may touch, use, or manipulate sacred or ceremonial objects. There may also be restrictions based on, but not limited to, gender or the uninitiated. With "Physical Use," objects come into contact with people, by being worn (for example, a mask), applied to the skin (for example, a pigment), or used as a container for other objects or people. This type of action rarely takes place in a museum setting, with perhaps the exception of ceremonies preceding repatriations.[55]

"Symbolic Use," unlike "Physical Use," tends to occur within a museum and, as the name suggests, carries the least amount of risk. A tribe enters into a partnership with a museum in order to gain access to an object for the "purpose of confirming artistic traditions or to use as a model for replication."[56] This is a similar relationship to what a museum would have with a researcher. The objects involved tend not to be subject to repatriation and the usually don't require direct contact. Perhaps most importantly, the physical presence of the object symbolically represents a connection to tribal ancestors and cultural legacies.[57]

"Life Ending Use" materializes when the object is ritually allowed to "die." The object is ritually disposed of (for example, by burning it or allowing it to decay through exposure to the elements) thereby nullifying or ending its sacred attributes. Native Americans believe that some ritual objects are imbued with life energy, force, or power, and require ritual termination in order

[55] (Sadongei 2001, 114)
[56] (Sadongei 2001, 114)
[57] (Sadongei 2001, 115)

to put an end to their purpose. An example of objects that require "Life Ending Use" would be the Zuni War Gods. Natural decay due to exposure from the elements is required for the ritual to be complete.[58]

When contaminated objects are returned, it is important for museum professionals and tribal members to engage in cross-cultural communication. The tribal concepts of use may influence how a contamination problem in processed. Knowing the cultural context of an object provides clues to how contaminants might enter the body, consequently allowing for an appropriate treatment or handling recommendations.[59]

As testing and analysis techniques continue to develop within the conservation community, it is important to consider an object's cultural context. The context can be most thoroughly understood through consultation with tribal leaders and, due to the incredible diversity in their religious beliefs and cultural practices, there is no single way to work with all Native American tribes.[60] Some tribes may view testing a cultural object as invasive and inappropriate. As an example, the Hopi tribe's religious leaders worked with the University of Arizona regarding where samples should be taken in order for testing to proceed. In consultation with the museum, tribes must be allowed to weigh the ramifications of testing and the compatibility of the action with traditional beliefs.[61] Therefore, procedures on how to honor individual tribal customs and beliefs should be created on a case-by-case basis in order to fully respect the tribes, as well as fulfill the spirit of NAGPRA. The consequences of pesticide residue

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[58] (Sadongei 2001, 115)
[59] (Sadongei 2001, 115-116)
[60] (Sadongei 2001, 116)
[61] (Pesticides n.d.)

testing and mitigation should be carefully deliberated to consider how it might affect tribal traditions, religion, and social structures.[62]

The Hopi Experience

The Hopi Tribe is situated on a reservation in northeastern Arizona that includes areas in which its ancestors have lived for over a millennium. They are a Puebloan tribe (*pueblo* meaning "village" in Spanish) that has practiced dry farming of native crops since ancient times. Accordingly, most of their cultural activities and religious ceremonies tend to focus on the raising of successful harvests. Ten Hopi villages exist on the reservation; they are situated around three prominent sandstone mesas. Many of these villages maintain traditional leadership structures and continue to carry on many of the traditional ceremonies that have been passed through the ages.[63]

The Hopi's multi-faceted religion and traditions are derived from several of the major prehistoric people of the southwest-- the *Anasazi*, *Sinagua*, *Salado*, *Cohonina*, *Mogollon*, and *Hohokam*. The major focus of Hopi religion is asking for rain from the cloud spirits and praying for the growth of bountiful crops. To accomplish this, religious traditions and ceremonies are held throughout the year, using various kinds of religious paraphernalia, which carry symbolic meanings and are imbued with sacredness. Created from simple materials found in nature, these paraphernalia are carved or woven, and decorated with symbolic forms. Many of the items that

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[62] (Sadongei 2001, 116)
[63] (Loma'omvaya 2001, 31)

are in collections worldwide still carry religious and cultural significance that is vital for the continued practice of Hopi religion.[64]

How successful has NAGPRA been for the Hopi? When using the number of objects physically repatriated as the measurement, it would seem to be a success. However, the Hopis feel (and justifiably) that this success may possibly be undone by the revelations of pesticide residues on museum objects. Contributing to this difficult situation is the fact that the Hopi were not informed of the danger that some of these objects might pose until after a number had already been repatriated.

In January 1996, the US government officially recognized the possibility of pesticide contamination by attaching to NAGPRA a requirement that museums and federal agencies must report pesticide and preservative treatment histories of all returned objects. Unfortunately, what tribes are often given is an incomplete and inconclusive report of this hazardous situation. The Hopi complain that they are seldom informed when in the repatriation process institutions will provide this information. In addition, when the information is provided it is often highly technical and difficult to understand.[65]

In the early stages of repatriation, many Hopi cultural advisors (usually elders) came in direct contact with possible pesticide residues. During visits and consultations with museums staff, these advisors examined collections for identification. In some instances, objects were handled and the Hopi cultural advisors were not warned about the possibility of pesticide residue, nor were they provided with personal protective equipment.

In 1999, after a scientific investigation of possible pesticide contamination, the Hopi declared a moratorium on further physical repatriations in order to protect the Hopi people.

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[64] (Loma'omvaya 2001, 31)
[65] (Loma'omvaya 2001, 32)

However, prior to the moratorium, over 60 objects were repatriated to the Hopi reservation and distributed to communities and individuals. Upon the return of objects, they were re-sanctified and then placed back into cultural use. In one case, sacred objects were placed in a ceremonial room where a qualified person with the proper blessings could accept responsibility for an object's care. In many cases, the repatriated objects are handled extensively in order to be cleaned, repaired, and prepared for storage, and in some instances, shared with others. These 60 objects are potentially stored in the same manner as other sacred Hopi objects, i.e., in family homes or activity rooms. Sacred objects are cared for almost on a daily basis. The family members in charge of their care can potentially experience chronic exposure. Sacred objects are also stored in *kivas*, or undergrounds ceremonial chambers that are often crowded and lack ventilation. Other times sacred objects are stores in *Piiki* houses where the family's corn, squash, flour or beans are kept and daily activities take place where family members, including the elderly and children, may be exposed.[66]

Almost any age group can interact with sacred objects, including the potentially contaminated ones. Participation in certain Hopi ceremonies can begin as early as age two or three and will continue into a participant's senior years. The handling of objects during a ceremony can be extensive, as described in the Hopi Resources Advisory Task Team during a February 2001 meeting:

> *First, an individual would potentially inhale, ingest, and absorb pesticide residues from objects they are to utilize in ceremonial/ritual performances, or contaminate other individuals, items or environments simply by preparing a contaminated object for a performance. Repairing, altering, painting and other preparations done by hand are done over several days at a time prior to the performance*

[66] (Loma'omvaya 2001, 34-35)

of a specific ceremony. No gloves are used and regular hand washing is usually not exercised during this busy preparation. For example, a person works on an object in a Kiva, eats a meal in an adjacent area, and then returns home for a tool, meanwhile touching various surfaces, objects or individuals after handling a contaminated object.

Secondly, the ceremonial performance can be conducted over multiple days. Most of these ceremonies involve physical exertion, which may lead to increased absorption through sweat glands, bodily fluids, and increased respiration. Many of these ceremonies are held in higher temperatures with sacred objects in direct contact with unprotected skin, eyes, and mouths, thus possibly increasing the rate of absorption and the possibility for acute poisonings. Note also that some items may be used in Kiva environments where they may be exposed during ceremonial preparations for up to a week at a time to a certain group of participants.

Third, more handling of the sacred object occurs prior to storage. The contamination of supplementary pieces or objects (feathers, attachments, strings, etc.) which are used in conjunction with the contaminated object could be anticipated.

Lastly, observers of ceremonies may also be at risk for exposure. At times, ceremonial participants have contact with observers at which time exposure may occur. Any residues from a participant or contamination of the local environment, such as in a Kiva enclosed setting, may result in exposure of the general public.[67]

The return of these objects was mandated by the government to right historic injustices committed, however, Hopi religious leader have come to the realization that every ceremony conducted in the desire for good health and happiness may have been undermined by contaminated objects. During religious ceremonies, people were exposed to an unknown danger

[67] (Loma'omvaya 2001, 34-35)

and the Hopi have essentially lost these objects a second time, heaping insult upon injury. The Hopi are even unable to provide for these sacred objects a ritual that would retire them in a traditional way. Traditional retirement calls for objects to be placed in the natural environment, but if these objects carry pesticide residues, they may contaminate the environment and create chances for accidental exposure.[68]

Even with the passage of NAGPRA, the Hopi continue to feel the injustices brought upon them by the U.S. government and American institutions. They feel the institutions (museums, federal agencies, universities, etc.) that treated sacred objects with pesticides should be responsible for their cleaning and testing. In addition, as a solution until the objects can be successfully decontaminated, the Hopi wish to build a facility on their reservation to house the repatriated sacred objects so they can be under Hopi care.[69] The 1996 addition to NAGPRA only provides tribes with a warning that an object may have been contaminated. That is little consolation to the tribes who now have to deal with the consequences of past actions that they had no say in.

The Seneca Experience

The Seneca Nation, otherwise known as the Haudenosaunee, is one of the six tribes that make up the Iroquois Confederacy, or the Six Nations. They occupy their aboriginal lands in New York state as set aside in the Treaty of Canandaigua of 1794. After the passage of NAGPRA, the Seneca began the process of repatriating human remains and cultural patrimony (initially wampum belts and strings) from the National Museum of the American Indian. After

[68] (Loma'omvaya 2001, 35)
[69] (Loma'omvaya 2001, 36)

this initial repatriation, the Seneca desired to finally return home their medicine masks (or false faces) from NMAI.[70]

To the Seneca people, the medicine masks are their scared helpers. In English, the masks are referred to as their "grandfathers." On November 14, 1998, four hundred and fifty-five medicine masks were returned to the Seneca. Over-shadowing the joy of the return of their "grandfathers" was the information, provided only three months prior to the return, that pesticides might contaminate them.[71]

The Seneca began asking that the medicine masks be removed from public display beginning in the 1970s when the museum was known as the Museum of the American Indian. Efforts to repatriate the masks from NMAI under NAGPRA began in November of 1993. By July 1998, the Seneca received confirmation from the Director of the Museum, W. Richard West that NMAI would go forward with the repatriation. In a letter dated July 27, 1998 Bruce Bernstein, Assistant Director for Cultural Resources confirmed that NMAI would be repatriating their "grandfathers" and he requested that they be allowed to sample the masks to test for potential residues. In the letter, he stated that the museum had used "fumigants" in the past and there was a possibility that some part of the collection had been treated. Representatives of the Seneca Nation visited the museum on September 24 and 25, 1998. At that time, six masks were picked at random for testing, one of which tested positive for arsenic. Later testing showed seven percent of the collection was contaminated.[72]

While this situation developed, the National Museum of the American Indian was in the process of moving to a new facility. The tribe was given the option of accepting the masks then, or allowing the masks to be moved to the new facility, which would cause further delays to their

[70] (Jemison 2001, 38)
[71] (Jemison 2001, 38)
[72] (Jemison 2001, 38)

return. The Haudenosaunee Standing Committee decided to accept the repatriation and see what further contaminant testing would conclude. Unfortunately, this meant the Seneca were left with a contamination problem about which they understood nearly nothing. Community members, justifiably, expressed fear and alarm about the information that arsenic was present in their "grandfathers." When the masks were returned, the Conservation Department of NMAI provided information via a letter indicating that some masks tested positively for arsenic, but it did not indicate the degree of contamination. It only provided some basic guidelines of precautions for the Seneca.[73]

After the masks were distributed to their respective communities, each community took a different approach to the care of their medicine masks. The representatives from the Six Nation Reserve decided against taking their medicine masks home since three had tested positive. They wanted to wait until further testing could be carried out, but still this left the masks in the care of the Onondaga Nation. Other communities immediately began raising money for additional testing, though still no one could tell them exactly what the test results meant. No test could tell them at what level arsenic exposure becomes unsafe for humans.[74]

Another community was successful in lowering the levels of arsenic residue after a series of cleanings, though the techniques they used may not be desirable to many. The medicine masks were first vacuumed with a HEPA filter, washed with soap and water, vacuumed again, and then washed again. It was a seemingly effective method for the removal of arsenic from the surface of the medicine masks.[75]

Like the Hopi, the Seneca face a difficult situation if they are to respect their own cultural traditions. The Seneca remain cautious about what they can share about their "grandfathers."

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[73] (Jemison 2001, 38)
[74] (Jemison 2001, 39-40)
[75] (Jemison 2001, 40)

The masks are considered to be alive and sacred. This can make testing for contamination difficult. Can a sample be taken? If so, where on the object can it be taken? Is destructive analysis appropriate? Tribal communities may be wary of consulting with museums for fear of betraying their ceremonial secrets. Additionally, though some of the members of the Seneca community have been educated regarding effects of pesticide contamination, individuals represent only one voice. Outside information is not always greeted with openness or acceptance. Traditional beliefs are extremely important and must be treated with the utmost respect.[76]

Museums can learn lessons in how to deal with contaminated heritage from the Seneca Nation's experience. Museums testing sacred objects for residues need to consult with the tribes involved in order to respect their religion and cultural traditions. Testing an object in an inappropriate manner can potentially harm a tribe culturally and spiritually. When tribes are provided with technical information, it needs to be conveyed in a way that is easy to understand. Additionally, museums should be open and honest regarding the condition of their collections. If any information comes to light after repatriation, institutions should disclose these new facts to the tribes.[77] It would seem common sense that all activities surrounding repatriation need to be done in consultation with the affected tribe, but this is clearly not always the case.

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[76] (Jemison 2001, 40)
[77] (Jemison 2001, 40)

Liability of the Museum

What is the liability of a museum to an individual for an injury, such as contracting cancer, resulting from the use or contact with museum objects? The following is a general overview, but laws change and vary greatly from state to state. It is important to direct specific questions concerning an institution's liability to the institution's own counsel. The liability discussed is separate from the penalties that may arise from the violation of the Occupational Safety and Health Act (OSHA) or the Federal Insecticide, Fungicide and Rodenticide Act (FIFRA). The first question dealt with here is whether an individual can sue the museum if they injured during the course of their work.

A local workers' compensation statute covers just about every employer-employee situation. As an example, an employee of the Federal Government will be covered under the Federal Employees Compensation Act. If a state is the employer, the workers are covered by the state Workers' Compensation program. In every state, by law, all private employers are required to carry workers' compensation insurance, which must meet state requirements. Workers' Compensation is the sole remedy for an injured employee against an employer for accidental injuries. Meaning, if a claim exists against an employer, the employee has only one avenue in which to make a claim: file for workers' compensation. If the claim is valid and is approved, the recovery is limited to what is allowed for the type of injury in question. No more, no less.

Worker's compensation is a type of insurance in which both the employer and employee give up a certain amount of legal rights. In this deal, the injured employee is insured to receive at least a minimum of financial assistance. Under workers' compensation, if the employee can show they were injured in the course of their duties, his or her employer will not dispute the claim. All the employee has to show is that they were hurt on the job. With these concessions on the employer, the employee is limited to the exact benefits set forth in the workers' compensation plan. So then there is only one relevant issue: was the employee injured in the course of their employment? Questions of negligence or relative negligence are not at issue.

Of course, another possible plaintiff in a case of negligence may be a volunteer. A volunteer may not covered under workers' compensation. Many workers' compensation programs allow for volunteers to be classified as employees. It should be checked as to whether or not they can be added to your plan. If not covered, he or she has the ability to bring a lawsuit against the museum. In order to succeed in a lawsuit, however, the volunteer would have to prove the following:

1) That the museum was negligent;
2) That the negligence was the direct cause of the alleged injury;
3) That he or she did not contribute to the negligence;
4) And that he or she had not assumed the risk of exposure (i.e., it was not the case that the volunteer was informed of the possible risk but made a free decision to continue volunteering.)

This kind of lawsuit is generally covered by the museum's general liability insurance coverage, with the insurance company providing defense counsel if needed. Of course, adding volunteers to an institution's workers' compensation plan will avert this unfortunate situation completely, as will thorough training.[78]

The museum's liability becomes much murkier when dealing with repatriated objects. What would the museum's liability be if in an individual were injured by an object after it was

[78] (Malaro 1981, 19-21)

repatriated? *Tort law* generally guides the resolution of cases where one party has caused harm to the person or property of another party. Thus tort law has the potential to be applicable to the issue of repatriation of contaminated objects. The body of law surrounding this issue is complex, so perhaps the best way to discuss its applicability is to evaluate three hypothetical scenarios. The first is a situation in which a museum has voluntarily repatriated to a tribe a sacred object that was contaminated with a poisonous substance. This object either has caused, or has posed a substantial likelihood of causing, adverse impact on the health of members of the tribe. The second scenario is similar, except that the museum has returned the object pursuant to the repatriation requirements of NAGPRA. Finally, what would happen if a tribe would like to repatriate an object, suspects that it may be contaminated, but is not sure what to do or to what extent or whether the item can even be decontaminated?[79] Do they even take possession of the object?

As to the first scenario, for those repatriations that took place before NAGPRA, there was no statutory or regulatory duty in place to warn Native people of pesticide contamination prior to the repatriation of the object. However, under tort law standards, a defendant may be held liable for injury to plaintiffs' person or property interests if there is proof of:

1. Duty of care owed by defendant to plaintiff.
2. Breach of the duty of care by the defendant.
3. Causation.
4. And damages suffered by the plaintiff.

However, these types of cases can be extremely complex and difficult for a number of reasons. First, the standard of finding liability (e.g., fault) may vary. Courts may apply the "negligence" standard, strict liability (e.g., for "abnormally dangerous conduct"), or standards specially

[79] (Tsosie 2001, 19-20)

applicable to product liability and failure-to-warn cases. Additionally, causation is extremely difficult to prove in cases where diseases have a long latency period or where there is scientific dispute about causation, as is the case with disease cause by pesticide exposure. Where multiple causes for disease are possible (e.g., smoking, chemical exposure of other source, etc.) it may be impossible to prove causation. A third problem is in calculating damages. Tort law is designed to award damages for economic loss or noneconomic loss (e.g., pain and suffering) caused by injuries to personal or property interests. The property interests here are difficult to quantify through the normal standard for "economic loss."[80] In the end, it would seem possible that a museum could face liability if they returned an object prior to NAGPRA that was contaminated; however, the burden of proof placed on the plaintiffs makes it an extremely difficult case to make.

If an object is repatriated according to NAGPRA, regulations currently require institutions to notify the tribe of contamination known to the museum and likely to be hazardous to humans. If an institution would fail to notify the tribe at least of known facts, it would appear to establish a breach of statutory duty of care to the plaintiff, enhancing the chances for success of a tort case. It should be noted that merely meeting the statutory duty might not be enough. For example, if a museum official claims not to have "actual knowledge" of chemical use, but he could have known of the contamination by referring to existing museum records, or, knowing industry practice, should have made some further inquiry to obtain knowledge, he/she may be liable.[81] It is advisable for a museum to obtain a signed acknowledgment of any warning regarding contamination issued during the course of repatriation.

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[80] (Tsosie 2001, 20)
[81] (Tsosie 2001, 22)

Finally, what happens if a tribe would like to repatriate an item, suspects it to be contaminated, but is not sure with what or to what extent, or whether the item can even be decontaminated. The tribe has the legal right to take physical possession of the item, but is unwilling to do so until the nature and extent of the contamination can be determined. Here, there is clearly no potential or present danger to the health of tribal members. However, the tribe is unable to obtain enjoyment of its legal right because of the potential contamination.[82]

The questions this case raises include: Who has the responsibility to ascertain the level of contamination? If the object is found to be contaminated, what should be done? Does the museum have the duty to test the object? Does the museum have the duty to decontaminate the object, if it's even possible? Do Native claimants have a legal cause of action to compel testing or decontamination? What happens to the object if it cannot be decontaminated? Do Native claimants have a cause of action for damages caused by the loss of use and enjoyment of the object? Currently, these are ethical rather than legal questions considering there is no clear legal answer to any of them. Based on NAGPRA, the only thing museums are compelled to do is notify tribes of known contamination. Beyond that, ethical, social, and political considerations shape the respective duties and responsibilities of the various parties to the objects and to one another.[83]

Conclusion

It seems fairly safe to state that the issues surrounding contaminated collections are fairly well recognized. Research seems to indicate that museums are aware of the issues, but have the

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[82] (Tsosie 2001, 22)
[83] (Tsosie 2001, 23)

majority of institutions implemented any formal protocols to deal with the issues? Most articles concerning the topic originate from large institutions, such as the American Museum of Natural History, the National Museum of the American Indian, the Smithsonian, or the National Park Service. What of smaller institutions, with even smaller budgets? Have they chosen to take any precautions in regards to contaminated collections objects? Not all museums collect animal specimens or ethnographic objects; items typically treated in museum collections with pesticides. Do museums that do not collect these objects (such as some art institutions) take any precautions? In order to shed some light into these questions, a very short survey was created and distributed through the Registrar's Committee of the American Association of Museums. It was posted twice and subscribers were asked to participate in a completely anonymous survey. The listserv reaches Registrars and Collections Managers around the country. Though the survey was brief and the survey response may not represent a statistically significant group, it seems to have shed some light on some of the questions posed here.

The following are some the survey questions accompanied by the overall results. A few of the answers have been omitted because they were ultimately deemed not to be useful or not to protect the complete anonymity of the participants.

Question	Answer Choices	Number of Responses	Percentage
For what type of museum do you work?	Art	14	25%
	History	11	19.6%
	Natural History	6	10.7%
	Historic House	6	10.7%
	Historical Society	4	7.1%
	Other	15	26.8%
What is your museum's budget?	Below $50,000	3	5.4%
	$50,000 - $499,000	16	28.6%
	$500,000 - $2,499,000	16	28.6%

	$2,500,000 and above	21	37.5%
Do you have evidence that any objects in your collection have been contaminated by arsenic or mercury?	Yes	26	46.4%
	No	30	53.6%
Does your Collections Management Policy include a section regarding the handling of hazardous objects in your collection? (Including objects contaminated by arsenic, mercury, or other chemicals)	Yes	21	37.5%
	No	35	62.5%
Does your museum routinely label hazardous collection objects? (i.e., arsenic, mercury contamination)	Yes	24	42.9%
	No	32	57.1%
Does your museum routinely train new employees and volunteers regarding how to handle contaminated or hazardous objects?	Yes	26	46.4%
	No	30	53.6%
Do you add contamination or hazard warnings to your collections database or paper records?	We add warnings to our collections database	9	16.1%
	We add warnings to our paper records	2	3.6%
	We do both	24	42.9%
	We do neither	21	37.5%
Are safety guidelines for handling museum collections posted in the workplace?	Yes	14	25%
	No	42	75%

Participants were given the opportunity to describe the types of evidence their institutions have for contamination of collections objects as well as an optional comments section. If the results of the survey were indicative of the museum profession as a whole, it would seem that hazardous collection objects are dealt with differently from one institution to another. In addition, some museums seem clearly more concerned about hazardous collection objects than others.

The graph found in Appendix C titled "Institutions Reporting Contaminated Objects" is a visual representation of responses from only those institutions that reported that they have confirmed contamination within their collection. The reported evidence for contamination ranged from museum records, to oral history, to testing, to finding labels on objects stating "arsenic contamination." Of those institutions with confirmed contamination, only 46% have a section in their Collections Management Policy dealing with the handling of hazardous materials. This may not be all that unusual, since some institutions may not include object-handling procedures in their CMP. More surprising, only 69% museums reported that they label their contaminated objects, 65% reported they provide training to new employees and volunteers as to how to handle hazardous objects, and a mere 31% post safety guidelines for handling hazardous and contaminated collection objects in the workplace. Very few museums take all three actions. Looking at this, one might assume then that institutions not reporting contamination follow none of these procedures, however, that is not the case.

Referring to the graph labeled "Institutions Reporting No Confirmed Contamination;" it's surprising to note that several of these institutions follow these procedures. One reason they do so is that they do not have the ability to confirm whether or not they have contaminated objects within their collection, but are taking precautions anyway because they have reason to suspect a contamination. However, one respondent reported rather disturbing experiences, which is similar to experiences other students have reported:

> *When I was in graduate school, I did an internship at [omitted]. We were moving the museum collection, and a portion (taxidermic animals) was known to have been contaminated with arsenic. There were strict handling guidelines, including the use of respirators, tyvek suits, goggles, nitrile gloves, etc. However, every other place I have*

worked has professed very little concern about handling objects that were suspected of being contaminated with arsenic (usually Native American cultural objects). We used cotton gloves and no other protection. I find this rather horrifying...

It is in the best interest of the museum to follow the most basic of precautions regarding hazardous material, whether or not a museum collection has confirmed cases of contamination or not. Appendix C contains guidelines that may be posted in the workplace for handling contaminated objects. Most of the suggestions are completely compatible with current collections management policies and procedures. The safety guidelines in general ask individuals to modify personal behaviors regarding hygiene; such as do not touch the outside of a used glove with an ungloved hand, do not touch your eyes, your hair, etc. With regards to work clothes, store dirty clothes and wash them separately from your other clothes to prevent cross contamination. These are mostly simple changes in behavior that will ensure the safety of everyone charged with handling collections.

Many institutions that report to have contaminated objects state old taxidermic specimens as their primary concern. Comments included:

- *Our concerns are not necessarily with pesticide contamination, but rather with arsenic contamination when used as a taxidermy preservative.*
- *We generally assume all natural history specimens are contaminated considering the fact the contaminants could be air-born and migrate to other objects in close proximity.*

Other types of objects reported to be contaminated are ethnographic objects, such as a collection of African objects and another one of Native American baskets. No one reported art (in the more traditional sense of the word, such as paintings) to be contaminated. Contamination, generally, seems to be less of a concern to self-reported art museums while natural history museums are most concerned. The survey also bore out that museums with smaller budgets adhere to safety protocols less often, though this conclusion is tentative as very few small museums responded to the survey (only 3 museums participated with a budget under $50,000).

The survey respondents in general supported the idea that even if the institution does not have any evidence of pesticide contamination, it is good practice to treat the objects as if they were anyway. Even the most basic of practices, like using a ventilator and nitrile gloves will greatly protect collections staff while not adding an undue burden to the institution. As demonstrated, the risks to human health posed by the formerly widespread practice of pesticide use is simply too dangerous to ignore. Every day the public hears of something new that will harm human health or cause cancer. It is good practice to mitigate this possibility, even if the probability of your institution's collection containing contaminated objects in slight. Though this survey may not represent a sample with statistical significance, it does provide a basic understanding of the inconsistency of museum practices across the board.

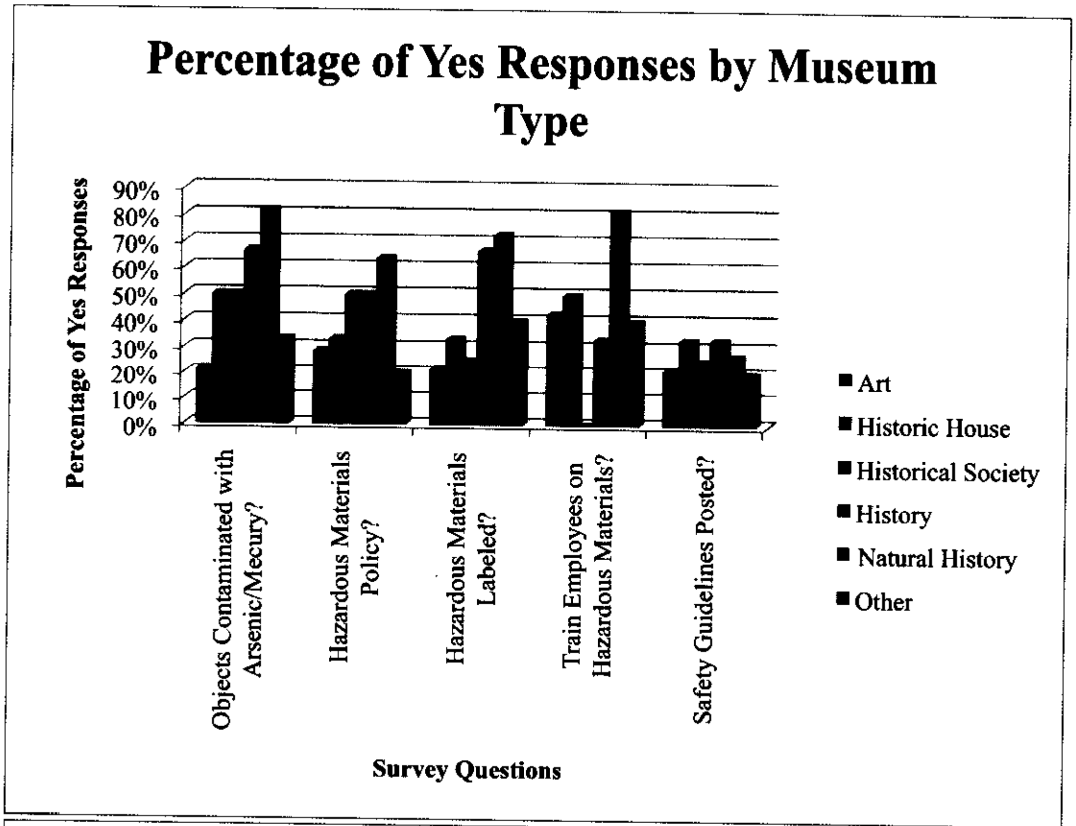
When repatriating objects in accordance with NAGPRA, museums need to go above and beyond the legal requirement placed upon museums and federal agencies to report pesticide and preservative treatment histories of all returned objects. Law is often slow to catch up to moral imperatives. Just because an institution follows the letter of the law does not mean it has met its ethical obligations. When returning a sacred object, giving the tribe a piece a paper stating your *sacred* object may be contaminated is simply not enough. The entire point of NAGPRA was to return objects to tribes in order for them to be reincorporated into their sacred use. In most cases, a contaminated object cannot be reincorporated into ceremonial use. Of course institutions need to be able to function within their means, and how museums interact with tribes will differ from institution to institution. But a greater effort needs to be made to provide tribes with information as well as resources when returning contaminated objects. If the museum has the resources at their disposal, they should attempt to help reduce the toxicity of the objects.

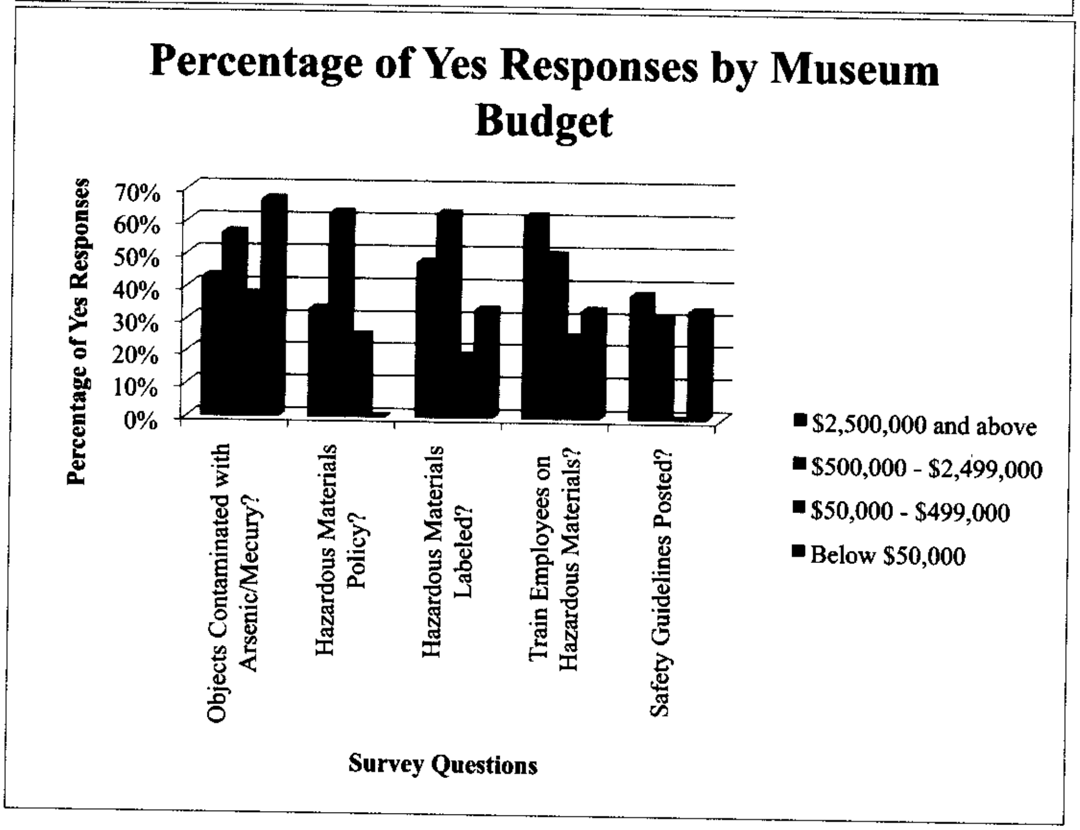
This paper began with a story of a collections intern being surprised when her instructor warned of the risks museum objects might pose to her health. However shocking this discussion may have been, it was the right thing to do. The intern's duties ended up not being all that different from her other internships. However, the lecture regarding contaminated objects did increase her awareness of what she did while she worked. She stopped playing with her hair when wearing gloves. She stopped rubbing her eyes when fatigued. These simple changes in behavior were directly connected with the information provided to her and probably greatly reduced her risk of exposure. Increased safety with museum collections can be that simple if that's all an institution can afford. For how well known of an issue pesticide contamination is in the museum field, it is disturbing how inconsistently the issues are dealt with.

Appendix A – Survey Results & Summary Graphs

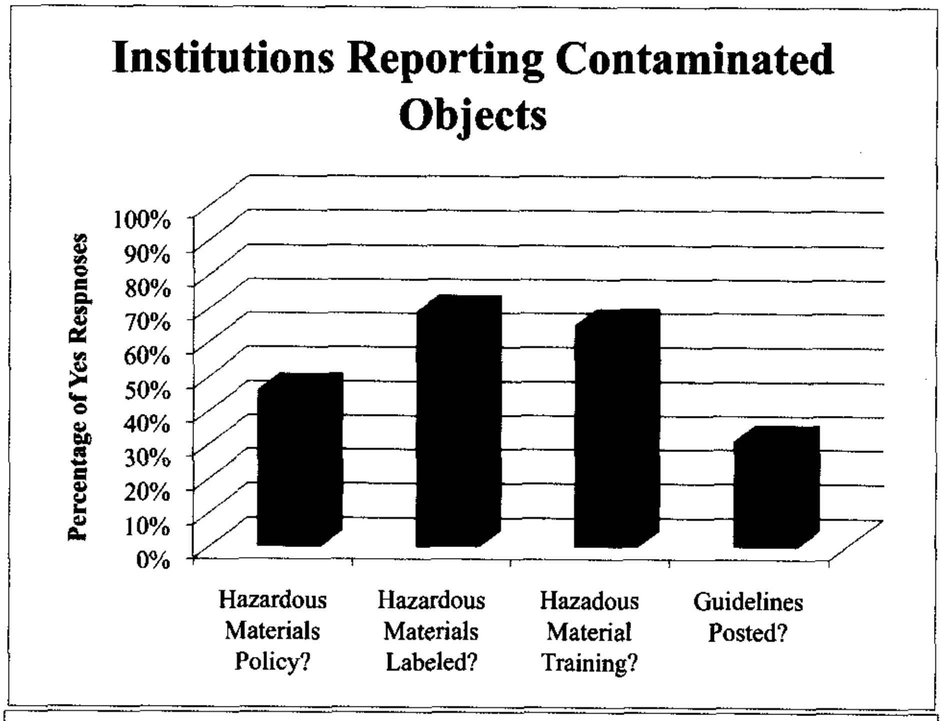
Type of Museum	Museum's Budget	Objects Contaminated with Arsenic / Mercury in Collection?	Hazardous Materials Policy in CMP?	Hazardous Collection Objects Labeled?	Train Employees to handle Hazardous Materials?	Add Hazard Warnings to Collections objects?	Safety Guidelines Posted in Workplace?
Art	$2,500,000 and above	No	No	No	No	Only to collections database	No
						We do neither	No
							Yes
					Yes	We do neither	No
			Yes	No	Yes	We do both	Yes
				Yes	Yes	We do both	No
		Yes	No	No	No	We do both	No
	$50,000 - $499,000	No	No	No	No	We do neither	No
			Yes	No	Yes	We do neither	No
	$500,000 - 2,499,000	No	No	No	No	We do neither	Yes
		Yes	No	Yes	Yes	We do both	Yes
			Yes	Yes	Yes	We do both	No
Historic House	$2,500,000 and above	No	Yes	Yes	Yes	We do both	No
		Yes	No	No	Yes	Only to collections database	Yes
	$500,000 - 2,499,000	No	No	No	No	We do neither	Yes
		Yes	Yes	Yes	No	We do both	No
	$50,000 - $499,000	No	No	No	No	We do neither	No
	Below $50,000	Yes	No	No	Yes	We do both	No
Historical Society	[illegible]	[illegible]	Yes	[illegible]	[illegible]	[illegible]	[illegible]
						[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
				Yes	[illegible]	[illegible]	
History	$2,500,000 and above	Yes	Yes	Yes	Yes	Only to collections database	Yes

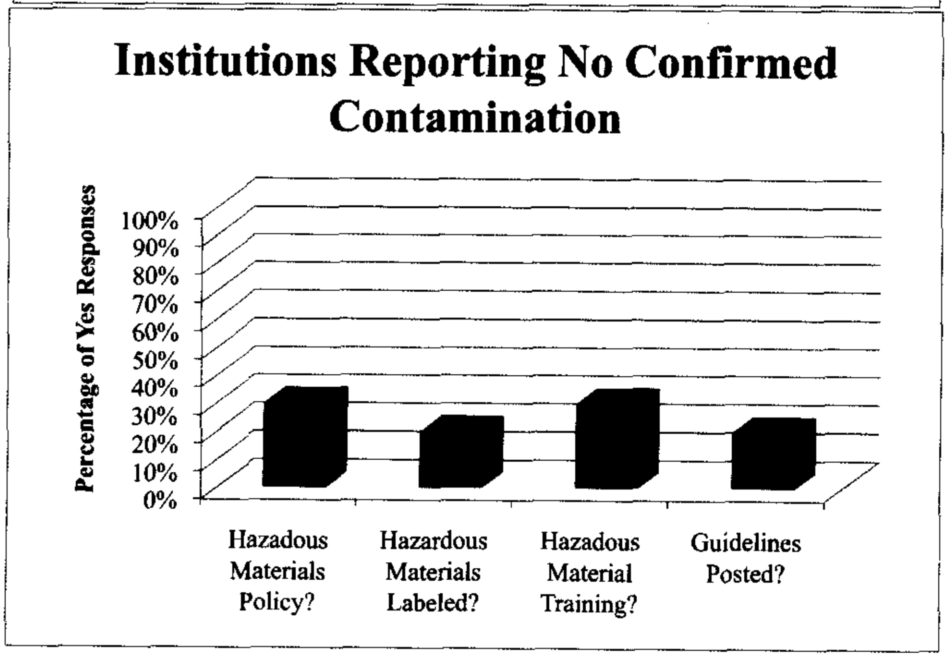
						We do both.	Yes
	$500,000 - 2,499,000	Yes	Yes	Yes	No	We do both	No
	$50,000 - $499,000	No	No	No	No	We do neither	No
				Yes	No	We do both	No
		Yes	No	No	No	We do both	No
[redacted]							
Other	[illegible]	No	No	No	No	We do neither	No
			Yes	Yes	Yes	Only to [illegible]	Yes
		Yes	No	Yes	Yes	We do both	No
							Yes
	$500,000 - 2,499,000	No	No	No	No	We do neither	No
			Yes	Yes	Yes	We do both	No
	$50,000 - $499,000	No	No	No	No	Only to [illegible]	No
						We do both	No
					Yes	We do neither	No
		Yes	No	Yes	No	We do both	No
			Yes	No	Yes	Only to [illegible]	No
	Under $50,000	No	No	No	Other	We do neither	No
		Yes	No	Yes	No	We do neither	Yes


Percentage of Yes Responses by Museum Type
Percentage of Yes Responses
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Objects Contaminated with Arsenic/Mecury?
Hazardous Materials Policy?
Hazardous Materials Labeled?
Train Employees on Hazardous Materials?
Safety Guidelines Posted?
Survey Questions
Art
Historic House
Historical Society
History
Natural History
Other


Percentage of Yes Responses by Museum Budget
Percentage of Yes Responses
70%
60%
50%
40%
30%
20%
10%
0%
Objects Contaminated with Arsenic/Mecury?
Hazardous Materials Policy?
Hazardous Materials Labeled?
Train Employees on Hazardous Materials?
Safety Guidelines Posted?
Survey Questions
$2,500,000 and above
$500,000 - $2,499,000
$50,000 - $499,000
Below $50,000

Appendix B – Graphs of Institutions Reporting Contamination and Non-Contamination





Appendix C – Safety Guidelines for Handling Contaminated Museum Collections

Post This throughout the Museum Workplace

- If you do not have information on any treatments applied to objects, treat is as you would as if pesticides were present.
- Wear nitrile gloves (not cotton or latex) while handling objects.
- Keep hands (gloved or not) away from the face.
- Do not touch door handles, phones, computer keyboards, vacuums, camera or cataloging equipment when hands are gloved.
- When removing gloves, make sure your hands do not come into contact with the exterior surface of the gloves.
- Always discard gloves after use and wash hands with soap with water, especially before eating or smoking.
- Handle potentially contaminated objects as little as possible.
- Wear a lab coat or other protective clothing to keep dust off clothing. Remove the lab coat when no longer handling contaminated material. If dealing with contaminated dust that is visible, you should also wear shoe and hair coverings.
- Always dispose or care for protective equipment properly after working with contaminated objects. Disposable items should not be reused.
- Keep lab coats clean so as to avoid transferring dust and dirt.
- If possible, work in a well-ventilated area.
- Assess your working situation and choose an appropriate type of respirator to wear. Surgical masks and dust masks are not suitable.
- No eating or drinking in the storeroom or around objects.
- Ensure that work surfaces are well cleaned after then have been in contact with artifacts.
- If you find dust on your clothing, remove your clothes as soon as you get home, bag and launder separately from other clothing.
- If you have any concerns about exposure, consult a board certified occupational medical doctor or toxicologist. Report and document any health irregularities that occur after examining, handling, or using contaminated objects.[84]

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[84] Guidelines partially based on recommendations created by Monona Rossol and Jane Sirois. (Davis, Caldararo and Palmer, Recommended Actions Regarding the Pesticide Contamination of Museum Materials 2001)

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