

## 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 and 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.

Mention of company names or products does not constitute endorsement by the National Institute for Occupational Safety and Health.

## HEALTH HAZARD EVALUATION REPORT

HETA 94-0104-2458

UNIVERSITY OF IOWA  
IOWA CITY, IOWA

HETA 94-0104-2458  
September 1994  
University of Iowa  
Iowa City, Iowa

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## Summary

On February 15-16, 1994, the National Institute for Occupational Safety and Health (NIOSH) conducted a health hazard evaluation at the University of Iowa library to evaluate possible health problems (skin itching, tingling, skin blotching, sinusitis, coughing, wheezing, and chest pain) related to handling books imported from India.

Air sampling for volatile organic compounds and surface wipe samples for organophosphate pesticides, organochlorine pesticides, and metals were collected. Air sampling did not reveal air contaminants (detectable with thermal desorption tubes-GC/MS) associated with the Indian books. No organophosphate or organochlorine pesticides were detected in any samples. Metals were detected in only one sample.

Twenty-five of 27 employees working with the books underwent interviews and skin examinations. Most employees described an odor associated with the Indian books and a "dirty or gritty" sensation on their hands after working with the books. Eleven employees reported one or more skin symptoms associated with contact to Indian books. Other symptoms reported to be associated with the Indian books included itchy eyes, sneezing, congestion, cough, and scratchy throat. There were no distinct skin eruptions seen on skin examination. Cellophane tape stripping of glitter-like particles was carried out on the skin of an employee and from a book. Polarized light microscopy of the glitter-like particles were consistent with glue particles.

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The source for the employees' reported symptoms was not found. The symptoms were consistent with irritative symptoms of the skin, and irritative or allergic symptoms of the eyes and upper airway. These symptoms could have been caused by environmental particulates/dusts, including glue and jute particles. Recommendations include: keeping work areas clean and free of dusts, washing with a mild soap and water after handling the books, and using protective barrier creams (with caution, since skin irritation may increase). Employees who report symptoms of irritation should be allowed to use gloves, protective clothing such as long sleeves, dust respirators and/or eye protection.

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KEYWORDS: SIC 8231 (Libraries), pesticides, volatile organic compounds, metals, irritant dermatitis, mucosal irritation, jute, bookbinding glue.

## **Introduction**

On February 15-16, 1994, the National Institute for Occupational Safety and Health (NIOSH) conducted a health hazard evaluation at the University of Iowa library to evaluate possible health problems (skin itching, tingling, skin blotching, sinusitis, coughing, wheezing, and chest pain) related to handling books imported from India.

## **Background**

The University of Iowa library is a six-story structure located on the University of Iowa campus in Iowa City, Iowa. The library receives books from overseas as part of the Library of Congress PL-480 program. This program provides foreign books for scholars at U.S. universities and also provides nations the ability to settle debt owned to the U.S. Government via book shipments. PL-480 books and serials are printed, bound, and packed in a variety of countries, including Brazil, China, Pakistan, several African nations, and the nations in South Asia: India, Bangladesh, Sri Lanka, and Nepal.

Over 20 years ago some library personnel noted a variety of symptoms thought to be related to PL-480 books. According to library personnel, the recent complaints included a distinct odor present during unpacking of the books, and a unique sensation on the skin of the hands after handling the books. Some employees complained of a variety of symptoms after handling the books which included: skin itching, tingling, and discolored blotching, symptoms of sinusitis, coughing, wheezing, and chest pain. Not all employees developed symptoms, and some could work with the books without difficulty. Symptoms usually did not develop with first contact, but slowly developed over several months of exposure to the books. An initial concern of library employees was that pesticides/insecticides were being used on or in the boxes of books. No dead insects were ever seen in the boxes during the unpacking process. Library of Congress (LC) personnel contacted by the library denied that any pesticide/insecticide agents were used on or in the boxes.

Although the University of Iowa receives PL-480 books and serials from several countries, only the books shipped from South Asia through a LC field office in New Delhi, India, produced complaints from employees. The University of Iowa receives approximately 3600 books per year from the Indian field office. These books are referred to as India or Indian books. The shipments arrive randomly throughout the year, sometimes in large batches (e.g., 27 boxes in December of 1993). According to the LC office in New Delhi,<sup>1</sup> these books are printed throughout the Indian subcontinent. The books are bound either by the publisher (51%) or by two LC contractors (49%), and are shipped from the printers to the New Delhi office by postal system, diplomatic pouch, Indian railways, or road transport. In India, the books are either packed using corrugated rolls or brown paper or

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placed unwrapped in boxes or sacks. Once they arrive at the New Delhi facility, monographs may remain in storage for 3 to 6 months, and serials for 1 to 12 months. Prior to shipment to the United States, the books are packed in plastic-lined corrugated boxes which are sealed using Indian-made adhesive tape and then banded with plastic straps and steel seals. Approximately 510 boxes are needed for a shipment. The period of time from packing the first to the last box is about 45 days. Once the appropriate number of boxes have been gathered for a shipment, the shipping agent places the boxes inside wooden containers. These containers hold 32 to 34 boxes and have an inner plastic lining and an outer aluminum lining. The containers are sealed by American embassy staff using sealing wax and the embassy seal. All of these procedures take place at the LC New Delhi office. The containers are then taken to another location in Delhi for customs formalities, and transported via railway or road transport to Bombay. In Bombay, the wooden containers are placed into one large shipping container and shipped to Baltimore via ocean freight. In Baltimore, the wooden containers are unloaded from the shipping containers and shipped to the LC. The wooden containers are not opened until they reach the LC mailroom in Washington, D.C. The wooden containers are then unpacked, and individual boxes are sent via mail or other parcel carrier to the participating libraries. It takes about six months from the date of shipment from India until the libraries receive the books.

The books arrive at the University of Iowa library in the original cardboard boxes. At the university library, the boxes are stored temporarily in the basement shipping/receiving area until personnel from the Acquisitions Department are available to unpack them. Weeks or months may lapse prior to the unpacking of the boxes. All unpacking of the boxes is carried out in the shipping/receiving area. (Since June 1992, boxes and individual book dust covers have been discarded in the area dumpster during the unpacking process.) The books are then put on carts and taken from shipping/receiving to a basement storage room. Because of a backlog, some books may remain in storage for several months. Approximately once a week, books are taken from storage to the first-floor Acquisitions Department for review and selection. At this point some books may be rejected, some distributed to other university libraries, and some selected for the University of Iowa library. After selection and computer check-in, the books are once again stored in holding areas on the basement and third floors. Books may remain in these holding areas for months to years. Ultimately, these books are taken from the holding areas back to Acquisitions and catalogued, with the assignment of call numbers and the input of information on the library computer. Approximately 200-300 PL-450 books are catalogued each month. Finally, the book bindings are marked in a separate area on the first floor and put into circulation in the library stacks. The complete process from unpacking the books to putting them into circulation can take months to years. Up to five Acquisition Department employees may be involved in handling the books throughout this process.

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As a result of symptoms reported by some employees at the University of Iowa, there have been changes in work practices. Employees have begun to unpack boxes in the open air of the loading dock and to discard book covers and the shipping boxes immediately after unpacking. In addition, some employees use long-sleeved clothing, gloves, barrier creams, and disposable dust masks while handling the books. Library personnel felt that these practices have helped, but there is still concern about the source of the problem. Concern has been heightened over the previous year since information from an electronic mail group consisting of library acquisition personnel in the United States and Canada has indicated that other libraries may have employees also complaining of symptoms associated with Indian books.

According to LC personnel, no insecticides, rodenticides, pesticides, fungicides, anti-mildew agents, or any other chemicals are applied to the shipment on LC premises. Because the aluminum-lined wooden containers are only opened in Washington, D.C., the LC doubts that the books would be affected by any chemical applied in transit. There are no reported symptoms among LC personnel. The only distinguishing features of the Indian books, as compared to books from other LC offices, are the use of diplomatic pouch facilities and ocean freight, and the practice in some LC field offices of receiving unbound books. According to a representative of the LC, complaints of an odor from the books have not been reported from LC offices.

### **Previous Evaluations**

In May 1993, the University of Iowa sampled the surfaces of four Indian books with a portable air pump and 25-millimeter methylcellulose ester filters. The filters were analyzed by light microscopy, and the vacuumed material was identified as jute (an Asian plant fiber used in sacks, covers, and cords), other fibers, and various other particles. In November 1993, air samples were collected at the University of California-Los Angeles with polyurethane foam (PUF) XAD-2 tubes for organophosphate and organochlorine pesticides, because UCLA library employees were also reporting "pesticide-like" odors emanating from books imported from India. The samples were analyzed by Gas Chromatography using a flame photometric detector. No pesticides were detected.

## Methods

### Air Sampling - Thermal Desorption Tubes

Air sampling using thermal desorption tubes was conducted to determine if volatile organic compounds (VOCs) might be released from the Indian books. (Some employees reported unusual odors, including "pesticide-like" odors associated with the books.) Two area air samples were collected. The first sample was collected during unpacking of European-type books, which had not been associated with odors or symptoms. The second sample was collected during unpacking of the Indian books. The European-type books were carted into the unloading area and unpacked before the Indian books so that potentially different VOCs from the Indian books could be differentiated from the European-type books. Thermal desorption tubes were used for sample collection since the VOC concentrations were expected to be low. The samples were analyzed by gas chromatograph/mass spectrometry (GC/MS), and major components were identified (see Appendix A for complete analytical discussion).

The samples were collected using SKC model 222 low-flow sampling pumps. Flow rates of 48.8 milliliters per minute (mL/min) (European-type books) and 43.9 mL/min (Indian books) were used to collect the samples. Sampling times were 26 minutes during the unpacking of European books and 29 minutes during the unpacking of Indian books. The pumps are equipped with a pump stroke counter, and the number of strokes necessary to pull a known volume of air was determined. This information was used to calculate an air volume per pump stroke "K" factor. The pump stroke count was recorded before and after sampling, and the difference used to calculate the total volume of air sampled. The amount of air sampled was essentially the same for each sample (1270 mL for the European books, 1273 mL for the Indian books).

### Wipe Samples

Surface wipe samples were collected to determine if the Indian books were contaminated with organophosphate pesticides, organochlorine pesticides, or metals. Pesticides reportedly are sometimes applied to cargo to prevent importation of certain insects from India. Also, jute fiber, which is used to make the India book covers, may contain pesticide residues from cultivation of the jute plant.<sup>2</sup>

Because of speculation that anti-mildew agents are applied to books, metal sampling was conducted since some anti-fungal/anti-mildew compounds contain various metals. For example, the following metal-containing compounds are used as antifungal agents: inorganic copper, organic copper, arsenic-copper, organomercury, organotin, cadmium, manganese, and zinc-containing compounds. Additionally, several arsenical compounds

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are used as pesticides. Phosphorous and phosphide compounds are used as rodenticides.<sup>3</sup>

The wipe samples were collected with 100% cotton gauze pads (hexane-extracted) moistened with deionized water or hexane (1-2 mL). Hexane was used on some wipe samples to facilitate sample collection of possible non-polar pesticides. While wearing a disposable polyethylene glove, the NIOSH investigator wiped a gauze pad over a 100-square centimeter area by a series of vertical and horizontal S-strokes, as described in the NIOSH draft Method 0700, Lead in Surface Wipe Samples.<sup>4</sup> The gloves were changed after each sample to prevent cross contamination. The same method and wiping pressure was used for each sample. After collecting the samples, the gauze pads were placed in individually cleaned and labeled amber glass bottles. The samples were submitted, with blanks, to the NIOSH contract laboratory (Data Chem, Salt Lake City, Utah) for analysis. The specific pesticides and metal analyses, and the limit of detection for each substance, can be found in Tables 1 and 2. The specific areas sampled are listed in Table 3. The analytical methodology used for analyses of the samples can be found in Appendix A.

### Medical Investigation

The NIOSH medical officer confidentially interviewed library personnel who worked with the Indian books. The interview included the following questions: name, age, current job, years at job, exposure to Indian books, work-related complaints or medical problems, allergy history, medical care sought, and current medications.

Using statistical methods (two by two tables, prevalence risk ratio determinations, and confidence limits), associations between certain characteristics and outcomes were determined. Prevalence is denoted as the percentage of cases (with an illness or symptoms) existing in the population at one point in time. A prevalence risk ratio (PRR) is the prevalence among workers with certain exposures or characteristics divided by the prevalence of workers with other exposures or characteristics. A PRR of 1.0 signifies similar prevalences in the two groups. The 95% confidence limits indicate the probable range within which the PRR actually falls. Ordinarily, if the 95% confidence limit includes 1.0, the apparent association between the risk factor and the outcome had a probability of more than 5% of occurring by chance alone and is not considered significant. Data was entered on the Epi-Info statistical program version 5. Single table analysis was used to calculate the PRR and the Greenland, Robins 95% confidence limits for the risk ratio.

Skin examinations were conducted for individuals complaining of skin problems. Finally, photographs were made and cellophane tape stripping done of glitter-like particles that appeared on the skin of one employee after working with the books. Another tape strip revealed similar particles on an Indian book surface. The tape strips were sent to NIOSH, Division of Physical Sciences and Engineering, Measurements Research Support Branch, Measurements Development Section, for qualitative identification by polarized light microscopy.

## **Results**

### Air Samples

Air sampling did not reveal air contaminants (detectable with thermal desorption tubes-GC/MS) associated with the Indian books. The air samples collected during unpacking Indian books and European-type books are shown in Figures 1 and 2 (The key identifying the VOCs follows Figure 4). The blanks (no air was passed through the tubes) are shown in Figures 3 and 4. Despite the air sampling being conducted before collection of the wipe samples, some contamination with hexane (peak #10) still occurred because of the extremely high sensitivity of the thermal desorption tubes. The other identified VOCs are trace contaminants of indoor building environments.

### Wipe Samples

No organophosphate or organochlorine pesticides listed in Table 1 were detected in any samples. No metals listed in Table 2 were detected, except on one sample. A small amount of iron was detected on the outside of a box surface. On the same sample, an extremely small amount of platinum and thallium (approximately 1 microgram each) in excess of the blank sample was detected. Other metal concentrations did not exceed those of the blank samples.

### Medical Interviews

Twenty-seven employees of the University of Iowa library were identified by library supervisory personnel as individuals who currently work or have worked in the past with Indian books. Twenty-five employees agreed to participate in confidential, individual interviews, for a response rate of 93%.

Of the 25 respondents, 18 were female and 7 male. The age range for respondents was 19-59 years with a mean of 35 years. Years worked at the library ranged from 0.5 to 25, with a mean of 7. Fourteen respondents worked in Acquisitions, three in Cataloging, two in Serials Acquisitions, two in Government Publications, two in Marking/Preservation, one in International Studies, and one in Serials Cataloging.

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Each person had some exposure to the Indian books. Eight individuals reported working with the Indian books regularly, while 17 reported minimal or intermittent contact with these books. Twenty-four employees described an odor associated with the Indian books. This odor was characterized as: a "chemical" odor by 11; a "unique or distinct" indescribable odor by 6; a "moldy, not unique" odor by 4; and an "insecticide" odor by 3. Eighteen employees described a "dirty or gritty" sensation on their hands after working with the books.

Eleven employees complained of one or more skin symptoms that they associated with contact with the Indian books. These symptoms included: itching/burning of exposed skin (ten workers); skin discoloration described as white and/or red blotches on exposed skin (seven workers); tingling fingers (two workers), and swelling of fingers (one worker). Ten employees noted that the symptoms improved after washing the hands with soap and water. Five employees regularly used gloves while working with the Indian books, three regularly used barrier creams, and one wore long-sleeved shirts. All five noted some improvement in symptoms.

Other symptoms noted by employees to be associated with working with the Indian books included: itchy eyes (six workers); sneezing (five workers); congestion (four workers); cough (two workers); and scratchy throat (one worker).

Nine respondents stated that they had a previous history of allergic conditions. One individual had sought medical care from a health professional for possible work-related skin and upper respiratory problems.

The results of the prevalences and PRRs are shown in Table 4. The employees who reported frequent contact with the Indian books were more likely to express complaints of skin symptoms than the other employees (87% vs. 23% with a PRR of 3.7 and confidence limits of 1.5-9.1). The employees who reported frequent book contact were more likely to complain of other respiratory and irritative symptoms, but the PRR was not statistically significant (62% vs. 41% with a PRR of 1.5 and confidence limits of 0.7-3.3). There was no statistically significant association between previous history of allergies and any of the symptoms. There was no statistically significant association of years worked with any of the symptoms.

### Skin Examinations and Tape Strip

The skin examinations revealed no distinct skin eruptions. Several individuals with blotching of the palms had a condition consistent with physiological vascular mottling of the skin, which is considered normal in many people.

One individual had distinct glittery particles, less than one millimeter in size, on the palms. These reportedly appeared immediately after the employee handled Indian books.

Macroscopic photographs of the skin confirmed the presence of reflective foreign bodies on the skin surface. Cellophane tape was used to obtain a sample of the particles from the skin of the employee. A similar procedure was used to collect samples of similar particles found on the covers and pages of Indian books. Qualitative identification by polarized light microscopy showed that the observed optic properties and morphology of the particles were most consistent with those of glue particles.

## **Discussion**

No definitive source of the employees' complaints and symptoms was found. Air sampling revealed no contaminants associated with the unpacking or the handling of the Indian books. Although one box had small, unexplained amounts of platinum and thallium on its outer surface, there is no evidence from the wipe sampling that any chemicals are applied to the books at any point in their processing. The levels of platinum and thallium found on the box exterior are unlikely to cause health effects. During the investigation, none of the employees had evidence of either an allergic or irritant contact dermatitis on physical examination of the skin.

The employees who reported frequent contact with the Indian books were more likely to express complaints of skin symptoms than the other employees (PRR of 3.7 and confidence limits of 1.5-9.1). There are limitations to the accuracy of this result and it may be influenced by several biases. These include recall bias and reporting bias, which may make the groups of interviewed employees different in their recollection of events or assessment of the etiology of health effects. In addition, there are no non-exposed employees in this investigation, and the definitions of "frequent" and "infrequent" book contact are based upon self-reporting and subjective criteria. All these factors can lead to an error in the determination of PRR and the confidence limits.

The variety of self-reported symptoms that employees associated with unpacking or handling the India books fell in the general categories of irritative symptoms of the skin, and irritative or allergic symptoms of the eyes and upper airway. Many things can cause these symptoms, including environmental particulates/dusts. Dusts may produce mechanical effects and irritant skin eruptions.<sup>5</sup> Airborne particles may also induce mucosal or airway irritation. Microscopic analysis of particulates from the skin of an employee and from a book showed that these were consistent with glue particles. Glues can cause a contact dermatitis,<sup>5</sup> and the small particles from glues can conceivably cause irritation by penetrating the skin and forming small, erythematous papules. Other sharp particles in dust may induce lesions.<sup>6</sup> In May 1993, the University of Iowa sampled the surfaces of four Indian books and the vacuumed material was identified as jute, other fibers, and various particles. Jute has been identified as a skin irritant<sup>7,8</sup> and a nose, throat, and eye irritant.<sup>9</sup>

Some individuals described a moldy smell when working with the books. Mold spores are known to induce a variety of health effects including respiratory and mucosal symptoms.<sup>10,11</sup> In predisposed individuals, allergic symptoms can occur with inhalational exposure to jute, molds, and many other substances.<sup>12</sup>

Most individuals described a chemical odor or other odor very unique to the India books. During the course of the investigation no odors were detected during the unpacking or handling of the books. The Library of Congress denies the use of any chemicals in the book packaging process and the source of the odor remains unknown.

## **Recommendations**

1. Any employee with work-related health complaints should be evaluated by a health professional for documentation of symptoms and physical effects.
2. Special care should be taken to keep work areas clean and free of dusts. If possible, provide an adequate flow of fresh air and exhaust ventilation to allow dusts to be swept away. Avoid the use of compressed air as this will lead to dusts being stirred up into the air.
3. Employees working with books should wash their hands with a mild soap and water after handling the books.
4. Employees should use protective barrier creams with caution. In the case of some particles and fibers, protective creams can actually increase irritation by allowing these particles to attach to oily skin. In addition these creams may cause allergic reactions, especially when used on already irritated skin.<sup>13</sup>
5. Employees who complain of skin, airway, and/or mucosal irritation while working with the books should be allowed the option to use gloves, protective clothing such as long sleeves, dust respirators and/or eye protection such as glasses or goggles. The Occupational Safety and Health Administration (OSHA) standard 29 CFR 1910.134 requires that all occupational respirator use must take place within the context of a respiratory protection program that includes evaluation of worker fitness to use a respirator, training, fit testing, and maintenance.

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**Table 1** Limits of Detection for Pesticides  
University of Iowa, HETA 94-0104

Organophosphate Pesticides		Organochlorine Pesticides	
Analyte	LOD* (µg/sample)	Analyte	LOD (µg/sample)
Merphos	1	A-BHC	0.01
Mevinphos	1	B-BHC	0.01
Ethoprop	0.2	D-BHC	0.01
Dichlorvs	0.2	Isodrin	0.01
Dimethoate	1	4,4'-DDE	0.01
Phorate	0.2	Endrin	0.01
Fensulfothion	2	4,4'-DDD	0.01
Tetrachlorvinphos	1	Lindane	0.01
Disulfoton	0.2	Heptachlor	0.01
Diazinon	0.2	Aldrin	0.01
Methyl Parathion	0.4	Heptachlor epoxide	0.01
Ronnel	0.4	Endosulfan I	0.01
Malathion	0.4	Endosulfan II	0.01
Chlorpyrifos	0.4	Dieldrin	0.01
Fenthion	0.4	Endrin aldehyde	0.01
EPN	1	Endosulfan sulfate	0.01
Bolstar	1	4,4'-DDT	0.01
Azinphos methyl	2	Endrin ketone	0.01
Sulfotep	0.2	Methoxychlor	0.01
Parathion	0.4	Chlordane	0.08
Demeton O	1		
Demeton S	1		
Tokuthion	1		
Coumaphos	2		
Triethylphosphoro-thioate	4		

\* LOD = Limit of Detection, µg=micrograms

Table 2 Limits of Detection - Metals  
University of Iowa, HETA 94-0104

Analyte	LOD* ( $\mu\text{g}/\text{sample}$ )	LOQ ( $\mu\text{g}/\text{sample}$ )
Aluminum	2.0	4.3
Arsenic	0.2	0.51
Barium	0.03	0.098
Beryllium	0.006	0.018
Calcium	4	11
Cadmium	0.03	0.087
Cobalt	0.05	0.16
Chromium	0.1	0.32
Copper	0.04	0.13
Iron	0.9	2.9
Lithium	0.03	0.075
Magnesium	0.5	1.5
Manganese	0.02	0.063
Molybdenum	0.04	0.14
Nickel	0.08	0.26
Lead	0.2	0.50
Phosphorous	1	3.3
Platinum	0.3	0.96
Selenium	0.4	1.1
Silver	0.02	0.058
Sodium	2.0	4.6
Tellurium	0.3	0.89
Thallium	0.3	0.79
Titanium	0.04	0.12
Vanadium	0.04	0.11
Yttrium	0.008	0.026
Zinc	0.3	0.82
Zirconium	0.2	0.4
Mercury (not ICP)	0.03	0.09

\* LOD=Limit of Detection, LOQ=Limit of Quantification,  $\mu\text{g}$ =micrograms

**Table 3** Areas Sampled  
University of Iowa, HETA 94-0104

Location of Sample	Wipe Media	Analyte
Book binding material/book cover	hexane	organochlorines
Inside cardboard box	hexane	organochlorines
Book cover	water	organochlorines
Outside cardboard box	water	organochlorines
Book binding material/book cover	hexane	organophosphates
Inside cardboard box	hexane	organophosphates
Book cover	water	organophosphates
Outside cardboard box	water	organophosphates
Outside cardboard box	water	ICP metals
Book cover	water	ICP metals
Outside cardboard box	water	Mercury
Book cover	water	Mercury

Table 4

Prevalence and Prevalence Risk Ratios (PRR)  
 For Symptoms in Employees with Different Characteristics  
 University of Iowa, HETA 94-0104

<u>Symptoms</u>	<u>Characteristics and Prevalences</u>		<u>PRR</u> <u>(Confidence limits)</u>
	<u>Frequent Book Contact</u>	<u>Infrequent Book Contact</u>	
Skin Symptoms *	87%	23%	3.7 (1.5-9.1)
Other Symptoms**	62%	41%	1.5 (0.7-3.3)

	<u>Previous Allergy History</u> <u>No Allergy History</u>		
Skin Symptoms *	33%	50%	0.7 (0.2-1.9)
Other Symptoms**	33%	56%	0.6 (0.2-1.6)

	<u>Worked &gt; 4 years</u> <u>Worked &lt;= 4 years</u>		
Skin Symptoms *	38%	50%	0.8 (0.3-1.9)
Other Symptoms**	54%	42%	1.3 (0.6-3.0)

\* These include itching, burning, discoloration, tingling, and/or swelling

\*\* These include nasal congestion, cough, itchy eyes, itchy throat, and/or sneezing.

Figure 1 Thermal Tube Air Sample CX-31 (India Books)\*

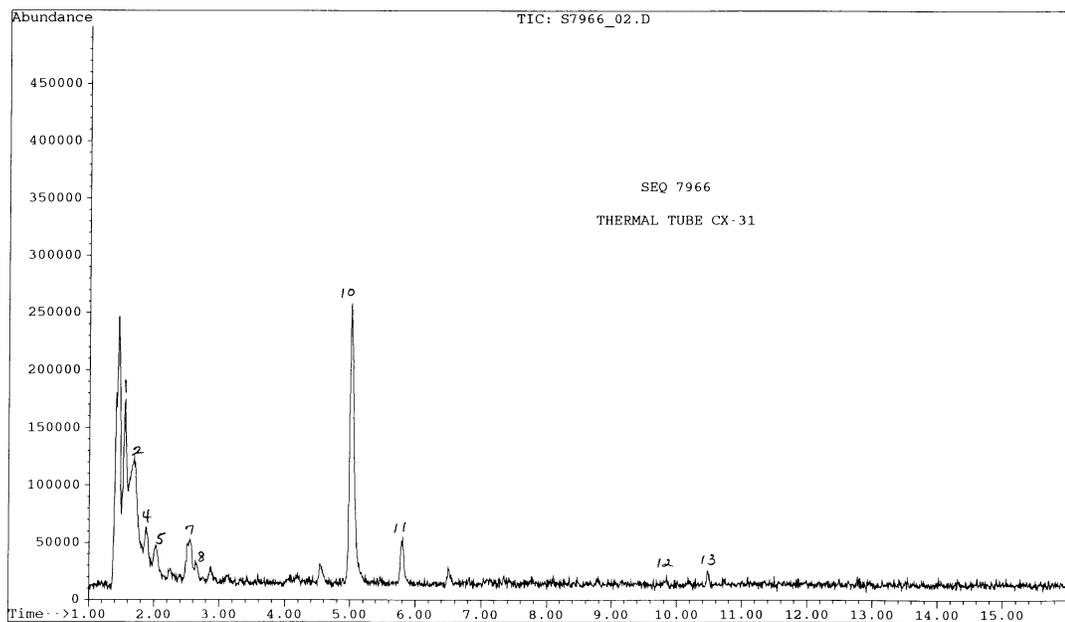
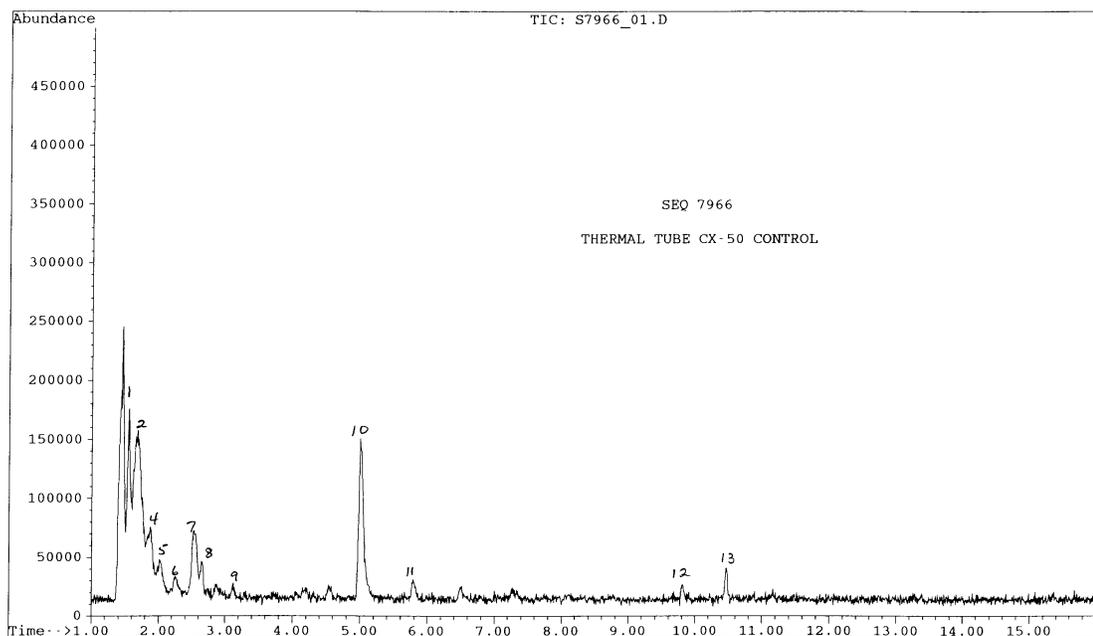


Figure 2 Thermal Tube Air Sample CX-50 (Non-India Books)\*



\* Key for peak identification follows Figure 4

Figure 3 Field Blank CX-21\*

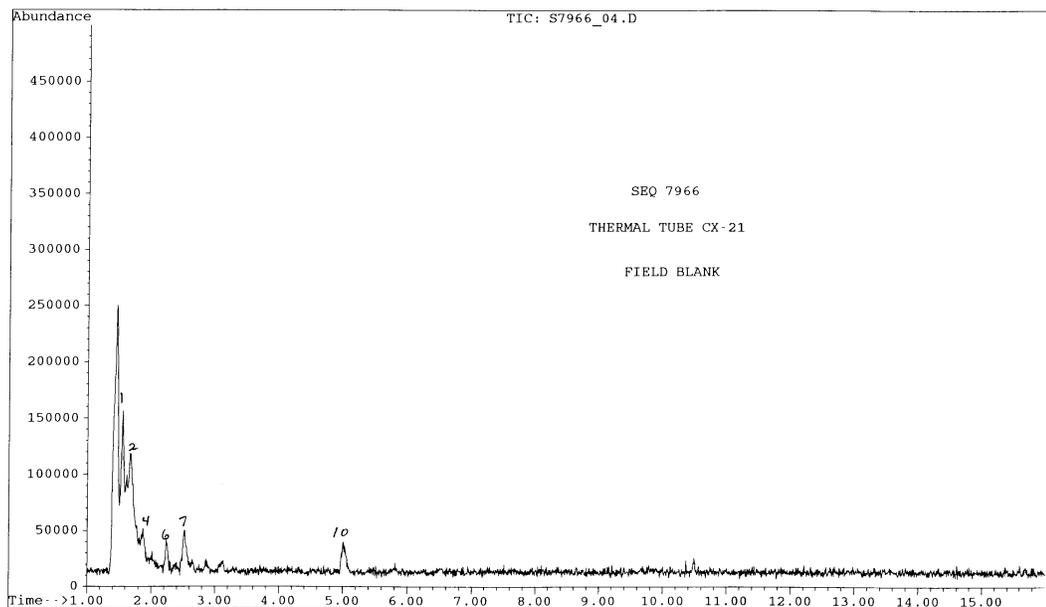
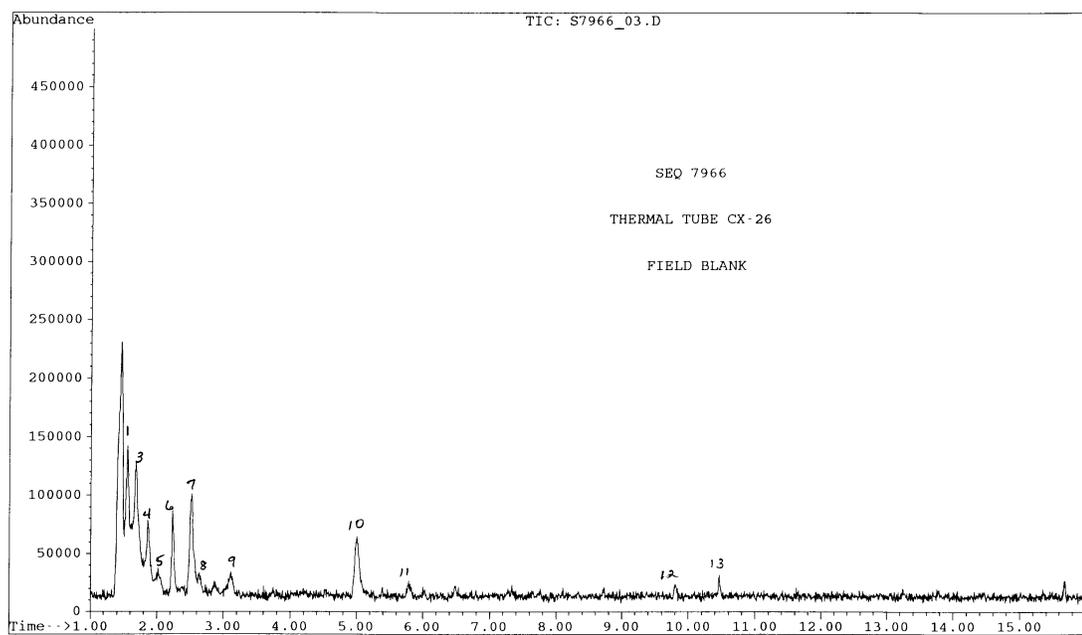


Figure 4 Field Blank CX-26\*



\* Key for peak identification on next page

Addendum to Figures 1,2,3,4  
Peak Identification Key

Peak Number	Corresponding Chemical
1	Air/carbon dioxide
2	Sulfur dioxide
3	Chlorodifluoromethane (Freon 22) and sulfur dioxide
4	Methanol/acetaldehyde/isobutane
5	Butane
6	Ethanol
7	Acetone
8	Isopropanol/trichlorofluoromethane (Freon 11)
9	Methylene chloride
10	Hexane
11	Methylcyclopentane
12	Toluene
13	Hexanal

## Appendix A

### Analytical Methodology for Samples

#### **Thermal Desorption Tubes**

Stainless steel thermal desorption tubes configured for the Perkin-Elmer ATD 400 thermal desorption system were prepared in-house at the NIOSH Cincinnati laboratory. Each thermal tube contained three beds of sorbent materials - a front layer of Carbotrap C (350 mg), a middle layer of Carbotrap (175 mg), and a back section of Carboxen 569 (150 mg). Prior to field sampling, the thermal desorption tubes were conditioned for two hours at 375 °C.

Samples were analyzed using the ATD 400 automatic thermal desorption system containing an internal focusing trap packed with Carbopack B/Carboxen 1000 sorbents. The thermal unit was interfaced directly to a HP5890A gas chromatograph and HP5970 mass selective detector (TD-GC-MSD). The mass spectrometer was operated under EI conditions in full scan mode (20-300 amu). Samples were analyzed separately by directly inserting each into the thermal desorber until with no other sample preparation. Each sample tube was desorbed at 300 °C for 10 minutes.

#### **Wipe Samples**

Analysis for organochlorine pesticides was conducted according to NIOSH Method 5503 with modifications for gauze wipe samples. The samples were desorbed in 20.0 mL hexane and shook for a minimum of three hours. The samples were analyzed by gas chromatography using a DB-17 fused silica capillary column equipped with an electron capture detector. Analysis for organophosphate pesticides was conducted according to NIOSH Method 5600 with modifications for gauze wipe samples. The samples were desorbed in 20.0 mL hexane and shook for a minimum of three hours. The samples were then analyzed by gas chromatography using a DB-1 fused silica capillary column equipped with a flame photometric detector.

Analysis for metals (other than mercury) was conducted according to NIOSH method 7300. Each wipe sample was transferred to a 250 mL Griffin beaker. 40 mL of concentrated nitric acid and 4 mL of 30% hydrogen peroxide were added to each beaker, and the samples were placed on a hotplate and heated to approximately 150 °C. Sample volume was reduced to approximately 1.0 mL. Samples were then quantitatively transferred to 10 mL volumetric flasks and analyzed with a Thermo Jarrell ASH ICAP 61 inductively coupled plasma emission spectrometer.

Analysis for mercury was conducted according to EPA Method 7471. Samples were prepared by transferring each wipe to a separate 300 mL BOD bottle, to which 5 mL H<sub>2</sub>SO<sub>4</sub> and 5 mL HNO<sub>3</sub> were added. The samples were placed in a hood for several minutes, as a brown-orange gas evolved. Samples were placed on a steam bath for five minutes, then removed from the steam bath while 58 mL of ASTM Type II water and 15 mL KMnO<sub>4</sub> were added. Samples did not retain color, so additional aliquots of KMnO<sub>4</sub> were added until 60 mL had been added. An 8 mL aliquot of K<sub>2</sub>S<sub>2</sub>O<sub>8</sub> was also added. Samples were placed back on the steam bath for 30 minutes, then 10 mL NH<sub>2</sub>OH·HCl was added to reduce excess permanganate. Due to the large amount of KMnO<sub>4</sub> required for samples digestion, organic contamination was suspected. Samples were analyzed on a Perkin Elmer 3100 spectrophotometer equipped with a flow injection autosampler. A reproducible sample volume was injected into an HCl carrier stream which carried the sample to a chemical manifold which mixed the sample with 10% stannous chloride, creating mercury vapor which was transported to the cold vapor cell for determination of mercury content.