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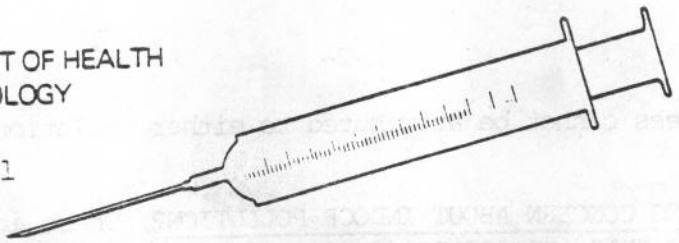

EPIDEMIOLOGY BULLETIN

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BUILDING-RELATED ILLNESS AND INDOOR AIR POLLUTION: A NEW PROBLEM?

HEALTH DEPARTMENT INVESTIGATIONS: The Consultative Service Program of the Bureau of Occupational Health has responded to a number of requests for assistance from occupants of buildings where the indoor air was alleged to be polluted. Occupants complained of respiratory or eye symptoms in 15 of 16 investigations completed to date. Results of these investigations are summarized below. Excluded from analysis were buildings where chemicals were known to be used or manufactured. Also excluded were requests to check for asbestos insulation. The limited resources of the Bureau has restricted investigations to places of work or schools; no private residences were studied. No investigations were conducted in 1980, four were conducted in 1981, and 12 have been completed through October of 1982. Of the 16 investigations, nine were in office buildings, and six involved either new buildings (1975 or later) or recently remodeled buildings. Environmental sampling was done in 15 investigations. This usually involved: screening with an infrared spectrophotometer; sampling for organic vapors using charcoal or silica gel tubes, which were then desorbed in the laboratory and run through a gas chromatograph; sampling for formaldehyde with sodium bisulfite tubes; and sampling for ozone, carbon monoxide (CO), toluene diisocyanate, and hydrogen sulfide using detector tubes with color indicators. Sampling results were negative in nine investigations. In the remaining six investigations, positive results were obtained for organic chemicals in four cases and for formaldehyde in three cases. All levels were below OSHA's threshold limit values (TLV). Although extensive ventilation tests were not done, it was determined by inspection, review of ventilation system specifications or smoke tube tests, that nine of the sixteen buildings were inadequately ventilated with fresh air.

Editor's Comment: The finding that air sample results were negative in the majority of buildings may be explained in several alternative ways. First, a pollutant may have been present at a very low concentration, but allergic symptoms were produced nevertheless in sensitized individuals. Second, some low-level pollutants, although innocuous by themselves, may have acted synergistically to produce symptoms. Third, the pollutant responsible for symptoms may not have been tested for. Finally, the symptoms attributed to indoor pollution may actually have been due to an unrelated medical condition or psychosocial factors (1).

More studies need to be performed to determine the incidence and prevalence of building-related illness, its causes, and the risk factors associated with its occurrence. What proportion of building-related illness, for instance, is due to a documented indoor pollutant? What proportion is due to simple "stuffy air" from inadequate ventilation? And finally, what proportion of so-called

building-related illness cannot be attributed to either pollution or poor ventilation?

WHY IS THERE INCREASING CONCERN ABOUT INDOOR POLLUTION? There are several reasons to account for this increasing concern among physicians, public health authorities, legislators and the general public. First, the use of asbestos for insulation in many buildings has led to concerns for the health of persons in those buildings, given the associations between occupational asbestos exposure and asbestosis, lung cancer and mesothelioma (2). Second, the banning of urea-formaldehyde insulation by the Consumer Product Safety Commission (CPSC) highlighted concerns about the safety of homes previously insulated with this material. The CPSC action came after results of animal studies indicated that formaldehyde was a carcinogen (3). Third, although legislation has effectively controlled excessive exposure to outdoor air pollution, the average person spends 90% of his time indoors (4), where pollutant levels frequently exceed those outdoors (5). Finally, the energy crisis has led to the construction of tightly sealed buildings with reduced air-exchange. While this has had the effect of reducing energy costs, it has brought the average building closer to mimicking the problems associated with the sealed environments of submarines and spacecraft. The control of "indoor" pollution has always been a prime consideration in submarine technology. Nuclear submarines, with their capability of staying submerged for prolonged periods, have had to be equipped so as to avoid oxygen depletion and the buildup of carbon dioxide (CO_2), CO, freon, hydrocarbons, ozone, particulates (e.g. cigarette smoke), radon and radon daughters (from radium dials and wrist watches), other forms of radiation (from the reactor), heat, and humidity (6).

WHAT ARE SOME OF THE KNOWN SOURCES OF INDOOR POLLUTION? Carbon monoxide is produced indoors by the smoking of tobacco and by the combustion of natural gas e.g. from unvented gas heaters, a frequent cause of asphyxiation (7). Recent evidence suggests that non-smokers with angina pectoris may have their condition aggravated if smoking is taking place in the same room (8). The use of methylene chloride paint-stripper in poorly ventilated areas leads to its inhalation and *in vivo* transformation to CO (9). Kerosene heaters, increasingly popular in the last several years, produce relatively little CO, although they generate significant amounts of CO_2 and SO_2 (10).

Smoking leads not only to increased CO levels in indoor air, but also greatly increases concentrations of respirable suspended particulates (RSP), which are responsible for eye and upper respiratory irritation in many non-smokers. Experimental and theoretical models have demonstrated that RSP levels generated by smokers are sufficient to overwhelm the average ventilation system (11).

The major indoor source of oxides of nitrogen (NO_x) is the gas stove. NO_x levels rise sharply during cooking periods, and even higher levels have been recorded when the stove is inappropriately used to heat the home. There is inconclusive evidence that exposure to NO_x may interfere with local host defenses against respiratory infection (12).

Radon, a radioactive gas, enters the atmosphere from the soil and building materials. Although it has a half-life of only 3.8 days, its daughter products are solids which attach themselves to dust particles which may then be inhaled. The radiation dose to the bronchial epithelium from these alpha-emitting particles is the highest dose received by man from natural sources. In poorly ventilated buildings, radon cannot be dispersed and its daughter products accumulate to levels which exceed outdoor levels by several fold (13). The health consequences of this "low level" radiation exposure are not known at

present. Higher levels of radon daughter exposure occurred in the past among uranium miners, and were subsequently associated with an increased risk of developing lung cancer.

The inhalation of dust from moldy hay may lead to hypersensitivity pneumonitis (farmer's lung). The fungi usually responsible for this illness, thermophilic actinomycetes, have also been implicated as the cause of an identical illness associated with contaminated office air conditioners (14), home heating systems (15), humidifiers, and car air conditioners (16). Correction of the problem requires decontamination and, if the problem recurs, engineering controls.

The usual sources of organic contaminants in office buildings are building materials, wet-process photocopiers, tobacco smoke, and maintenance products (17). Over 40 organic vapors have been found in some office building environments (18). Illness was recently described in a man exposed to caulk vapors following sealing of his log home with a toluene and petroleum distillate-based "butyl" caulk (19).

Since it is not possible to eliminate, or even reduce all sources of indoor pollution, proper ventilation with addition of fresh air is essential. Several authoritative guides are available for assessing the adequacy of building ventilation (20-22).

CONCLUSIONS: There is no question that indoor air pollution exists in some buildings, and that the air quality inside these buildings may be paradoxically worse than it is outside. The health effects of such indoor pollution need to be better defined and quantified.

Building-related illness, at least in the form in which it has been investigated in Virginia, is a poorly defined syndrome which is more often related to inadequate fresh air ventilation than to a documented exposure to high levels of a single air pollutant.

The most serious, well-described hazard of indoor air pollution is carbon monoxide poisoning.

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ERRATUM

The November issue of the Virginia Epidemiology Bulletin (Vol. 82, No. 11) incorrectly attributed two rabid animals to the city of Fredericksburg. The two animals (1 raccon, 1 skunk) were actually reported from Frederick County.

MONTH: December, 1982

DISEASE	STATE					REGIONS				
	THIS MONTH	LAST MONTH	TOTAL TO DATE 1982	TOTAL TO DATE 1981	MEAN 5 YEAR TO DATE	THIS MONTH N.W.	N.	S.W.	C.	E.
CHICKENPOX	92	10	924	1723	1005.8	5	37	45	1	4
MEASLES	0	0	14	13	125.2	0	0	0	0	0
MUMPS	5	1	44	134	130.2	0	1	3	0	1
PERTUSSIS	1	1	29	10	15.8	0	1	0	0	0
RUBELLA	0	0	12	9	218.2	0	0	0	0	0
MENINGITIS – ASEPTIC	15	37	262	274	224.6	3	4	1	5	2
BACTERIAL	18	23	211	224	168.2	4	2	5	1	6
ENCEPHALITIS – INFECTIOUS	5	7	45	40	33.6	1	0	1	2	1
POST-INFECTIOUS	0	0	1	6	8.8	0	0	0	0	0
HEPATITIS A (INFECTIOUS)	13	8	189	201	279.6	3	3	4	2	1
B (SERUM)	33	48	507	537	424.4	0	9	6	9	9
SALMONELLOSIS	89	105	1471	1572	1165.0	15	15	13	19	27
SHIGELLOSIS	10	18	159	1211	380.6	5	5	0	0	0
TUBERCULOSIS – PULMONARY	52	37	569	551	–	–	–	–	–	–
EXTRA-PULMONARY	11	9	115	115	–	–	–	–	–	–
SYPHILIS (PRIMARY & SECONDARY)	60	55	640	696	565.6	1	8	6	13	32
GONORRHEA	1638	1575	21,639	22,266	23,703.8	–	–	–	–	–
ROCKY MOUNTAIN SPOTTED FEVER	0	2	73	105	111.0	0	0	0	0	0
RABIES IN ANIMALS	94	106	745	167	4.8	8	86	0	0	
MENINGOCOCCAL INFECTIONS	6	6	73	103	73.8	0	1	1	1	3
INFLUENZA	16	20	398	5001	2794.0	0	0	5	0	11
MALARIA	2	0	41	33	34.6	–	2	–	–	–
OTHER: Hep. Unspec.	8	6	104	180	180.6	0	4	3	1	0

COUNTIES REPORTING ANIMAL RABIES: Arlington 1 raccoon, Fairfax 62 raccoons, 3 skunks; Prince William 4 raccoon, 2 skunks; Frederick 2 raccoon, Loudoun 12 raccoons, 2 skunks; Fauquier 3 raccoons, 1 cat; Rockingham 1 skunk; Shenandoah 1 raccoon; Rappanhannock 1 raccoon

OCCUPATIONAL ILLNESSES: Occupational pneumoconioses 6; Occupational dermatoses 1; Occupational hearing loss 21; Asbestosis 7; Methylmercaptan poisoning 2.

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