U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES ■ Public Health Service
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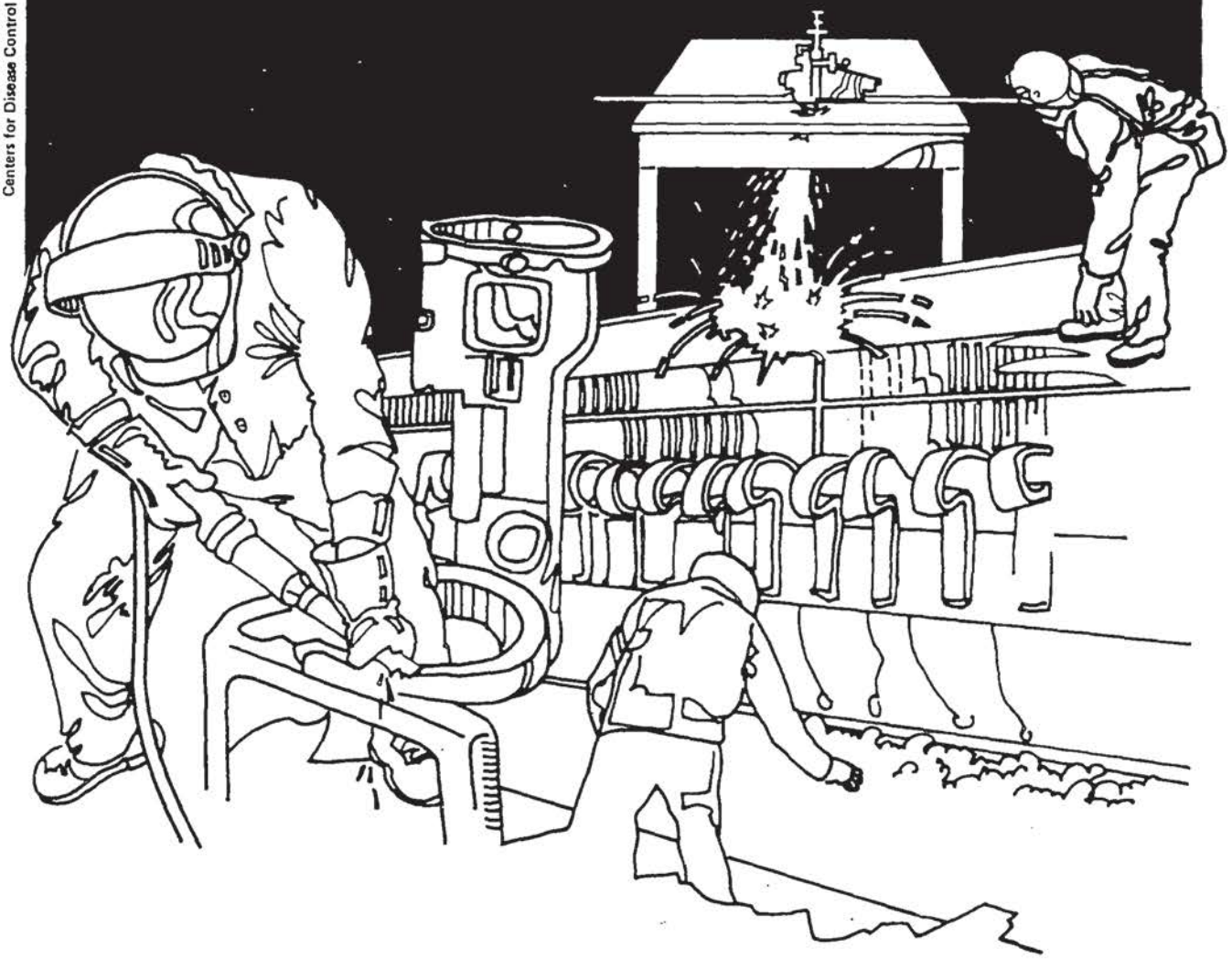
NIOSH



Health Hazard Evaluation Report

HETA 83-444-1481
GEORGETOWN UNIVERSITY
WASHINGTON, D.C.

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.

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NIOSH INVESTIGATORS:
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I. SUMMARY

On September 15, 1983, the National Institute for Occupational Safety and Health (NIOSH) was asked to evaluate a chlordane spill at Lauinger Library, Georgetown University, Washington D.C. On May 31, 1983 approximately two to five gallons of 1% chlordane solution was inadvertently introduced into the space above the false ceiling of a subterranean library room. Several library employees had experienced headache, nausea and irritability due to the incident and had sought medical attention.

NIOSH investigators visited the site on October 17, 1983 to collect data related to the incident, obtain air, surface wipe and bulk samples for chlordane analysis, interview employees regarding symptoms possibly related to the spill, obtain blood samples for chlordane and chlordane metabolites, and to request, for subsequent review, the medical records of those employees who sought medical attention.

Environmental samples obtained by the District of Columbia six or more days after the spill, which had been dry-mopped but not thoroughly cleaned up, documented chlordane concentrations of 325 ppm in a piece of contaminated ceiling tile and 215 micrograms of chlordane in an acetone-wetted, swab wipe of a four-square-inch area of floor tile. Documents were found to contain up to 416 ppm, and 13 swab wipes of various room surfaces ranged from not detectable (N.D.) to 27.8 ug per sample. Air samples taken by the District of Columbia and the University's industrial hygienist were negative at a lower limit of detection of 0.5 ug/m^3.

NIOSH samples, which were taken six months after the the spill and after cleanup, detected 0.1 to 0.3 ug/m^3 in three air samples and 0.1 to 0.3 ug sample in three of eleven toluene-wetted, filter wipes of 4 square inches.

The current OSHA standard for chlordane is 500 ug/m^3. In 1979, the Committee on Toxicology of the National Research Council (NRC) suggested that an interim guideline of 5 ug/m^3 be used by the Air Force in their evaluations of chlordane use in military housing. In 1982, this same committee reviewed available evidence and saw no reason to change their recommendation but stressed that there was a need for more information. All three air samples from the library room were less than a tenth of the NRC guideline.

Twelve employees (six worked full or part-time in library) and 1 former employee were interviewed and gave blood samples for analysis of chlordane, chlordane metabolites (heptachlor epoxide and oxychlordane) and monochlor (contaminant of chlordane).

During the four days following the spill, individuals involved in the cleanup of the solution or in intermittent retrieval of documents from the GDR experienced a complex of gastrointestinal and neurological symptoms consistent with acute chlordane toxicity. Symptoms for the majority of the individuals resolved within 48 hours; however, intermittent symptoms were reported up to two months following the initial exposure. Serum levels of chlordane and its metabolites obtained by NIOSH in October, 1983 showed no evidence of continued significant absorption of chlordane or its contaminants.

Cleanup of the chlordane spill effectively removed all but "trace" amounts of chlordane. The toxicological significance of these "trace" amounts is not known, but, considering the use of the room, health risks are believed to be minimal. A more timely cleanup may have precluded the reported symptoms. Recommendations are made to continue monitoring quarterly for a year to insure air concentrations of chlordane do not increase.

KEYWORDS: SIC 8231 (Libraries) chlordane, heptachlor epoxide, oxychlordane

II. INTRODUCTION

On September 15, 1983 NIOSH was asked via a confidential request to evaluate residual chlordane levels following the cleanup of an accidental spill in the Government Documents Room (GDR) of Lauinger Library, Georgetown University which occurred on May 31, 1983. NIOSH was also asked to evaluate the health effects from exposure during and after the spill.

In response to the request, a NIOSH medical officer and an industrial hygiene engineer conducted a field survey on October 17, 1983. Results of the survey were forwarded to the requestor(s) and the University's Safety and Health Department by letter on January 9, 1984. All persons who participated in the NIOSH blood tests were individually notified of their results in December 1983.

III. BACKGROUND

The GDR is located one floor below grade and measures 25'X36'X9'. It has a vinyl tile floor, painted concrete block walls and a suspended, acoustical tile ceiling.

On the morning of May 31, 1983, the GDR room of the Lauinger Library, Georgetown University, was contaminated with the pesticide chlordane (1% solution). A pest control firm hired by the university had drilled into the crawl space above the ceiling of the subterranean GDR and applied the chlordane. Within minutes of the initiation of the application, leakage was noted through the ceiling tiles and the application was stopped. Approximately two to five gallons of material was spilled. On June 3, 1983, the day the spill was reported to the University Safety Office, the GDR was closed except to personnel involved in the cleanup and to intermittent use by the librarians who needed to retrieve documents.

Also on June 3rd, the Division of Pesticides and Hazardous Waste Management, Department of Environmental Services, Government of the District of Columbia, was contacted by a library official who was concerned about "pooling" of the chemical on the floor of the GDR. The library official reported that a custodian who was cleaning up the chemical was noted to be irritable and nervous, and had reported headache and diarrhea after having gotten the pesticide on his skin and clothing. Books, floors, walls, and shelves were reported to have become saturated with the pesticide.

The initial clean-up was with 3:1 mixture of water and ammonia, and a "degreasing" compound. On the advice of the manufacturer of the pesticide, the floors were stripped with a wax remover, the shelving and walls were cleaned with bleach and detergent, and wet boooks were placed in plastic bags for discarding. All the ceiling tiles were removed and replaced and the walls were repainted with epoxy paint. Many documents considered to be irreplacable were photocopied by librarians wearing gloves.

On July 27th the GDR was reopended for full-time use. There are five GDR employees

IV. METHODS

A. Environmental

Chlordane residual was evaluated by: 1) collecting three area air samples in the GDR for chlordane analysis, 2) obtaining solvent wipe samples of surfaces (4 square inches) such as walls, floor, desk top and shelves for chlordane analysis, and 3) analyzing 4 documents from the shelves for residual chlordane. Data obtained by the University Safety Office, EPA and OSHA prior to NIOSH's involvement was reviewed.

Air samples were collected using Supelco, ORBO-42, 150 mg sorbent tubes at a flow rate of 0.5 liters per minute (LPM). Each sampling tube was desorbed with 1.5 ml toluene, sonicated for one hour, and analyzed via gas chromatography with electron capture detection. A 6'x 2mm i.d. glass column packed with 3% OV-17 and 3% QF-1 on 100/120 mesh gas Chrom Q was used isothermally at 180°C. Quantification was accomplished by summing the peak heights of the five major peaks. The limit of detection was 0.025 ug/sample.

The solvent wipes (toluene-wetted Whatman filter tabs) were extracted with toluene and analyzed as described above.

Ten-gram portions of the bulk document samples were extracted with methylene chloride, sonicated for one hour, and analyzed as described above.

B. Medical

Eleven current employees and one former employee who worked in the GDR were interviewed. Medical records of those individuals who received treatment either at Employee Health Services or at local emergency rooms were reviewed. In order to assess the possible ongoing exposure to chlordane following the cleanup by the university, blood samples were taken and analyzed for chlordane metabolites (heptachlor epoxide and oxychlordane), and a constituent contaminant of chlordane (trans-nonachlor). Samples were processed by ESA Laboratories in Massachusetts. The limit of detection was 1 part per billion.

V. CRITERIA/TOXICOLOGY

The primary exposures following the spill were to chlordane, a chlorinated hydrocarbon pesticide, and ammonia (used in cleanup).

A. Chlordane

Technical chlordane is a mixture of chlorinated hydrocarbons, 60% of which are isomers of chlordane (alpha and gamma) with the remaining part consisting of heptachlor, nonachlor, hexachlorocyclopentadiene, and other related dicyclopentadiene derivatives. From its introduction in 1947 until regulatory action by the United States Environmental Protection Agency (EPA) in 1976, chlordane had been used extensively for control of insects on grains, fruits, vegetables, and other agricultural products. In 1978 the EPA cancelled chlordane's registration as an agricultural pesticide[1], restricting its use to control of household pests, in particular, termites.

Chlordane is rapidly absorbed following dermal contact, ingestion, or inhalation. Chlordane is not found in tissue in the general population. Heptachlor epoxide, a metabolite of chlordane, is found in tissue in the general population. However, a small fraction of the heptachlor epoxide arises from the heptachlor component of chlordane. Oxychlordane, a metabolite peculiar to chlordane, and trans-nonachlor, a minor component of both technical chlordane and technical heptachlor, are also found in body tissues in the population.

The results of the second National Health and Nutrition Examination Survey (NHANES II) demonstrated chlordane metabolites (oxychlordane, heptachlor epoxide) and its contaminants (trans-nonachlor) to be present in up to 6% of the sample population at levels greater than 1-2 ppb (the limit of detection). Analysis was based on approximately 4200 specimens from persons in 54 locations throughout the United States from 1976 to 1980.[2]

In 9000 samples of human adipose tissue, gas-liquid chromatography demonstrated quantifiable residues of heptachlor epoxide (approx. 0.10 ppm in 90% of those sampled), oxychlordane (approx. 0.10 ppm in 90% of those sampled), and trans-nonachlor (approx. 0.10-0.18 ppm in 96-97%).[3]

A Japanese study of 21 pest control operators reported total chlordane levels (cis-chlordane + trans-chlordane + trans-nonachlor + oxychlordane) ranging from 0.57 ppb to 83 ppb (mean of 12 ppb).[4] Oxychlordane and trans-nonachlor are both detected in human milk at an average concentration of 0.005 and 0.001 ppm respectively.[5] Data from accidental ingestions of chlordane range from a whole body half-life of 21 days[6] to a serum half-life of 88 days,[7] with chlordane partitioning 300 times greater in adipose tissue than in serum.

All established cases of chlordane poisoning have been associated with gross exposure to large amounts of chlordane during spraying or manufacturing operations or by accidental ingestion or prolonged skin contact. Chlordane is a central nervous system stimulant. Acute chlordane poisoning produces central nervous system symptoms, including headache, blurred vision, dizziness, slight involuntary muscular movements, tremor, sweating, insomnia, nausea, and general malaise. More severe illness is characterized by convulsions, disorientation, loss of consciousness, personality changes, psychic disturbances, and loss of memory.[8] In addition, gastritis, enteritis, kidney involvement and diffuse bronchopneumonia leading to death have been reported in a cases of suicidal ingestion.[9] Although short term exposure to low levels of chlordane does not typically produce symptoms, little information exists about the possible human health effects of continued low level exposure.

There is one report in the medical literature describing a community-wide "outbreak" of chlordane toxicity. Accidental contamination of a public water system of Chattanooga, Tennessee resulted in exposure of 105 people in 42 houses to tap water containing concentrations of chlordane ranging from less than 0.1 to 92,500 ppb. In 23 houses the concentration exceeded 100 ppb, and in 11 houses it exceeded 1000 ppb. Of 71 residents affected, 13 (18%) had symptoms compatible with mild acute chlordane toxicity, including gastrointestinal symptoms (nausea, vomiting, or abdominal pain) and neurological symptoms (dizziness, blurred vision, irritability, headache, paresthesia, or muscle dysfunction). No individuals were hospitalized, and all recovered within 48 hours after exposure.[10]

Animal studies indicate that the liver can be affected and may be the most sensitive organ following chronic exposure to levels not producing overt symptoms of toxicity.[11] One study comparing liver function enzymes in 56 controls with 71 pesticide-exposed workers showed no difference in five serum (SGOT, SGPT, LDH, alkaline phosphatase, CPK) and one urinary (D-glucaric acid) parameters for liver function despite larger tissue stores of DDT and dieldrin in the pesticide-exposed group.[12]

Carcinogenicity data are limited to long-term high-dose exposure of mice. The incidence of hepatoma is increased in B6C3F1 mice fed chlordane. However, a similar high incidence of hepatocellular carcinoma fails to appear in significant numbers in rats fed chlordane.[13] Death records of 1403 workers employed for longer than three months in the manufacture of chlordane and heptachlor from 1946-1976 showed no excess deaths from cancer.[14] (A statistically significant excess of cerebrovascular disease (17 observed vs. 9.3 expected was observed.)[14] An extension of the study showed a statistically significant trend in standard mortality ratios for cancer deaths in workers with increasing

duration of employment. Measurement of and stratification by the extent of exposure were not reported.[15]

According to the NRC Committee on Toxocology, "limited human studies with long-term exposure have not revealed any consistent or significant detrimental effect."[8]

B. Ammonia

Air samples were not taken for ammonia since the ammonia was only used during a cleanup operation which occurred more than 5 months prior to NIOSH involvement. The following brief description of toxic effects from overexposure is included because some health effects experienced by the cleanup crew may have been due to ammonia.

Ammonia is a severe irritant of the eyes, respiratory tract, and skin. Human exposure to vapor concentrations of 134 ppm for five minutes cause eye, nose, and throat irritation in most subjects. Exposure from 2500 to 6500 ppm can cause severe corneal irritation, dyspnea, bronchospasm, chest pain, and pulmonary edema.[16]

VI. RESULTS AND DISCUSSION

A. Environmental

1. Data Obtained Before NIOSH Evaluation

Environmental samples taken by the District of Columbia on June 6, 1983 (after the liquid chlordane was mopped up but before more thorough cleaning with an ammonia solution) revealed that the ceiling tile in the area of the spill was contaminated with 325 ppm chlordane and an acetone-wetted, 4-square-inch, swab, surface wipe sample of floor tile in the area of the spill detected 215 ug of chlordane.

Two documents believed contaminated with the liquid pesticide were analyzed and found to contain 416 and 291 ppm. A document not believed to be contaminated contained 0.3 ppm.

Of 13 swab wipe samples taken from various floor, wall, shelf and ceiling surfaces, and analyzed for chlordane residue, 5 were N.D. (not detectable), 5 ranged from 1 to 5 ug/swipe and 3 detected 5.9 (floor), 18.3 (shelf) and 27.8 (ceiling) ug/swipe.

Two air samples taken by the District of Columbia and several taken by the University's Industrial Hygienist were N.D. The limit of detection was approximately 0.5 to 1.0 ug/m^3 depending on the sampling rate and time. No air samples were taken until 6 days after the spill and initial cleanup.

2. Environmental Data (NIOSH 10/17/83 Survey)

Chlordane wipe and air sample data are presented in Table 1. Sample locations are illustrated on Figure 1.

a. Air Samples

Chlordane was detected in all three air samples in concentrations of 0.18, 0.13 and 0.13 micrograms per cubic meter (ug/m^3) indicating that chlordane vapor was evolving from contaminated areas within the room. One air sample was taken by the University Safety Office at the same location as the NIOSH sample that detected 0.18 ug/m^3. No chlordane was detected; however, this was explained upon review of the University's laboratory report. NIOSH's limit of detection (LOD) for chlordane was 0.02 ug/sample. The LOD of the laboratory used by the University was 0.2 ug/sample. Therefore, considering the volume of air sampled, chlordane would had to have been present in concentrations greater than 0.5 ug/m^3 to have been detected in the University's air sample. The concentrations found by NIOSH were all below 0.5 ug/m^3.

The current OSHA standard for chlordane is 500 ug/m^3. NIOSH has not issued a recommended standard for chlordane. In 1979, the Committee on Toxicology of the National Research Council (NRC) suggested that an interim guideline of 5 ug/m^3 be used by the Air Force in their evaluations of chlordane use in military housing. In 1982, this same committee reviewed available evidence and saw no reason to change their recommendation but stressed that there was a need for more information. All three air samples from the GDR room were less than a tenth of the NRC guideline.

b. Wipe Samples

Of the 13 wipe samples, (4 square inches each), 3 were positive. The top surface of the fluorescent light fixture directly below the spill area was contaminated with 0.22 ug using a "wet" (solvent) wipe. No chlordane was detected using a "dry" wipe on an area next to that tested by the "wet" wipe. All other samples were taken using a "wet" wipe technique. A floor wipe (row 4, middle aisle, 5 feet from rear wall) contained 0.04 ug of chlordane and a wipe of the top shelf of row 2, 6 feet from the rear wall, detected 0.46 ug of chlordane.

c. Bulk Samples

Three of the four documents analyzed contained chlordane. The document that was obviously contaminated and had a strong "pesticide-like" odor was found to contain 210 ppm chlordane. Two documents taken from shelves that were not known to be contaminated with the liquid pesticide contained 0.2 and 0.31 ppm chlordane.

3. Followup Sample Data Taken After Additional Cleanup Recommended by NIOSH

NIOSH recommended in a letter dated January 9, 1984 that:

a. The fluorescent light fixture in the false ceiling directly below the hole in the ceiling that the chlordane was pumped into should be cleaned. The concrete dust on the top of the fixture from the drilling operation suggests that it was not cleaned.

b. The metal shelving units directly beneath the spill area should be moved to inspect the floor area beneath them for signs of pesticide contamination. Due to a water leak, clear water drained into one side of the shelving unit and an amber-colored solution was reported to have drained out the other side. (This could be a significant area of contamination and may be responsible for the detectable airborne concentrations of chlordane).

c. The surfaces of the shelving units that are moved should be cleaned again.

d. The door to the GDR room should be left open as much as possible to increase air circulation. If the door is closed, all of the air trying to enter via the ceiling diffusers must leave the room via the small grille in the south wall.

e. Documents that were wetted with the liquid pesticide will usually have a characteristic, pesticide-like odor. Even though most of them have been discarded, due to relocating some documents, some additional copies may be discovered which should also be discarded.

f. We also recommend that air samples be obtained after the above recommendations are accomplished. The enclosed cover sheet from out laboratory report discusses the analytical method used for analysis of the NIOSH chlordane air samples. It may be helpful in explaining the differences in the lowest detectable limit between the laboratory used by the University and by NIOSH. We would be happy to supply some ORBO 42 tubes for the first air sampling after the recommended cleanup and will also analyze duplicate samples if desired.

The cleanup recommended by NIOSH was accomplished and followup air samples were taken by the Universities Industrial Hygienist on 2/15, 2/21 and 2/22/84 using ORBO-42 sorbent tubes supplied by NIOSH. The samples were shipped back to NIOSH for analysis. These 3 samples are listed in Table 1 as A4, A5 and A6. Two of the three samples, both of which were taken in the area of the spill were positive at 0.2 and 0.3 ug/m^3 which indicates that the additional cleanup may have not been successful in reducing the airborne chlordane levels to N.D. or that the ventilation system was recirculating more air in February (colder outside temperature) than in the previous October (milder outside temperature) and therefore bringing in less outside (dilution) air.

Of note was the fact that the chlordane spill, although reported to the library office on the same day as the spill, was not reported to the Universitys Safety Office until June 3, 1983 (4 days later). This resulted in the spill being initially cleaned up without proper protective gear and resulted in several days of "higher-than-necessary" chlordane exposure to the library staff.

B. Medical

Medical interviews and records of individuals who sought attention at local emergency rooms or at the Employee Health Service were obtained for 13 individuals. These 13 people represented the following occupations:

	#
GDR librarians - full-time	3
GDR librarians - part-time/students	3
Reference librarians - full-time	4
Maintanence men	2
Cleaning woman	1

Of all those interviewed, symptoms were experienced referable to being in the GDR by 10 of 13 individuals. A summary of their symptoms is presented in Table 2.

On the basis of exposure information provided by the individuals, a group of 10 people was identified as having potentially high dermal or inhalational exposure. This group was selected based on the amount of time spent either directly involved cleaning up the spill, working in the library retrieving documents during the week following the spill, or working more than 20 hours per week in the GDR after it reopened in July, 1983. Of this group with potential high exposures, a sub-group of six individuals involved directly in the clean-up or with retrieving documents during the week following the spill was also looked at. Frequency of symptoms is noted in Tables 3 and 4 for these two groups.

From reports of physical examinations conducted within four days of the spill, lateral nystagmus was noted in one individual, while bilateral swelling of the hands and painful paresthesias to light touch with inability to grip secondary to pain on clenching fists was noted in another.

The gastrointestinal and neurological symptoms described here are similar to those described in the outbreak of water-borne chlordane exposure.[13] The gastrointestinal symptoms described were nausea and diarrhea. The neurological symptoms consisted of headache, dizziness, irritability, paresthesias, muscle dysfunction, and blurred vision.

Ten (77%) of the 13 persons interviewed or for whom medical records were available gave a history of either dermal or inhalation exposure to the spill. Nine of these ten individuals (90%) described symptoms compatible with chlordane exposure. Three gave a history of gastrointestinal and neurological symptoms, while six others had gastrointestinal symptoms alone or isolated neurological symptoms. Only symptoms commencing between 11:30 a.m. on May 31st and June 3rd, and those that commenced during the one week period in July following the reopening of the GDR, were considered relevant. No symptoms persisted to the time of our visit in October.

The group of individuals involved directly in the clean-up, with the highest dermal and/or inhalational exposure, also had the highest prevalence of symptoms. Neurological sequelae (headache, irritability, confusion, malaise, dizziness, paresthesias, numbness) were most commonly reported. Nausea was experienced by 50% of those questioned. Throat irritation and respiratory burning was most likely related to the ammonia solution used in the cleanup.

Tests of liver function in two symptomatic individuals during the first week following exposure were within normal limits.

On October 17th, blood was drawn from 12 participants for chlordane, heptachlor epoxide, oxychlordane, and t-nonachlor. If employees were still receiving ongoing exposure to significant quantities of chlordane from the work environment, we would have anticipated finding measurable levels of chlordane, its metabolites, or constituent contaminents in the blood. The limits of detection are 1 ppb (part-per-billion). Samples were processed by ESA Laboratories in Massachusetts. Three values were reported for each sample submitted: 1) sum of heptachlor epoxide + oxychlordane 2) chlordane 3) t-nonachlor. A summary of the laboratory results are presented in Table 5.

No detectable chlordane or t-nonachlor was found in any of the samples, and in 11 of 12 samples tested for heptachlor epoxide + oxychlordane. The one sample with a detectable level had 2 ppb of heptachlor epoxide + oxychlordane, just above the minimal limit of detection. Since both heptachlor epoxide and oxychlordane are detected with a frequency of 4% in the general population based on survey data summarized by Murphy, et.al.,[2] it is not unexpected to find one person in our sample with a detectable level.

VII. CONCLUSION

On May 31, 1983, an accidental spill of the pesticide chlordane occurred in the Government Documents Room (GDR) of the Lauinger Library, Georgetown University, contaminating the walls, shelves, books, floors, and ceiling of the room.

Environmental air samples obtained as long as 8 months after the spill and subsequent cleanup indicated that chlordane-contaminated room surfaces such as the vinyl floor, shelfs and books are still off-gassing resulting in air levels of chlordane from 0.2 to 0.3 ug/m^3.

During the four days following the spill, individuals involved in the clean-up of the solution or in intermittent retrieval of documents from the GDR experienced a complex of gastrointestinal and neurological symptoms consistent with acute chlordane toxicity. Symptoms for the majority of the individuals resolved within 48 hours, however intermittent symptoms were reported up to two months following the initial exposure. Biologic exposure monitoring measured by serum levels of chlordane showed no evidence of continued significant absorption of chlordane or its contaminants.

The long-term health effects of this type of exposure are unknown. Judging from the lack of observed health effects in pesticide applicators or in chemical workers involved in the manufacture of chlordane, it is possible to infer that the long-term health risks following this brief exposure are minimal. Nonetheless, exposure to chlordane, a described animal carcinogen, should be kept to an absolute minimum.

VIII. RECOMMENDATIONS

1. Chemical spills should be reported to the University Safety Office as soon as possible after the incident so that the proper cleanup/followup actions can be initiated more quickly.

2. We believe the GDR can be operated without significant health risk as long as airborne levels do not increase. To insure this is the case, air sampling should be repeated every 3 months and the air handling system should be checked to insure that it is providing outside air at the rate of at least 0.1 CFM of outside air per square foot (D.C. Building code, Section 503.9). For the GDR, this would be a minumum of 100 CFM of outside air (0.1 X 1000 ft^2). If the chlordane air concentrations stay at the current levels or below, it would seem reasonable to discontinue sampling after one year.

3. Documents directly contaminated with the liquid pesticide will usually have a characteristic, "pesticide-like" odor. Even though most have been discarded, due to relocating some documents, additional copies may be discovered which should also be discarded.

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XI. DISTRIBUTION AND AVAILABILITY OF REPORT

Copies of this report are currently available upon request from NIOSH, Division of Standards Development and Technology Transfer, Publications Dissemination Section, 4676 Columbia Parkway, Cincinnati, Ohio 45226. After 90 days, the report will be available through the National Technical Information Service (NTIS), 5285 Port Royal, Springfield, Virginia 22161. 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. Confidential Requestors
2. Lauinger Library
   Georgetown University
3. NIOSH, Region III
4. OSHA, Region III

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

Figure 1
GDR Room
HETA 83-444
October 17, 1983

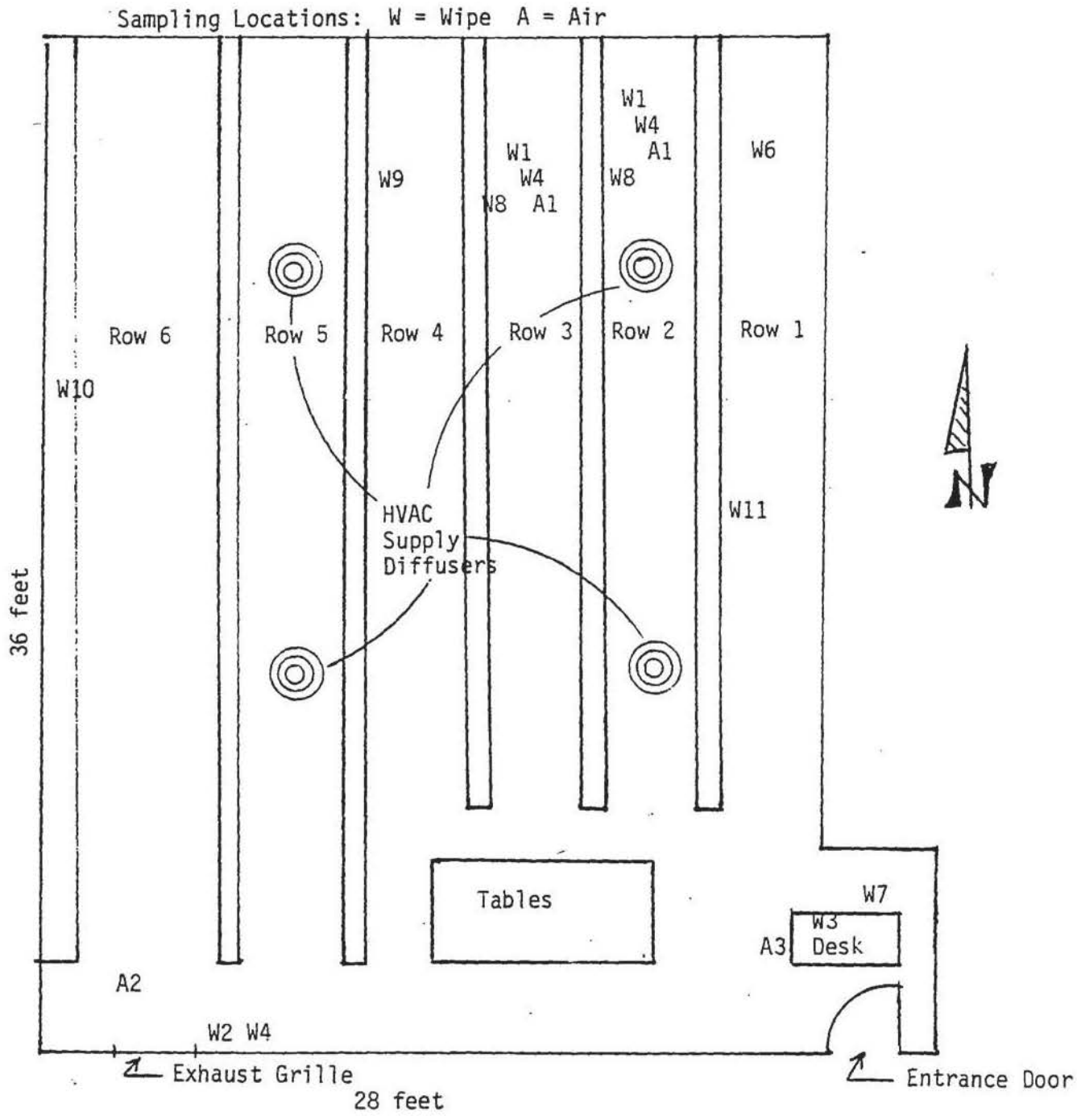

Table 1
Chlordane Results
Wipe and Air Samples
Government Document Room
HETA 83-444

October 17, 1983

Sample #/Type[1]	Location	Chlordane
W1/light	Fluorescent light	0.22 ug/wipe
W2/wall	Next to exhaust grill	N.D.[2]
W3/desk	Desk top	N.D.
W4/floor	Row 2, 5' from North wall	0.04 ug/wipe
W5/floor	SW corner of room	N.D.
W6/floor	Row 1, 5' from North wall	N.D.
W7/floor	Under Librarians desk	N.D.
W8/floor	Row 2, 6' from North wall	0.46 ug/wipe
W9/shelf	Row 4, 3rd shelf from top	N.D.
W10/shelf	West wall shelf, 3rd shelf from top	N.D.
W11/shelf	Row 1, 4th shelf	N.D.
W12/blank	Handled with glove	N.D.
W13/blank	Handled with glove	N.D.
A1/air[3]	Row 2, under spill area	0.2 ug/m^3
A2/air	SW corner of room	0.1 "
A3/air	Librarians desk	0.1 "
A4/air	2nd aisle, top shelf (2/15/84)	0.3 ug/m^3
A5/air	2nd aisle, top shelf (2/21/84)	0.2 "
A6/air	Top of Librarians desk	N.D.[4]

[1] W = 4 square inch Toluene-wetted, Whatman filter tab wipe sample
see figure 1 for illustration of sample locations

[2] N.D. = not detectable; Lower Limit of Detection = 0.02 ug/wipe

[3] Air samples taken at 500 cc/min for approximately 7 hours

[4] N.D. = not detectable; Limit of Detection = 0.025 ug/sample (0.1 ug/m^3)

Table 2
Frequency of Symptoms
Georgetown University Library
Chlordane Spill

Symptom	N=13
Headache	46%
Dizziness	46%
Irritability/confusion	38%
Nausea	31%
Malaise	31%
Paresthesias/numbness	23%
Limb swelling	15%
Throat irritation/respiratory burning	15%
Facial twitching	8%
Diarrhea	8%
Skin rash	8%
Blurred vision	8%
Insomnia	8%
Alcohol intolerance	8%
No symptoms	23%

Table 3
Frequency of Symptoms Among Group Identified
as Potentially Highly Exposed*
Georgetown University Library
Chlordane Spill

Symptom	N=10
Headache	50%
Dizziness	50%
Irritability/confusion	50%
Malaise	40%
Nausea	30%
Paresthesias/numbness	30%
Limb swelling	20%
Throat irritation/respiratory burning	20%
Facial twitching	10%
Diarrhea	10%
Skin rash	10%
Blurred vision	10%
Insomnia	10%
Alcohol intolerance	10%
No symptoms	10%

*involved in clean-up, retrieving documents during the spill, or employed greater than 20 hours per week in the GDR

Table 4
Frequency Of Symptoms Among Group Directly
Involved in the Clean-Up*
Georgetown University Library
Chlordane Spill

Symptom	N=6
Headache	83%
Irritability/confusion	83%
Malaise	67%
Dizziness	67%
Nausea	50%
Paresthesias/numbness	40%
Limb swelling	40%
Throat irritation/respiratory burning	40%
Facial twitching	17%
Diarrhea	17%
Skin rash	17%
Insomnia	17%
Alcohol intolerance	17%

*involved in clean-up or retrieval of documents during the spill

Table 5
Chlordane Levels in Blood
Georgetown University Library
October 17, 1983

Substance	# above MDL*
Chlordane	0/12
t-nonachlor	0/12
heptachlor epoxide + oxychlordane	1/12

*MDL = minimal limit of detection, 1 ppb