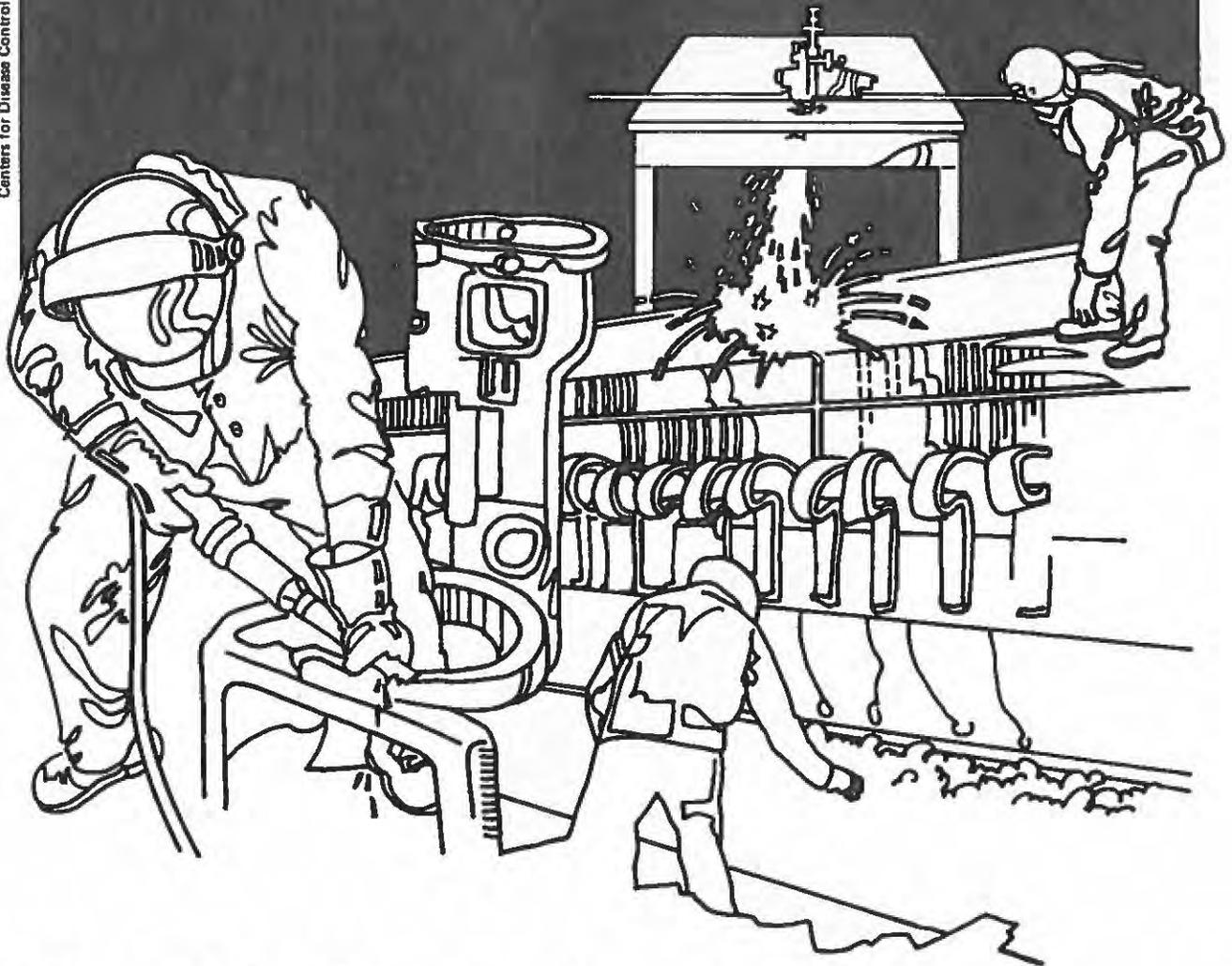


NIOSH



Health Hazard Evaluation Report

HHE 80-240-855
NEW YORK UNIVERSITY
NEW YORK, NEW YORK

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.

HE 80-240-855
April 1981
New York University
New York, New York

NIOSH INVESTIGATORS:
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I. SUMMARY

In September 1980, the National Institute for Occupational Safety and Health (NIOSH) received a request for a health hazard evaluation from the Director of the Public Affairs Department, New York University. The employees of the Department had been evacuated from the sixth (top) floor of a newly refurbished office building during July, 1980, following multiple complaints of headache, eye irritation, fatigue and nausea. The Department was temporarily relocated in a different building. Employees on the fourth and fifth floor experienced similar, but milder symptoms.

Environmental samples were collected in the building and in the temporary offices of the Department for formaldehyde, ethyl acrylate, and organic solvents. Medical questionnaires were administered to 53 of 61 employees of the fifth and sixth floors. The responses were analyzed for patterns of symptoms and exposures.

All sampled substances were found to be within the O.S.H.A. exposure standards and NIOSH recommended standards; however, sampling took place two months after the employees had vacated the building in mid-July. The responses to the questionnaire revealed a high prevalence of symptoms of mucosal membrane irritation and headache with fatigue or nausea during June and July concurrent with ongoing construction and varnishing of the interior of the office spaces. There were no spatial or temporal associations indicating any one agent.

No conclusive toxicity determinations could be reached because environmental monitoring occurred two months after symptoms were experienced. The symptoms were consistent with exposure to formaldehyde or volatile organics which were found in trace amounts in the building. Recent measurements indicated that the building was safe for re-occupancy. The interviews implicated several possible sources for organic solvents, including art work in the office, construction materials, and recirculation of vapors from a nearby exhaust stack. Ethyl acrylate vapors from a window caulking applied during May and June, 1980, may have been responsible for the initial health complaints. Recommendations included increasing the ventilation rate, installing a separate exhaust system in the art studio, and raising the height of the exhaust stack. Employees have since re-entered the office without incident.

Keywords: SIC 8221 (Colleges, Universities, and Professional Schools); Office Building, Ventilation, Formaldehyde, Organic Vapors, Ethyl Acrylate, Fatigue, Headache, Nausea, Eye Irritation.

II. Introduction

In early September 1980, the Director of the Public Affairs Department, New York University, requested an investigation because their newly refurbished office building had been evacuated in July as the result of employees' health complaints. NIOSH was asked to determine the cause of the symptoms and to determine whether the building was safe for re-entry.

After an initial environmental/medical evaluation on September 3, 1980, medical questionnaires were administered to workers on September 9, 18 and 23. Environmental sampling took place on September 4, 10 and 22. On October 15, 1980 preliminary findings and recommendations were sent to the Vice-President for Public Affairs, N.Y.U., and NIOSH investigators met with the employees to explain the results of the investigation.

III. Background

The Public Affairs Department of New York University moved into its new premises in May 1980. The Department occupies the top floor of the six-story loft building at 25 West 4th Street, New York City. The building is owned by N.Y.U. and had commercial tenants for many years. Over the past three years, the commercial tenants have been replaced by N.Y.U. staff offices. The fourth and fifth floors have been used as N.Y.U. offices for the past 1 1/2 years. The Department of Development occupies the fourth floor and the east half of the fifth floor, while The Department of Rehabilitation Counseling occupies the west half of the fifth floor. The third floor is vacant while undergoing renovation. The basement continues to house a hat manufacturer. The hat manufacturer uses solvents in a spray booth which is vented through an exhaust stack near the roof on the north side of the building.

The sixth floor is divided into approximately 16 interior offices or rooms and 12 exterior offices, with open office space and a central corridor in between. The floor has approximately 8,000 square feet (80' x 100'). A photocopier is located in a separate, unoccupied room. A large room in the northeast corner is used as an art studio. The office area is finished with 10 foot-high hung ceilings, vinyl-fabric wall coverings, clear lacquered wood doors and trim, and carpet. The art studio, storeroom, bathrooms, and photocopier room have rubber-vinyl floor tiles.

Renovation had not been completed when the Public Affairs Department moved into the premises. Through May and June wood walls were lacquered and carpeting and electrical wiring completed. Windows of the 4th, 5th and 6th floors on the north side of the building were removed and replaced using a caulking compound containing ethyl acrylate. Portions of the roof were asphalted because of leaks.

The fifth and sixth floors share an air ventilation system. Air intake is located on the north side of the building, facing a courtyard, at the fifth floor level. Fresh air averaged about 20%, but has been increased at times since July to "air out" the office. Windows in the exterior offices can be opened, but generally were kept closed for temperature control. The second, third and fourth floors share a separate air ventilation system.

Forty employees and work-study students moved into the office on approximately May 20, 1980. Within two weeks, variable odors were noted throughout the office space, but greatest toward the north side. Major odors were described as acrid, plastic, or sweet smells. Employees throughout the sixth floor began complaining of eye irritation, headache, dizziness and fatigue in early June. Employees on the fourth and fifth floors experienced similar, but milder symptoms. Many persons on these floors noted a "plastic" odor. A physician of the employee health service met with the staff on July 8 and recommended evacuating the building pending resolution of the problem. On July 16, thirty-three of 40 employees vacated the office on the sixth floor. The remainder left by mid-September. Several employees on the fourth and fifth floors had left the building; however, they had all returned before NIOSH was contacted.

The administration of the Department requested consultation from several agencies. The New York City Environmental Health Services inspected the office on June 14, 1980, and found no specific odors. On June 20, representatives of the N.Y.U. Medical Center "found nothing unusual". A consulting firm conducted an investigation and concluded that the source of the odors was the recently applied finishes and adhesives. A second consulting firm conducted environmental sampling on July 29 and August 5. Ammonia and toluene were undetectable using Draeger Indicator Tubes. Formaldehyde was analyzed by NIOSH method P & CAM 125 and not found. The latter firm commented that the ventilation seemed to average about one air change per hour (normal is about 5).

Corrective actions included airing out the office twice with all windows opened, repairing the roof top exhaust for the basement tenant's spray booth, vacuuming the air plenums twice, cleaning debris from the vacant third floor, removing stagnant water in the north courtyard, and increasing the fresh air intake to the air conditioning system. Despite these actions, several employees noted persistent odors whenever they returned to the office for short periods of time. Therefore, the employees decided not to return to the building. In September 1980, the Director of the Public Affairs Department requested NIOSH to inspect the building and investigate the health complaints.

IV. Evaluation Design and Methods

Initial employee interviews and a walk-through inspection implicated organic solvent vapors possibly from construction materials and adhesives, ethyl acrylate caulking, or vapors from the hat manufacturing company. Therefore, area environmental samples were collected for formaldehyde and organics, including ethyl acrylate. Formaldehyde was measured using the C.E.A.-555 (lower limit of detection is approximately 10 parts per billion). Organic vapors were measured using charcoal tubes connected to MSA pumps. Samples were collected for an average of 5 hours at 1.5 liters per minute. Samples were desorbed using carbon disulfide and analyzed by gas chromatography.

Sampling locations included several offices on the sixth floor, the exhaust stack of the hat manufacturer, and the art studio in the temporary offices of the Public Affairs Department. Samples were collected on September 4th and 9th when the exhaust stack of the hat manufacturer was not being used and on September 22nd when the hat manufacturer was in operation.

The medical evaluation was based on an analysis of responses to a questionnaire administered by NIOSH to the employees of the sixth and fifth floor offices. The NIOSH questionnaire contained questions on job title, location, symptoms, odors, past medical history, and smoking habits. Included in the survey were 36 of 40 people on the sixth floor, 13 of 15 on the east division of the fifth floor, and 4 of 6 on the west division of the fifth floor. Additionally NIOSH analysed the responses to a questionnaire administered in July to employees of the fourth and fifth floors by the Department of Development and another questionnaire given to the sixth floor staff by one of its members.

V. Evaluation Criteria

The environmental evaluation criteria used in this report as related to airborne exposure to toxic substances are the (1) NIOSH recommended standards, (2) Threshold Limit Values (TLV) of the American Conference of Governmental Industrial Hygienists (ACGIH), and (3) Federal occupational health standards as promulgated by the Occupational Safety and Health Administration, U.S. Department of Labor (29 CFR 1910.1000). Threshold Limit Values for mixtures of hazardous substances were also evaluated using the formula $C_1/T_1 + C_2/T_2 + \dots C_N/T_N$, where C_1 indicates the observed atmospheric concentration and T_1 the corresponding TLV. Exposure is considered excessive if the sum of the ratios exceeds unity.

Appropriate values are presented in the following table:

<u>Substance</u>	<u>NIOSH Recommended Standard^a mg/m³ (p.p.m.)^c</u>	<u>ACGIH TLV^b mg/m³ (p.p.m.)</u>	<u>OSHA Standard^b mg/m³ (p.p.m.)</u>
Ethyl Acrylate	100 (25)	20 (5) ^d	100 (25)
Toluene	375 (100)	375 (100)	750 (200)
Formaldehyde	1.2 (0.8) ^e	3 (2)	4.5 (3)
Hexane	360 (100)	90 (25) ^d	1800 (500)
111-Tri-chloroethane (methylchloroform)	1900 (350) ^f	1900 (350)	1900 (350)
"hydrocarbons"	-----	-----	(100-1,000)

- a. 10 hour day, 40 hour week, except as noted
- b. 8 hour day, 40 hour week
- c. milligrams per cubic meter of air (parts per million parts of air)
- d. TLV Intended change for 1979
- e. 30 minute ceiling
- f. 15 minute ceiling

Exposure to the toxic substances potentially present in the office air could affect the body in several ways. First, vapors from some chemicals (such as formaldehyde, ethyl acrylate, etc.) can act as respiratory irritants, causing burning and tearing of the eyes, stuffy nose, scratchy throat, and, in large doses, gagging, coughing or wheezing(1). Second, vapors from organic solvents can cause narcosis or unconsciousness in large doses. Lower doses can result in headaches, lightheadedness, dizziness, nausea, or confusion(2,3). Organic solvents volatilize easily, producing odors which can be described as sweet, plastic, aromatic, or gasoline-like. Some have little or no odor. The strength of the odor does not correlate with the health effects of exposure.

The odors and known health effects of substances potentially present in the office space are summarized in Table 1.

VI. RESULTS AND DISCUSSION

A. Environmental Findings

The environmental concentrations of all substances measured were low and well within recommended levels. Calculated threshold limit values for mixtures did not exceed unity.

Formaldehyde was tested in several locations throughout the fifth and sixth floors and outside the building on 9/14/80. Levels ranged from 20 to 30 p.p.b. (parts per billion) in all locations. The mean value for the sixth floor was 25 p.p.b. (0.038 mg/m^3). This value is less than 5 per cent of the NIOSH recommended standard.

Organic solvent vapors were sampled by charcoal tubes on 9/4 and 9/10 when the exhaust stack was not in operation. The results are shown in Tables 2 and 3. Toluene was the only substance detected. On both days it was present uniformly throughout the sixth floor at a mean level of 0.14 mg/m^3 (range= 0.08-0.18). This value represents less than a thousandth of the NIOSH recommended standard.

Organics were again sampled on 9/22 when the exhaust stack was in operation. Samples were collected in the art studio, from the exhaust stack, and in the temporary art studio in another building. The results are shown in Table 4. Toluene was present in all locations at approximately the same levels as before. The exhaust stack air contained 2.5 mg/m^3 of toluene compared to only trace amounts when not in operation. It also contained C6 - C7 hydrocarbons, hexane, and 1,1,1-trichloroethane at low levels. On this day, the art studio on the sixth floor had trace amounts of the C6-C7 hydrocarbons. As the hydrocarbons were not found in samples collected when the exhaust stack was not in operation, it is possible that the stack could act as a source of contamination.

It is to be noted that the major components of the exhaust stack vapors are also the major components of the vapors found in the commercial products used in the temporary art studio.

In interviews, individuals mentioned various intermittent odors. One acrid odor was noted by the NIOSH staff during the survey around room 605 on 9/10 and 9/22. This odor was also detectable on the roof of the building from the odor of asphalt used to repair the roof. Room 605 is equipped with a window air conditioner and is also supplied by the central air movers. Both systems were in operation on 9/10, but only the central air-moving system was in operation on the 9/22. Apparently, the central air-moving system can act as a conductor of intermittent odors.

B. Medical Findings

Responses to the NIOSH questionnaire by the sixth floor employees were analyzed for patterns of symptoms and exposures. Thirty-six persons answered the questionnaire, including 23 females and 13 males. The most commonly reported symptoms were fatigue, headache, burning eyes, dizziness, nausea, and dry throat. (Table 5) Males were slightly less symptomatic than females; however, except for nausea, the differences were not significant. Nausea was much more common among females ($p < .02$). Symptoms were not associated with prior histories of

asthma, allergies, headaches, and eye problems, or current cigarette smoking. More females than males smoked, but the difference was not significant ($\chi^2 = 1.05$, 1 degree of freedom). Additionally, smoking did not account for the greater prevalence of nausea among females ($p = .18$, Fisher's exact test).

Skin rashes were reported by 6 persons (17 percent). Five of the six had had prior similar rashes. The morphology of the lesions was not consistent among employees. Therefore, dermatitis was likely not a feature of this exposure.

Overall the symptoms were consistent with exposure to mild upper respiratory tract irritants and possibly central nervous system depressants. Examples of such substances could include any of the organic substances mentioned above.

Symptoms began for the most part in early June with mucosal membrane irritation, headache, and fatigue. Through July, more persons were affected and the pattern of symptoms became more non-specific. Since 28 of 36 persons eventually experienced some symptoms by the end of July, a case definition was established as a person reporting 4 of 5 of the following symptoms: fatigue, headache, dizziness, burning eyes, or dry or sore throat. Eleven persons satisfied the case definition. Twelve other employees had 2 or more symptoms in no clear patterns and 13 remained asymptomatic or had unrelated medical problems. The 11 cases developed their symptoms earlier than other employees. Figure 1 illustrates the reported dates of onset of symptoms. Cases had dates of onset averaging 1.5 weeks after moving into the building in late May (standard deviation = 1.15). Persons with more non-specific symptoms developed their symptoms 3.7 weeks after moving in (s.d. = 1.76). The difference was highly significant ($p < .01$, Student's t-test). Thus, a small number of employees experienced a consistent pattern of symptoms in early June, followed by the gradual development of more non-specific symptoms among a larger number of employees through mid-July when the office was vacated.

There was no clear spatial distribution of symptoms; however, persons in the art studio and the open office space were most frequently affected. Generally, persons in exterior offices with windows were not affected. Symptoms were relieved by leaving the building.

The NIOSH questionnaire was also administered to employees on the fifth floor. On that floor, the prevalence of symptoms was substantially less; however, some individuals did experience eye and throat irritation and others, headache and fatigue. No one met the criteria of the case definition. The dates of onset were variable, ranging from early May until July. Some dated their symptoms to the installation of the new windows on the north side of the building.

The reported odors in the building were greatest in early June and July. While variable from day to day, the major odors included acrid, plastic, or sweet smells. Each odor was reported by different people throughout the office. Many felt the acrid or plastic smell was due to the window caulking used in early June. The roof was also repaired at approximately this time. Others noted that the sweet or "solvent" smell increased on construction days, especially with wood varnishing, and may have been stronger closer to the art studio. While some persons described increased symptoms on the days with stronger odors, there was not a consistent association between the strength of the odors and the severity of the symptoms.

The questionnaire administered by the Department of Development to its staff on the fourth and fifth floors was analyzed by NIOSH. Thirty-five persons responded. The responses were dated in early to mid-July, but the dates of onset of symptoms were not recorded. The questionnaire asked about windows, ventilation, odors, and health symptoms. The most prevalent symptoms were similar to those reported in the NIOSH questionnaire: headache(54%), excessive tiredness(43%), nausea(31%), eye irritation(28%), and sinus irritation(26%). Other symptoms were reported substantially less frequently.

Location on the fourth or fifth floor and the presence or absence of a window in the office were not associated with symptoms. On the other hand, the reporting of a "plastic-type" smell was significantly associated with the presence of 4 symptoms: eye irritation(odds ratio= 12.5, $p=0.0035$), headache(O.R.= 5.9, $p=0.018$), excessive tiredness(O.R.= 4.5, $p=0.033$), and nausea(O.R.= 4.3, $p=0.049$) (significance testing was by Fisher's exact test).

Because the plastic-type odor and early symptoms were reported by employees on the fourth floor, as well as the fifth and sixth floors, the ethyl acrylate in the caulking used to replace the windows was likely responsible for the initial complaints. (The fourth floor has a separate air-moving system and the empty caulking tubes were stored on the vacant third floor.)

C. Conclusions

The results of the medical questionnaire and the environmental evaluation indicate that employees on the sixth floor were likely exposed in early June to a variety of organic vapors causing mild respiratory irritation and central nervous system depression. Conditions at the time of monitoring were different from those existing during summer when the symptoms were experienced. Since the beginning of July, several steps were taken to decrease odors, and possibly, vapors from the building. The results of testing by NIOSH in September indicate that there are no vapors present in the office in amounts sufficient to cause physiologic effects or ill-health. Any remaining odors reflect levels of organic vapors, more than 1,000 times lower than those known to cause health effects. Therefore, NIOSH concludes that the building is safe for occupancy.

Past conditions cannot be duplicated; however, events may be reconstructed. The sources of the vapors were likely multiple. Employees occupied the sixth floor office while construction was continuing. Ethyl acrylate, a respiratory irritant with a strong acrid odor, was contained in caulking applied to the window frames in early June. Its vapors likely affected many persons for several days. Additionally, organic solvents were present in the construction materials and varnish applied during working hours. Small amounts of vapors could also have been generated in the art studio. Finally, under certain wind conditions, vapors from the exhaust stack of the hat manufacturer could have drifted into the intake of the air moving system, which is located approximately 10 feet below the exhaust stack on the north side of the building. Once a vapor enters a modern office, which typically recirculates 80% to 90% of the air, it tends to remain in the system for some time.

While it is unlikely that any one substance accumulated to toxic levels, it is possible that the mixture of vapors could have interacted to have caused a physiologic response. Clearly, several persons experienced a common pattern of symptoms beginning in early June. Furthermore, as these employees continued to develop symptoms in the face of multiple odors, a new office situation, and continuing construction, other employees began to experience multiple symptoms of ill-health. These later symptoms likely represent manifestations of stress experienced by the employees due to the disrupted office environment. During interviews many employees reported anxiety, frustration, and stress over the conditions in the new office. The evolution over time into a non-specific pattern of symptoms indicates that a toxic exposure was probably not solely responsible for all of the observed health effects.

While airborne concentrations of vapors are substantially below toxic levels and the building is safe for occupancy, odors can still be detected. These odors and "stale air" could be unpleasant to some employees and, possibly, be associated with further stress-related symptoms. Therefore, recommendations are made to further reduce these odors.

VII. Recommendations

1. The Art Studio (room 615) should be equipped with a separate exhaust to remove vapors from the studio and not recirculate them to the rest of the office.
2. The exhaust stack from the hat manufacturer should be extended a minimum of 10 feet to avoid recirculation of vapors.
3. The current ratio of 1/3 fresh air, 2/3 recirculated air should be maintained as feasible.
4. Future office refitting by New York University should be completed and the spaces aired out before occupancy by office employees.

5. An office health committee should be established to review complaints relating to health problems or discomfort. The committee should have representatives from the administration, employees, and building management.

VIII. AUTHORSHIP AND ACKNOWLEDGEMENT

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X. DISTRIBUTION AND AVAILABILITY

For the purpose of informing the "affected employees" the employer should post this report for at least 30 days in a prominent place(s) near where employees work.

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Copies of this report have been sent to:

New York University, Public Affairs Department
U.S. Department of Labor, Region II
New York State Department of Health, Division of Occupational Safety and Health
NIOSH, Public Health Service, Region II

Health Effects of Suspected Vapors

<u>Substance</u>	<u>Odor</u>	<u>Health Effects</u>
Ethyl Acrylate (2)	Sharp Acrid	Irritation of eyes, respiratory tract, and skin. Burning and tearing of eyes.
Formaldehyde (2,4)	Sharp, Bitter Acrid	Irritation of eyes and respiratory tract. Suspected carcinogen. Tingling of eyes, nose, and posterior pharynx at 2-3 ppm (3-4.5 mg/m ³). Tearing of eyes at 4-5 ppm.
Hexane (2,5)	Gasoline-like	Mild upper respiratory irritant and central nervous system depressant; chronic exposure causes peripheral neuropathy. Dizziness greater than 1000 ppm (3600 mg/m ³). Slight nausea, headache and irritation on eyes and throat at 1500 ppm (5400 mg/m ³).
Toluene (6)	Sweet, pungent	Mild fatigue, weakness, confusion, lacrimation and mild paresthesias of the skin at 200 ppm (750 mg/m ³). Euphoria, headache, and dizziness at 600 ppm.
1,1,1-Trichloroethane (7)	Chloroform-like	Irritation of eyes, light headedness, and incoordination at 1000 ppm (5485 mg/m ³) for 20 minutes.

Table 2

Environmental Sampling for Organics on 9/4/80

<u>Sample Location</u>	<u>Sample Volume (liters)</u>	<u>Analysis</u> ^① (mg/m ³)	
		<u>Toluene</u>	<u>Others</u>
Room 605 (Exterior, SE corner)	270	0.15	N.D. ^②
Room 615 (Art Studio, NE corner)	534	0.13	N.D.
Room 623 (Exterior, NW corner)	411	0.11	N.D.
Room 602 (Interior, SE)	218	0.18	N.D.
Room 624 (Interior, W end)	365	0.08	N.D.
Open Office (NE area)	382	0.11	N.D.
Open Office (SW area)	526	0.11	N.D.

1. Analysis by gas chromatography for identification of organics.

2. None detected.

Table 3

Environmental Sampling for Organics on 9/10/80

<u>Sample Location</u>	<u>Sample Volume (liters)</u>	<u>Analysis</u> ¹	
		<u>Toluene</u>	<u>Others</u>
Room 605 (Exterior, SE corner)	452	0.13	N.D. ²
Room 615 (Art Studio, NE corner)	618	0.13	N.D.
Room 619 (Exterior, N wall)	537	0.15	N.D.
Room 624 (Interior, W end)	662	0.17	N.D.
Open Office (NE area)	690	0.16	N.D.
Open Office (SW area)	670	0.15	N.D.
Open Office (SW area)	674	trace	N.D.
Exhaust Stack			

1. Analysis by gas chromatography for identification of organics.

2. None detected

Table 4

Environmental Sampling for Organics on 9/22/80

<u>Sample Location</u>	<u>Sample Volume (liters)</u>	Analysis ¹ (mg/m ³)			<u>1,1,1 trichloro- ethane</u>
		<u>Toluene</u>	<u>C₆-C₇</u>	<u>Hexane</u>	
Room 615 - Center (Art Studio)	286	0.07	trace	n.d. ²	n.d.
Room 615 - Window (Art Studio)	288	0.04	trace	n.d.	n.d.
Room 615 - East wall (Art Studio)	252	0.08	trace	n.d.	n.d.
Exhaust Stack	248	2.50	6.6	1.57	3.47
Temporary Art Studio ³ - South Hall	474	0.15	7.8	3.86	12.53
Temporary Art Studio - Middle	484	0.12	6.7	3.00	8.06
Temporary Art Studio - N.W. corner	488	0.06	2.9	0.12	3.48

1. Analysis by gas chromatography for identification of organics.

2. None detected

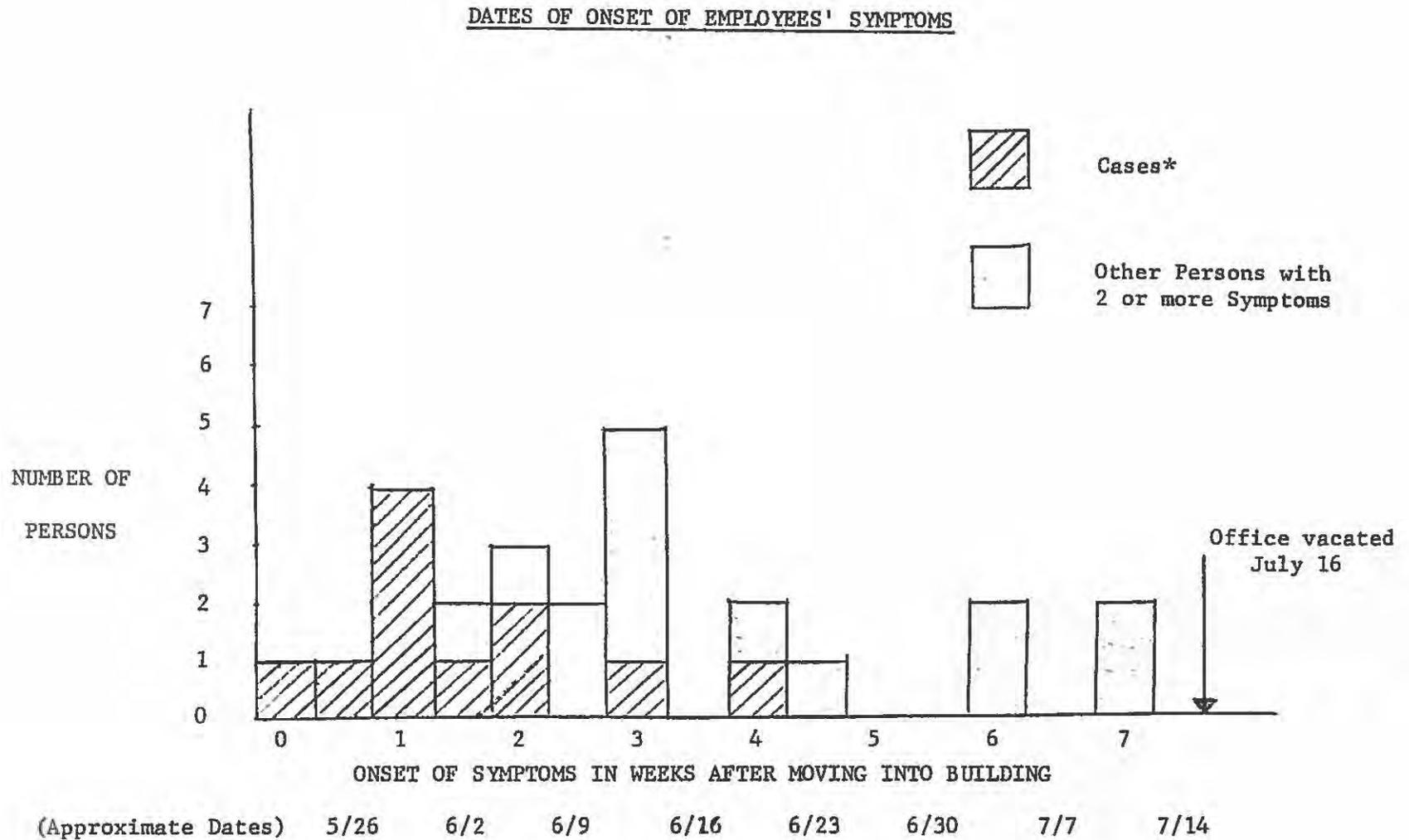
3. Located on 7th floor of 4 Washington Place, New York City.

Table 5

Prevalence of Symptoms During Summer 1980
Among Employees of the Public Affairs Department
(Percent experiencing symptoms)

<u>Symptoms</u>	<u>Total</u> (N=36)	<u>Female</u> (N=23)	<u>Male</u> (N=13)
Fatigue	58	70	38
Headache	50	52	33
Burning Eyes	42	48	31
Dizziness	39	43	31
Nausea	39	57	8
Dry or Sore Throat	33	35	31
Chest Tightness	33	39	23
Tearing Eyes	22	26	15
Short of Breath	19	22	15
Sensitivating to Light	17	17	15
Rash	17	13	23
Cough	14	18	8
Stuffy Nose	8	13	0
Wheezing	8	9	8
Vertigo	3	0	8
Cigarette Smoking	36	43	23

Figure 1



* Cases defined as experiencing 4 of 5 symptoms: fatigue, headache, dizziness, burning eyes, or dry or sore throat.

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