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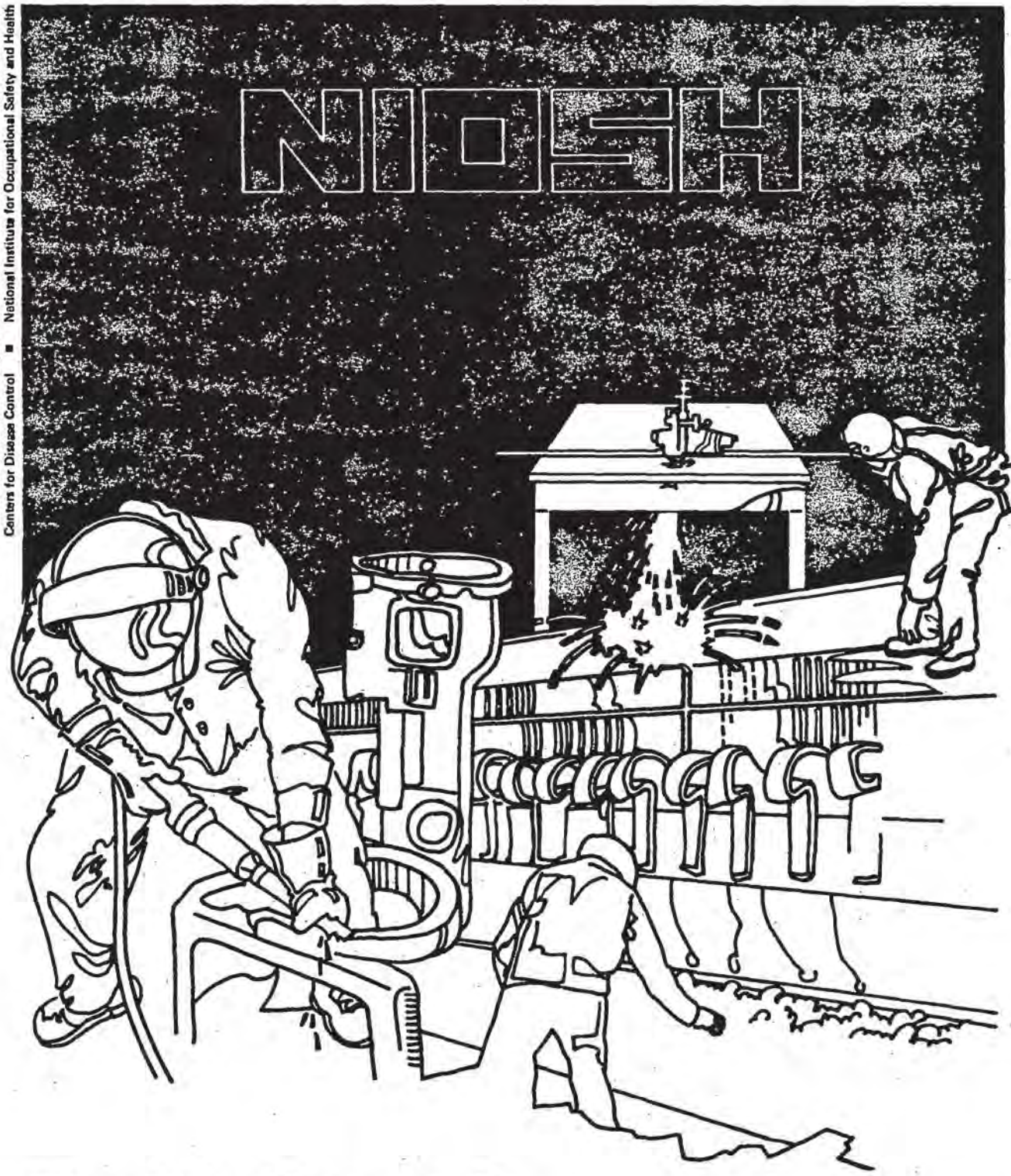

Health Hazard Evaluation Report

HETA 82-027-1281
DENVER MUSEUM OF
NATURAL HISTORY
DENVER, COLORADO

PREFACE

The Hazard Evaluations and Technical Assistance Branch of NIOSH conducts field investigations of possible health hazards in the workplace. These investigations are conducted under the authority of Section 20(a)(6) of the Occupational Safety and Health Act of 1970, 29 U.S.C. 669(a)(6) which authorizes the Secretary of Health and Human Services, following a written request from any employer or authorized representative of employees, to determine whether any substance normally found in the place of employment has potentially toxic effects in such concentrations as used or found.

The Hazard Evaluations and Technical Assistance Branch also provides, upon request, medical, nursing, and industrial hygiene technical and consultative assistance (TA) to Federal, state, and local agencies; labor; industry and other groups or individuals to control occupational health hazards and to prevent related trauma and disease.

HETA 82-027-1281
MARCH 1983
DENVER MUSEUM OF NATURAL HISTORY
DENVER, COLORADO

NIOSH INVESTIGATOR:
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I. SUMMARY

In October 1981, the National Institute for Occupational Safety and Health (NIOSH) received a request from the Denver Museum of Natural History, Denver, Colorado, to evaluate the potential health hazards of curators and/or preparators to exposures to dichlorodiphenyl trichloroethane (DDT). The request stated that 3-4 employees were potentially exposed to DDT on various occasions while cleaning, packaging, and storing of skeletons that had been coated with the pesticide.

In November 1982, NIOSH performed personal and area air monitoring for three days while employees cleaned, packaged, and removed all of the skeletons in the storage area. Due to a renovation program by the Museum this area was also completely cleaned and all materials were removed and transferred to another storage facility.

Prior to the clean-up and renovation activities, NIOSH assisted Museum officials in developing a program to reduce the DDT exposure to the employees. This program included personal protective gear, engineering controls to reduce the exposure, and proper disposal techniques.

Bulk samples of dust, dirt, and scrapings from the skeletons collected at various locations in the storage area indicated DDT levels from 4 to 5500 micrograms per gram (ug/g). Personal and area air samples taken for DDT exposures were below (range 0.001-0.1 mg/M^3) the NIOSH criterion of 0.5 milligrams per cubic meter (mg/M^3) and the OSHA standard of 1.0 mg/M^3.

On the basis of the data obtained in this investigation, NIOSH determined that a potential health hazard could exist to preparators and curators who normally work with the skeletons which had been treated with DDT. It is felt that an overexposure in this situation was avoided due to personal protective clothing and proper clean-up and disposal techniques which were developed for handling the DDT material prior to the exposure. Therefore, it is believed that the potential for further exposures can be reduced and/or eliminated if the recommendations included in Section VIII of this report are followed.

KEYWORDS: SIC 8421 (Arboreta, Botanical, and Zoological Gardens), dichlorodiphenyl trichloroethane, DDT, arsenic, zoological exhibits, preparators, curators, taxidermists, mammal skeletons, Botswanna, Africa.

II. INTRODUCTION

In October 1981, the National Institute for Occupational Safety and Health (NIOSH) received a request from a representative of the Denver Museum of Natural History, Denver, Colorado. The request stated that 3-4 employees (preparators and curators) were potentially exposed to dichlorodiphenyl trichloroethane (DDT) while cleaning skeletons which were to be used for display at the Museum. An environmental survey was conducted during the second week in November 1982 to evaluate potential exposures to DDT. A preliminary report/letter was sent to the requestor on October 16, 1982. Included in the letter were recommendations for personal protective clothing and engineering controls to reduce and/or eliminate the potential DDT exposures.

III. BACKGROUND

DDT was used as a disinfectant on numerous animal specimens that were shipped to various museums throughout the United States from Africa prior to the mid 1970's. This means of shipping mammalian species took place routinely through the early 1970's until importing of materials containing DDT was banned. It is estimated by the requestor that numerous museums in the United States have a similar problem as that of the Denver Museum. Normal exposures occur when a curator or preparator would need animal hides or skeletons for display. Display preparation requires the operator to spend numerous hours cleaning these materials prior to performing preservation techniques and assembling of the carcasses. The employees suspected a potential exposure to DDT during this cleaning process. Although the chemical was known to be present on the skeleton, it was not known how widespread the DDT contamination was in the storage area.

In 1982 the Zoological department was told by the Museum's administration that the existing bone storage room would no longer be available to the department. This was due to the demolition and renovation program that the Museum was undergoing in the auditorium, located directly above the storage room. This storage room was to be completely cleaned by the second week in November 1982; therefore one employee in the Zoological department spent three days cleaning and packing the skeletons, as well as removing all other materials in the storage area. Another employee assisted the clean-up operation for one-half day. Prior to performing this task NIOSH and Museum personnel developed a program to reduce and/or eliminate the potential exposure to DDT which was anticipated during the cleaning process (refer to the Recommendations, Section VIII). After implementing these recommendations, the cleaning process was then monitored by NIOSH.

It was later brought to the attention of the NIOSH investigator that arsenic was also a common additive in the disinfecting solution used to preserve the species prior to shipment to the States. Unfortunately, NIOSH was not made aware of this concern until after analysis of the samples had been completed.

IV. ENVIRONMENTAL DESIGN AND METHODS

A variety of sampling techniques were used to evaluate the potential exposure. Initially area and bulk samples (e.g., dust, dirt, and scrapings from the skeletons) were taken to determine the extent of the problem. Later personal and area samples were taken during the clean-up operation. The following is a description of the techniques used:

A. DDT Bulk Samples

A total of six bulk samples--2 dirt, 2 dust, and 2 skeleton scrapings--were collected for DDT analysis. These samples were all analyzed by gas chromotography and electron capture.

B. DDT Personal and Area Samples

A total of three personal and six area type air samples were collected for DDT during the clean-up operation. DDT was collected on 37 mm filters and a chromosorb tube was placed directly behind each filter. Air was pulled through the sampling set up at one liter per minute (LPM) with air sampling pumps. All the personal and area samples were analyzed by gas chromatography and electron capture.

V. EVALUATION CRITERIA AND TOXICOLOGY

A. Environmental

The three sources of criteria used to assess the workroom concentrations of DDT were (1) the Occupational Safety and Health Administration (OSHA) standards (29 CFR 1910.1001); (2) the NIOSH criteria for a recommended standard; and (3) the American Conference of Governmental Industrial Hygienists (ACGIH) Threshold Limit Values for Chemical Substances and Physical Agents in the Workroom Environment (TLV) (1981).

NIOSH recommends that occupational exposure to DDT be controlled so that workers are not exposed to a workroom air concentration for an 8-hour time-weighted average (TWA) exposure of 0.5 mg/M^3 (skin)*. The ACGIH-TLV criterion and OSHA standard for DDT for an 8-hour (TWA) exposure is 1.0 mg/M^3 (skin).*

* Skin notation refers to the potential contribution to the overall exposure by the cutaneous route including mucous membranes and eye, either by airborne, or more particularly, by direct contact with the substance.

B. Toxicological[1,2,3]

DDT is a chlorinated hydrocarbon insecticide that is more persistent in the environment than most other synthetic organic pesticides. DDT was once widely used in the United States and it has hence stopped. Toxic effects were normally observed from industrial and agricultural uses. Prior to its ban in this country the major concern was chronic absorption, particularly as a residue in food stuffs. In general these pesticides act on the central

nervous system to stimulate or depress its function. Mild chlorinated hydrocarbon poisoning causes such symptoms as dizziness, nausea, abdominal pain, and vomiting. Other symptoms include confusion, malaise, headaches, and eye and skin irritation. Both NIOSH and OSHA recommend that skin contact should be avoided.

C. Population at Risk

Those employees at greatest risk to DDT and/or arsenic exposures are those persons directly involved with the cleaning of the skeleton bones, e.g., curators, preparators, and assistants. This is potentially true for any such work/exposure to mammalian species that were killed and transported from Africa prior to the mid 1970's. This is especially suspected for those shipments that originated from Botswanna, Africa.

VI. ENVIRONMENTAL RESULTS AND DISCUSSION

Six bulk samples were taken for DDT and the analytical results indicated levels from 4 to 5500 ug/g (refer to Table 1). These levels only suggest the range of contamination present in this environment and not the potential exposure to the employee.

Three breathing zone air samples and six general area air samples were also taken for DDT. The sample results indicated levels ranging from 0.002 to 0.1 mg/M^3 which is less than the criterion of 0.5 mg/M^3 (NIOSH) or the OSHA standard, which is also 1.0 mg/M^3 (refer to Table 2).

No medical complaints were mentioned by any of the employees who were involved in the operation evaluated by NIOSH.

VII. CONCLUSIONS

Based on these results it can be concluded that the employees working with the skeletons coated with DDT were not overexposed to airborne concentration of DDT above the recommended limits for the conditions NIOSH evaluated.

It is impossible to determine if the employees would have been exposed to higher levels of DDT had they not prepared themselves with the personal protective clothing and the engineering controls that were instituted prior to their exposure. However, like other chlorinated compounds, DDT is most efficiently absorbed by ingestion/skin contact which would normally occur when the employees worked with the materials in question.

VIII. RECOMMENDATIONS

The following are recommendations presented to the Denver Museum prior to the employees handling the skeletal materials which were coated with DDT. The Museum implemented these recommendations and, therefore, it is felt that these steps helped reduce the potential exposure to the employees involved in the cleaning operation.

1. Personal protective clothing should be mandatory when handling pesticides such as DDT and this includes:

   a. Coveralls (impervious), boots, gloves, and head caps should be worn during all cleaning phases. This would include cleaning as much of the DDT off the skeletons that is possible, packing the cleaned skeletons for shipment to the new storage area, and cleaning the storage area after all the skeletons have been removed from this area.

   b. Organic pesticide type respirators (disposable or non-disposable) should be worn during each of the cleaning phases described above. These respirators should be NIOSH/MSHA approved for working with pesticides.

2. Personal hygiene procedures should be strictly adherred to during the cleaning procedures. This would include cleaning of one's hands and face before eating, drinking, or smoking. These employees should also shower as soon as possible after the work day.

3. Engineering controls to reduce and/or eliminate exposures should be instituted at each of the cleaning phases. Examples would include:

   a. A cleaning enclosure/compartment could be designed to collect the waste DDT materials during the cleaning of the bones. This container could simply be a large drum (hazardous shipping drum) with a heavy mesh screen positioned on the top of the drum. During the cleaning, the skeletons could lay on top of the screen and thus allow the waste material to drop into the container.

      NOTE: For a more efficient collection of fine dust particles which may not settle out in the drum a vacuum system hose could be dropped into the drum and positioned approximately 2-3 feet from the bottom. This would then capture the fine particles before they escape from the top of the drum. As necessary the vacuum hose could be pulled closer and closer to the top until the drum is full.

   b. During the cleaning of the basement, brooms and a vacuum system should be used. The vacuum system should use a high efficiency filter system to prevent small particulates from becoming airborne.

4. Storage and shipping of DDT waste materials should be performed according to the Environmental Protection Agency's (EPA) hazardous waste criteria. This would include proper storage containers, hazardous shipping markers and billets, and proper disposal of this material according to EPA regulations. (Refer to information presented during the October 14 meeting.)

IX. REFERENCES

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3. Industrial Toxicology, third edition, Hamilton and Hardy, Publishing Service Group, Inc., 1974.

4. "Threshold Limit Values for Chemical Substnces in Workroom Air", American Conference of Governmental Industrial Hygienists, 1982.

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XI. DISTRIBUTION AND AVAILABILITY

Copies of this report are currently available upon request from NIOSH, Division of Standard Development and Technology Transfer, Information Resources and Dissemination Section, 4676 Columbia Parkway, Cincinnati, Ohio 45226. After 90 days the report will be available through the National Technical Information Service (NTIS), Springfield, Virginia. Information regarding its availability through NTIS can be obtained from NIOSH, Publications Office, at the Cincinnati address.

Copies of this report have been sent to:

1. Denver Museum of Natural History
2. U.S. Department of Labor/OSHA - Region VIII.
3. NIOSH - Region VIII.
4. Colorado Department of Health.
5. State Designated Agency.

For the purpose of informing affected employees, a copy of this report shall be posted in a prominent place accessible to the employees for a period of 30 calendar days.

TABLE 1

DDT - Bulk Samples

Denver Museum of Natural History
Denver, Colorado

November 1982

Area Description	DDT (ug/g)
West Shelf (near door/dirt sample)	1700
West Shelf (center/skeleton scrapings)	2800
West Shelf (near windows/dirt sample)	5500
Stand/Table (skeleton scrapings)	1100
Center Table (dust sample)	28
Box on Floor (dust sample)	4
LABORATORY LIMIT OF DETECTION ug/sample	0.002

ug/g = micrograms of substance per gram.

TABLE 2

DDT - Area and Personal Samples

Denver Museum of Natural History
Denver, Colorado

November 1982

Job/Area Description	Sampling Time (minutes)	mg/M^3 DDT
1st Day		
West Shelf	240	0.1
North Stand	240	0.02
East Shelf	240	0.02
Operator/Preparator	240	0.10
Operator Assistant	120	0.04
2nd Day		
West Shelf	450	0.002
North Shelf	450	0.005
East Shelf	150	0.034
Operator/Preparator	450	0.1

EVALUATION CRITERIA	NIOSH	0.5
	OSHA/ACGIH	1.0
LABORATORY LIMIT OF DETECTION	ug/sample	0.002

mg/M^3 = milligrams of substance per cubic meter of air.

ug = micrograms

NOTE: Both NIOSH and OSHA recommend that skin contact should be avoided.

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