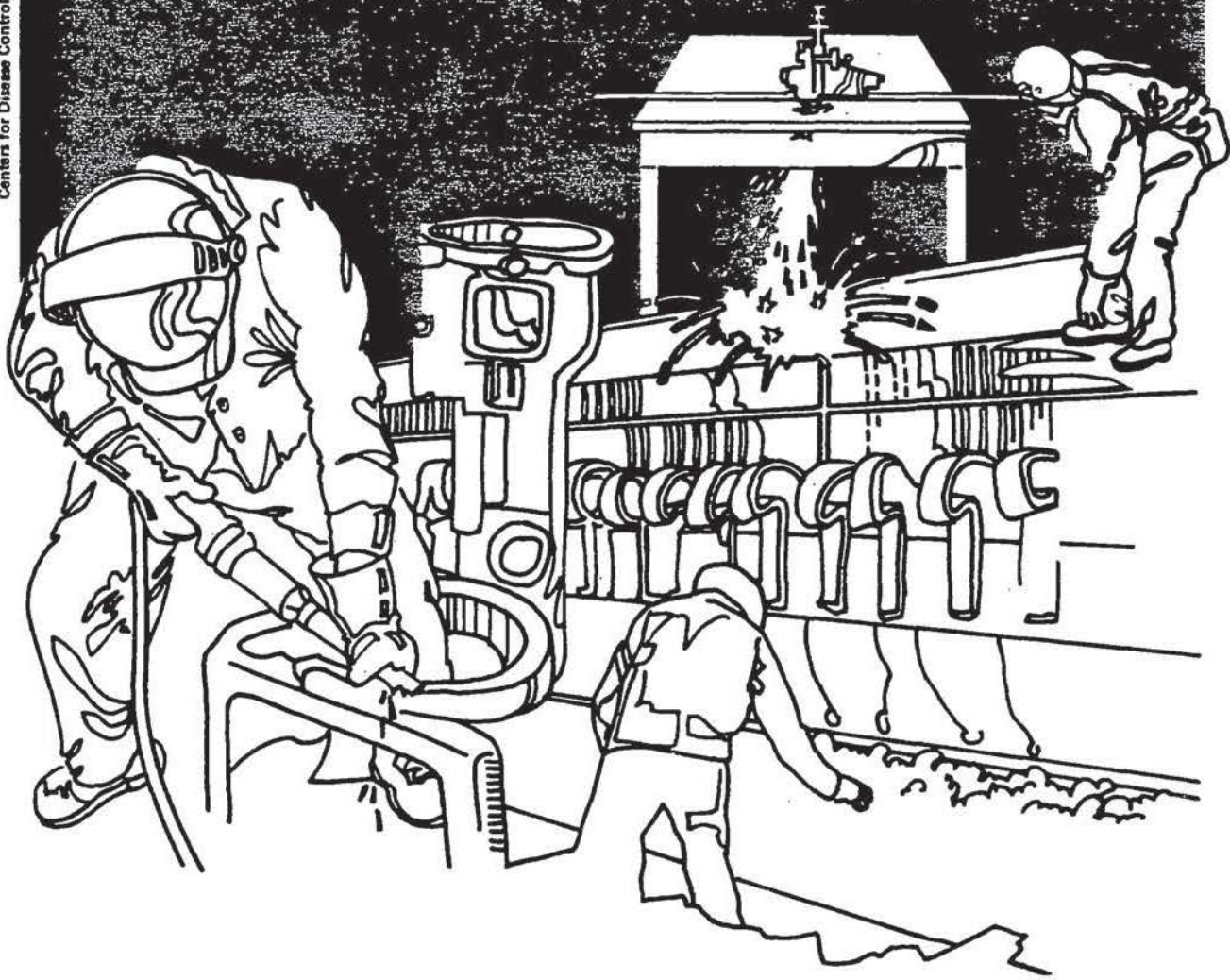


NIOSH



Health Hazard Evaluation Report

HETA 81-001-1159
BOOKKEEPERS TAX SERVICE, INC.
LUFKIN, TEXAS

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.

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

HETA 81-001-1159
AUGUST 1982
BOOKKEEPERS TAX SERVICE, INC.
LUFKIN, TEXAS

NIOSH INVESTIGATORS:
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I. SUMMARY

On October 1, 1980, the 2 owners of the Bookkeepers Tax Service (BTS) in Lufkin, Texas asked the National Institute for Occupational Safety and Health (NIOSH) to investigate possible copper or solvent intoxication in themselves and their 2 employees. They had experienced a variety of symptoms, including mucous membrane irritation, dizziness, headaches, gastrointestinal problems, and a metallic taste, beginning sometime in 1979 after renting space in a building owned by National Cash Register (NCR). Although they vacated the building in September 1980, the owners continued to experience symptoms. The requestors also consulted both the Texas State Health Department (TSHD) and the Occupational Safety and Health Administration (OSHA), and both agencies conducted evaluations before NIOSH arrived.

NIOSH investigators visited the NCR building in Lufkin, Texas on October 23, 1980. The NIOSH industrial hygienist measured exhaust air flow in a spray booth in the rear of the building. He obtained soil samples for copper content outside the building and in the soil outside the owners' home, as well as a sample of the air conditioner filter, swipes of dust at various places in the building, and a vacuumed sample of dust from the carpets. The NIOSH physician interviewed both BTS owners and 1 of 2 former employees (1 refused to be interviewed), and all 5 NCR employees still working in the building. Blood and urine samples were obtained from the BTS owners, and urine from the employee; blood samples were obtained from 4 NCR employees.

NIOSH found no evidence for solvent exposure or for copper fume or unusual copper dust exposure. NIOSH vacuum samples found the highest copper levels in the carpet and air conditioner filter in the NCR portion of the building (140-410 mg/kg), but they were not adjudged to be related to the requestors' symptoms. The TSHD and OSHA did air sampling for formaldehyde and carbon monoxide, and water and air sampling for copper. All levels were within normal limits. Airflow through the exhaust vent in the "paint booth" was adequate, but NIOSH investigators observed that the ventilation system for the entire building relied on entirely recirculated air with no fresh make-up air. Despite persistent symptoms in the requestors, the BTS employee denied persistent symptoms since leaving the building. All urine and blood samples on BTS personnel contained copper in the normal range. Arsenic and mercury levels in urine were also normal. All 5 NCR employees denied any symptoms associated with their work, although they acknowledged that ventilation was poor in the building, and all sampled had normal blood copper levels.

On the basis of data collected in this study, no evidence of toxic exposures to copper, formaldehyde, carbon monoxide, or solvents was found. While the symptoms reported were not fully explained, NIOSH felt that indoor air quality might be poor, especially in the warmest summer months. Recommendations included improvement of the NCR building ventilation system with fresh make-up air.

KEYWORDS: indoor air quality, building-associated illness, copper, formaldehyde, carbon monoxide

II. INTRODUCTION AND BACKGROUND

On October 1, 1980, the National Institute for Occupational Safety and Health (NIOSH) received a request from the owners of Bookkeepers Tax Service, Inc. (BTS) in Lufkin, Texas to investigate possible copper intoxication in the owners and employees of BTS. According to the requestors, BTS personnel had experienced a variety of symptoms -- mucous membrane irritation, headaches, dizziness, "allergic" symptoms, burning skin, gastrointestinal illness, feelings of dislocation, and a metallic taste in the mouth -- beginning months after renting office space in a building owned by National Cash Register Co. (NCR) in March 1979. The two owners and one of two BTS employees experienced some or all of these symptoms during most of 1980. They reported an exacerbation of symptoms during the summer heat wave, with a further worsening after the offices were flooded in July 1980. A second BTS employee reportedly had complained of more frequent "colds" and ear problems in the summer of 1980.

Evaluation of the BTS owners by their family physician in September 1980 yielded apparently elevated levels of urinary copper. (NIOSH investigators later learned, however, that those urine samples had been improperly collected in jars with brass-colored metal tops.) After learning of their apparently elevated urine copper, the BTS owners vacated their rented space at the NCR building in Lufkin. Urine samples collected from the two BTS employees at that time yielded normal urine copper levels. However, four of five NCR employees in the same building reportedly had elevated blood copper levels.

The requestors consulted the Texas State Department of Health (TSDH) and the Occupational Safety and Health Administration (OSHA) in September 1980 because of their growing conviction that they were being made ill by toxins in the NCR building. They requested that environmental monitoring be done for copper and for "solvents". Both agencies performed air sampling for copper, formaldehyde, and carbon monoxide, and analyzed office water for copper. In addition, they took wipe samples of walls and air conditioning (AC) vents and ducts, and also analyzed a specimen of vacuum cleaner dust from the NCR vacuum cleaner supplied by the owners of BTS. The results of those sampling efforts are shown in Tables I and II. Air contamination with copper dust or fume both inside and outside the building could not be demonstrated, and air sampling for carbon monoxide and formaldehyde yielded negligible levels. While copper was found in a number of wipe samples, levels were low except in the vacuum cleaner floor sweepings (one sample showed copper = 480 mg/kg) and in a piece of AC filter from the NCR system supplied by the owners of BTS. Two wipe samples supplied by the BTS owners also showed the presence of arsenic in ug/gm concentrations.

NIOSH investigators visited the NCR building in Lufkin, Texas on October 23, 1980. The building is a single-story brick structure with an estimated area of 2000 square feet. Flanked by a vacant lot on one

side and the maintenance headquarters of Eastern Texas Transmission Corporation on the other, it fronts on a state highway across from a mobile home and trailer sales facility.

Inside the NCR building, three front offices and a storeroom were formerly occupied by BTS. A hallway connects the front of the building with a large room in the rear where NCR maintains its sales and service office. A bathroom and closet open off the hall. A file room, storeroom, small office, and a spray booth room open off the large rear room and are used by NCR personnel.

III. METHODS

NIOSH investigators conducted interviews with all NCR employees. We gathered information about office and work activities (including grinding or polishing of cash register parts and uses of solvents for cleaning), about ventilation, and about the health status of each individual. On the first visit, the medical officer took blood samples for serum copper levels, and the industrial hygienist collected bulk samples of AC filter and a piece of carpet. On a later visit, the NIOSH industrial hygienist collected vacuum samples from the carpets in the NCR and BTS office areas.

NIOSH also interviewed the two requestors and one of two former employees of BTS. The second employee refused an interview request. In addition to seeking information about their health status, the NIOSH medical officer asked the three interviewees to collect a 24-hour urine sample and to permit drawing of a blood sample. All three provided urine samples, and two provided blood samples.

NIOSH reported individual results to each person in a letter, and an Interim Report on the investigation was sent out in February 1981.

IV. EVALUATION CRITERIA

NIOSH uses the American Conference of Government Industrial Hygienist (ACGIH) threshold limit values (TLVs) and OSHA permissible exposure levels (PELs) for copper fumes, mist and dust (dust and mist 1 mg/M³; fume 0.2 mg/M³) (1). Copper toxicity is rarely reported in humans, except in cases where large amounts are ingested (2,4). Copper ingestion may cause nausea, vomiting, and diarrhea. If large concentrations are absorbed, as has occurred in case reports of suicide attempts with copper sulfate, the affected individual may develop seizures and progress to coma and death (3).

At inhaled concentrations at or above the PEL, persons exposed to copper fume or dust above the PEL may develop mucous membrane irritation, malaise, and nasal stuffiness (5). Nasal septal perforation has also been described. "Metal fume fever" with chills, headache, and myalgia beginning several hours after exposure, has also been reported with overexposure to copper fume (4,5).

V. RESULTS

A. Environmental

Inspection of the premises and interviews with NCR employees lead to the following observations about the workplace environment.

(1) There are no obvious sources of dispersed copper dust and no source of fume. Most of the cash registers serviced by NCR -- many of which appear to contain small parts of copper-containing alloys -- are electronic. They require no grinding and are cleaned by soft brushing or with solvents in the spray booth room. Old cash registers requiring grinding or buffing with the wheel in the NCR storeroom are repaired only rarely. NCR personnel estimated that the grindstone in the storeroom had been used for approximately 30 minutes total in the preceding year.

(2) Solvent cleaning and touch-up painting are confined to the spray booth room. NCR estimated that they had used the ventilated room for approximately two hours total within the preceding year. The cleaning solvent used most often is a kerosene-like hydrocarbon. Other substances used occasionally include spray paints and paint thinner. The spray booth room is vented to the outside. Despite the dust-matted appearance of the filter in the spray booth, an acceptable exhaust face velocity of 100 feet per minute (fpm) was measured on October 23, 1980.

(3) The current interior panelling and decorating materials, including the carpets, wall panelling, and ceiling, were installed when the building was constructed in 1970.

(4) The air conditioning system is wholly recirculated, and no fresh make-up air is part of the system.

Table III contains the results of assays of bulk samples collected by NIOSH. Copper concentrations in vacuum cleaner sweepings from the carpet in the NCR portion of the building were several hundred times greater than copper in soil samples. It is noteworthy that vacuumed samples from the rug in the NCR portion of the building contained more than three times the concentration of copper in dust vacuumed from the area formerly occupied by BTS. This suggests that fine copper dust from the cash registers or from some other source in the NCR portion of the building is falling into the carpet. Since the air conditioner filter, located in the inlet in the NCR service room, also contained more copper than other bulk samples with the exception of the carpet sweepings, this further suggests that something in the NCR service room is the environmental source of copper present in the building.

B. Medical

All 5 NCR employees (four men and one woman) consented to interviews and 4 to having blood drawn. They ranged in age from 28-44 years (mean 38 years) and had been employed from 6 months to

10 years (mean 6.4 years) at NCR. All five spent an average of two hours daily in the office, and the remaining time in the field. All five denied any symptoms like those reported by BTS personnel, and none felt that s/he had experienced any work-related health problems. Several employees mentioned a sixth employee who had had severe hypertension and had suffered a "stroke" the preceding year. The blood copper levels of the four NCR employees were normal and ranged from 89-157 ug % (normal = 70 - 160 ug%) with a mean of 112.5 ug%.

Interviews with the two requestors revealed that while some of their symptoms had decreased since September 1980, both claimed that they continued to experience intermittent sensations of burning skin which they relate to their past exposures at the NCR building. One reported aching back and leg pain and a swollen "gland" in the neck. Both also reported that the act of looking through their files removed from the BTS offices, and briefly handling an air conditioner filter they had removed from the NCR building, precipitated a recurrence of eye, nose, and skin burning due to "poisons" in the papers and filter. Handling the filter did not produce these symptoms in the NIOSH investigators. There were no reports of cough, fever, or malaise.

A limited physical exam of one requestor revealed several abnormalities but there was no apparent relationship between these findings and the alleged occupational exposures. (The NIOSH medical officer suggested a consultation with a qualified internist).

The interview with the single cooperative employee of BTS confirmed reports of nose and throat irritation, daily headaches, fatigue, and feelings of alienation while working in the NCR building. She had noted a deterioration in her general sense of well-being from early 1980 through the summer and felt that her health status had improved since she stopped work in the NCR-BTS offices.

NIOSH laboratories assayed blood samples for copper from the two requestors and found normal levels (93 and 119 ug%, respectively). Twenty-four hour urine samples from the three BTS personnel yielded normal levels of copper (0.005-0.0095, normal 0.07 ug%); arsenic (0.5-1.9 ug/L, normal 100ug/L); and mercury (4 ug/L, normal 20ug/L). Since the time of the NIOSH visits, the requestors have continued to insist that they are poisoned with a variety of heavy metals and other toxins present in the NCR building, and in their files removed from the building.

VI. DISCUSSION

Despite the apparent coincidence of some symptoms of overexposure to copper fume and dust as reported by Cohen and by Gleason, and some of the symptoms experienced by BTS personnel, and despite the presence of copper-containing dust in the carpet and air conditioner filter of the

NCR building, NIOSH found neither environmental (air) sampling evidence of overexposure nor biological evidence of excess copper absorption in any persons currently or formerly working in the NCR building. In addition, there was no evidence of "solvent" exposures or of elevated levels of carbon monoxide or formaldehyde. Because there were no occupants in the BTS portion of the building, and because NCR employees did not complain of health problems, NIOSH did not conduct further air sampling for other low level air contaminants.

It is apparent from discussions with both NCR and BTS personnel that air quality in the building is poor. According to NCR personnel, the air conditioner's cooling capacity is inadequate for summer temperatures in Lufkin. The absence of any fresh make-up air in the system has prompted NCR employees to leave their back door open in clement weather.

The symptoms of mucous membrane irritations, headache, fatigue, nausea, and an unusual taste, while non-specific, are typical of or have been described in so-called "poor indoor air quality--building associated illness" settings (6). The issue of air quality has been central to a large number of investigations of similar symptoms in office building workers. NIOSH has conducted a number of these investigation as have other public health agencies. In only a minority of cases have toxic agents responsible for the cluster of symptoms been clearly identified by conventional industrial hygiene techniques (6). It is typical of such outbreaks that symptoms subside when the workers are away from the workplace, as occurred with the one employee of BTS. Because of the few individuals involved at BTS, and the fact that they had already vacated the building, a more comprehensive epidemiologic approach was not possible, and further testing was not warranted.

NIOSH does not have a toxicologic explanation for the symptoms reported by BTS personnel. We found no environmental evidence to support the contention of the requestors that they had been poisoned and made chronically ill by substances in the NCR building.

VII. RECOMMENDATIONS

We recommend that NCR alter the air conditioning system in the Lufkin building by providing a source of fresh make-up air. In addition, increasing the cooling capacity of the unit would increase employee comfort during the hot summer months.

VIII. REFERENCES

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IX. AUTHORSHIP AND ACKNOWLEDGEMENTS

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X. DISTRIBUTION AND AVAILABILITY OF REPORT

Copies of this report are currently available upon request from NIOSH, Division of Standards Development and Technology Transfer, 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. Requestors
2. Texas State Health Department
3. National Cash Register, Dallas office

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.

Table 1

*Copper Concentrations
Bookkeepers Tax Service, Inc.
Lufkin, Texas

September 24, 1980

Sampling Location	Sampling Period	**Concentration (mg/M ³)
Outside Environment	0855-1130	<0.002
Work Area -- National Cash Register, Inc.	0858-1138	<0.002
Spray Booth -- National Cash Register, Inc.	1100-1200	<0.002
Manager's Office -- Bookkeepers Tax Service, Inc.	0920-1155	<0.005

U.S. Department of Labor (OSHA), Standard (8-hr TWA, Dust/Mist)	1.0
U.S. Department of Labor (OSHA), Standard (8-hr TWA, Fume)	0.1
NIOSH, 8-10 hr. TWA, Recommendation	--
ACGIH, 8-hr. TWA, Recommendation (Dust/mist)	1.0
ACGIH, 8-hr. TWA, Recommendation (Fume)	0.2

* As collected by Texas State Health Department (Using 0.8 u, AA, mixed cellulose ester membrane filters and a sampling rate of 1.5 liters per minute)

** mg/M³ - Milligrams of substance per cubic meter of air sampled

Table 2

*Wipe Sample(s) Copper Determination(s)
Bookkeepers Tax Service, Inc.
Lufkin, Texas

September 25, 1980

<u>Sample Location</u>	<u>Concentration (micrograms/sample)</u>
(a) Air Vent Grill, Room "B"	<2.0
(a) Wall Surface, Room "B"	2.8
(a) Wall Surface, Room "A"	<2.0
(a) Air Vent Grill, Room "C"	<2.0
(a) Wall Surface, Room "C"	2.1
(a) Air Vent Grill, Room "E"	6.2
(a) Wall Surface, Room "E"	2.8
(b) Return Air Duct	66.0
(b) Exhaust Hood Filter Surface	38.0
(b) Floor Sweepings - Vacuum Cleaner	480.0

* As collected by Texas State Health Department (Using dry WHATMAN filters--except vacuum cleaner sample)

(a) Bookkeepers Tax Service area

(b) National Cash Register area

Table 3

Bulk sample Copper Concentrations
 Bookkeepers Tax Service, Inc.
 Lufkin, Texas

Sample Number	Date of Sample	Location	*Concentration (mg/kg)
**1	11-10-80	Air Conditioning Filter	38.0
**2	11-10-80	Air Conditioning Filter-- Furnished by Manager	140.0
**3	11-10-80	Carpet Sample--Office Area	5.2
**4	11-10-80	Manager's Residence-- Soil Sample, Driveway Side	1.0
**5	11-10-80	Manager's Residence-- Soil Sample, Opposite Side of House	0.9
**6	06-24-81	Floor Sweepings-Vacuum Cleaner	130.0
***7	06-24-80	Floor Sweepings-Vacuum Cleaner	410.0

* mg/Kg - Milligrams of substance per kilogram of sample
 ** Sample collected from Bookkeepers Tax Service area/location
 *** Sample collected from National Cash Register area

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