Aug 23 [illegible]

#2

INTERNAL CORRESPONDENCE

FROM PITTSBURGH MEDICAL DEPARTMENT

To
R. S. Adams - Olean
C. G. Bell - Cleveland
H. Harness ~~R. H. Brown~~ - ~~Mobile~~
F. B. Colby - Garwood
H. T. Condon - Pt. Comfort
D. Conosa - Edgewater
W. G. Dotson - Badin
B. H. Droz - Wenatchee
G. J. Fickes - Vancouver
E. N. Goas - Cressona
H. Harness - Mobile
J. Hobbs - Alcoa Fab.
H. T. Condon ~~R. R. Hood~~ - ~~Point Comfort~~ Davenport
F. Kramer - Bauxite Alumina
M. A. Marr - Buffalo
R. H. Moore - Rosiclare
J. J. Moroney - Massena
R. E. Paine - Vernon
D. D. Kent ~~H. Pracht~~ - ~~Davenport~~
J. T. Quirk - Bridgeport
R. C. Roberts - E. St. Louis
J. W. Schachtele - Chillicothe
R. E. Schenk - Detroit
H. A. Semken - Rockdale
D. F. Shantz - Richmond
C. S. Short - N.K.
C. L. Teubert - Chicago
E. M. Trimble - Bauxite Mining
W.V.M.Williams - Alcoa Smelting
R. G. Wood - Lafayette
E. B. Youngblut - Lancaster

Re: INDUSTRIAL HYGIENE

Attached are the following items which should be of considerable interest:

1. A.C.G.I.H. Threshold Limit Values, 1955.
2. Information on aluminized cloth for protection against radiant heat.
3. Hazardous exposure to so-called safe solvents.
4. Letter from Mr. J. T. Hobbs re Controlled Atmosphere Generating Units.

Lester V. Cralley

LVC/db

cc: Dr. D. A. Irwin
Mr. C. L. Bradshaw
Mr. T. Bonney

APC 001309

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AL-369 4[illegible]

THRESHOLD LIMIT VALUES FOR 1955

Adopted at the Seventeenth Annual Meeting of the American Conference of Governmental Industrial Hygienists, Buffalo, April 24-28, 1955

VALUES are given in the following tabulation for the maximum average atmospheric concentration of contaminants to which workers may be exposed for an eight-hour working day without injury to health.

These values are based on the best available information from industrial experience, from experimental studies, and, when possible, from a combination of the two. They are not fixed values but are reviewed annually by the Committee on Threshold Limits for changes, revisions, or additions as further information becomes available. Threshold limits should be used as guides in the control of health hazards and should not be regarded as fine lines between safe and dangerous concentrations. They represent conditions only within which it is felt that workers may be repeatedly exposed, day after day, without their health being adversely affected. It is felt, at the present time, that workers should not be exposed to a working environment containing any of these substances in excess of the value indicated.

These values are not intended for use, or for modification for use, in the evaluation or control of community air pollution or air pollution nuisances.

ESTABLISHED VALUES

GASES AND VAPORS

SUBSTANCE	PPM*
Acetaldehyde	200
Acetic acid	10
Acetic anhydride	5
Acetone	1,000
Acrolein	0.5
Acrylonitrile	20
Ammonia	100
Amyl acetate	200
Amyl alcohol (isoamyl alcohol)	100
Aniline	5
Arsine	0.05
Benzene (benzol)	35
Bromine	1
Butadiene (1,3-butadiene)	1,000
Butanone (methyl ethyl ketone)	250
Butyl acetate (n-butyl acetate)	200
Butyl alcohol (n-butanol)	100
Butyl cellosolve (2-butoxyethanol)	200
Carbon dioxide	5,000
Carbon disulfide	20
Carbon monoxide	100
Carbon tetrachloride	25
Cellosolve (2-ethoxyethanol)	200
Cellosolve acetate (hydroxyethyl acetate)	100
Chlorine	1
Chlorobenzene (monochlorobenzene)	75
Chloroform (trichloromethane)	100
1-Chloro-1-nitropropane	20
Chloroprene (2-chlorobutadiene)	25
Cresol (all isomers)	5
Cyclohexane	400
Cyclohexanol	100
Cyclohexanone	100
Cyclohexene	400

* Parts of vapor or gas per million parts of air, by volume.

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SUBSTANCE	PPM*
Cyclopropane	400
o-Dichlorobenzene	50
Dichlorodifluoromethane	1,000
1,1-Dichloroethane	100
1,2-Dichloroethylene	200
Dichloroethyl ether	15
Dichloromonofluoromethane	1,000
1,1-Dichloro-1-nitroethane	10
Dichlorotetrafluoroethane	1,000
Diethylamine	25
Dimethylaniline (N-dimethyl-aniline)	5
Dimethylsulfate	1
Dioxane (diethylene dioxide)	100
Ethyl acetate	400
Ethyl alcohol (ethanol)	1,000
Ethylamine	25
Ethyl benzene	200
Ethyl bromide	200
Ethyl chloride	1,000
Ethyl ether	400
Ethyl formate	100
Ethyl silicate	100
Ethylene chlorohydrin	5
Ethylene dibromide (1,2-dibro-moethane)	25
Ethylene dichloride (1,2-dichloro-ethane)	100
Ethylene oxide	100
Fluorine	0.1
Fluorotrichloromethane	1,000
Formaldehyde	5
Gasoline	500
Heptane (*n*-heptane)	500
Hexane (*n*-hexane)	500
Hexanone (methyl butyl ketone)	100
Hexone (methyl isobutyl ketone)	100
Hydrogen chloride	5
Hydrogen cyanide	10
Hydrogen fluoride	3
Hydrogen selenide	0.05
Hydrogen sulfide	20
Iodine	1
Isophorone	25
Mesityl oxide	50
Methyl acetate	200
Methyl alcohol (methanol)	200
Methyl bromide	20
Methyl cellosolve (methoxy-ethanol)	25

SUBSTANCE	PPM*
Methyl cellosolve acetate (ethylene glycol monomethyl ether acetate)	25
Methyl chloride	100
Methylal (dimethoxymethane)	1,000
Methyl chloroform (1,1,1-trichloroethane)	500
Methylcyclohexane	500
Methylcyclohexanol	100
Methylcyclohexanone	100
Methyl formate	100
Methylene chloride (dichloro-methane)	500
Naphtha (coal tar)	200
Naphtha (petroleum)	500
Nickel carbonyl	0.001
Nitrobenzene	1
Nitroethane	100
Nitrogen dioxide	5
Nitroglycerin	0.5
Nitromethane	100
2-Nitropropane	50
Nitrotoluene	5
Octane	500
Ozone	0.1
Pentane	1,000
Pentanone (methyl propyl ketone)	200
Perchlorethylene (tetrachloro-ethylene)	200
Phenol	5
Phosgene (carbonyl chloride)	1
Phosphine	0.05
Phosphorus trichloride	0.5
Propyl acetate	200
Propyl alcohol (isopropyl alcohol)	400
Propyl ether (isopropyl ether)	500
Propylene dichloride (1,2-dichloro-propane)	75
Stibine	0.1
Stoddard solvent	500
Styrene monomer (phenyl ethylene)	200
Sulfur monochloride	1
Sulfur dioxide	10
1,1,2,2-Tetrachloroethane	5
Toluene	200
o-Toluidine	5
Trichloroethylene	200
Turpentine	100
Vinyl chloride (chloroethene)	500
Xylene	200

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TOXIC DUSTS, FUMES, AND MISTS

SUBSTANCE	MG. PER CU. M.†
Antimony	0.5
Arsenic	0.5
Barium (soluble compounds)	0.5
Cadmium	0.1
Chlorodiphenyl	1
Chromic acid and chromates as CrO_3	0.1
Cyanide as CN	5
Dinitrotoluene	1.5
Dinitro-*o*-cresol	0.2
Fluoride	2.5
Iron oxide fume	15
Lead	0.15
Magnesium oxide fume	15
Manganese	6
Mercury	0.1
Parathion (O,O-Diethyl-O-*p*-nitrophenyl thiophosphate)	0.1
Pentachloronaphthalene	0.5
Pentachlorophenol	0.5
Phosphorus (yellow)	0.1
Phosphorus pentachloride	1
Phosphorus pentasulfide	1
Selenium compounds (as Se)	0.1
Sulfuric acid	1
Tellurium	0.1
Tetryl (2,4,6-trinitrophenyl-methylnitramine)	1.5
Trichloronaphthalene	5
Trinitrotoluene	1.5
Uranium (soluble compounds)	0.05
Uranium (insoluble compounds)	0.25
Zinc oxide fumes	15

Radioactivity: For permissible concentrations of radioisotopes in air see "Maximum Permissible Amounts of Radioisotopes in the Human Body and Maximum Permissible Concentrations in Air and Water," Handbook 52, U. S. Department of Commerce, National Bureau of Standards, March, 1953. In addition, see "Permissible Dose from External Sources of Ionizing Radiation," Handbook 59, Department of Commerce, National Bureau of Standards, Sept. 24, 1954.

† *Milligrams of dust, fume, or mist per cubic meter of air.*

MINERAL DUSTS

SUBSTANCE	MPPCF‡
Alundum (aluminum oxide)	50
Asbestos	5
Carborundum (silicon carbide)	50
Dust (nuisance, no free silica)	50
Mica (below 5% free silica)	20
Portland cement	50
Talc	20
Silica	
high (above 50% free SiO_2)	5
medium (5 to 50% free SiO_2)	20
low (below 5% free SiO_2)	50
Slate (below 5% free SiO_2)	50
Soapstone (below 5% free SiO_2)	20
Total dust (below 5% free SiO_2)	50

‡ Millions of particles per cubic foot of air.

TENTATIVE THRESHOLD LIMIT VALUES

The following values are suggested for further consideration before being presented for adoption as established values. (§ marks materials added this year and for which bibliographic material has been prepared. The other materials appeared in last year's report.) It is proposed that the entire list will be presented for adoption at the meeting of the American Conference of Governmental Industrial Hygienists in 1956, if no reason to the contrary is forthcoming.

	Aldrin (1,2,3,4,10,10-hexachloro-1,4,4a,5,8,8a-hexahydro-1,4,5,8-dimethanonaphthalene)	0.25	mg/M³
	Allyl alcohol	5	ppm
	Allyl propyl disulfide	2	ppm
	Ammate (ammonium amidosulfate)	15	mg/M³
	Benzyl chloride	1	ppm
§	Butyl amine	5	ppm
	Butyl mercaptan	10	ppm
	Calcium arsenate	0.3	mg/M³
	Chlordane (1,2,4,5,6,7,8,8-octachloro-3a,4,7,7a-tetrahydro-4,7-methanoindane)	2.0	mg/M³
§	Chlorine trifluoride	0.1	ppm
§	Chlorinated diphenyl oxide	0.5	mg/M³
	Crag Herbicide (sodium-2,4,dichlorophenoxy ethyl sulfate)	15	mg/M³

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	2,4-D(2,4-dichlorophenoxyacetic acid)	10	mg/M^3
	D. D. T. (2,2-bis-(*p*-chlorophenyl)-1,1,1-trichlorethane)	2.0	mg/M^3
	Diacetone alcohol (4-hydroxy-4-methyl pentanone-2)	50	ppm
§	Diborane	0.1	ppm
	Dieldrin (1,2,3,4,10,10-hexachloro-6,7, epoxy-1,4,4a,5,6,7,8,8a-octahydro-1,4,5,8-dimethanonaphthalene)	0.25	mg/M^3
§	Difluorodibromomethane	100	ppm
	Diisobutyl ketone	50	ppm
	EPN (ethyl-*p*-nitrophenyl thiono benzene phosphonate)	0.5	mg/M^3
	Ethyl mercaptan	250	ppm
§	Ethylene diamine	10	ppm
§	Ethylene imine	5	ppm
	Ferro vanadium dust	1	mg/M^3
	Furfural	5	ppm
§	Furfuryl alcohol	200	ppm
§	Hydrazine	1	ppm
§	Hydrogen bromide	5	ppm
§	Hydrogen peroxide, 90%	1	ppm
§	Hydroquinone	2	mg/M^3
§	Isopropylamine	5	ppm
	Lead arsenate	0.2	mg/M^3
	Lindane (hexachlorocyclohexane, gamma isomer)	0.5	mg/M^3
	Malathon (0,0-dimethyl dithio phosphate of diethyl mercaptosuccinate)	15	mg/M^3
	Methoxychlor (2,2,diparamethoxyphenyl-1,1,1,trichloroethane)	15	mg/M^3
§	Methyl acetylene	1,000	ppm
	Methyl isobutyl carbinol (methyl amyl alcohol)	25	ppm
	Methyl mercaptan	50	ppm
	Molybdenum		
§	(soluble compounds)	5	mg/M^3
§	*(insoluble compounds)*	15	mg/M^3
	p-Nitroaniline	1	ppm
	Organo mercurials (as mercury)	0.01	mg/M^3
	Perchloromethyl mercaptan	0.1	ppm
	Phenylhydrazine	5	ppm
	Picric acid	0.1	mg/M^3
§	Propylene imine	25	ppm
	Pyridine	10	ppm
§	Quinone	0.1	ppm
	Sodium hydroxide	2	mg/M^3
	Sulfur hexafluoride	1,000	ppm
	Sulfur pentafluoride	0.025	ppm
	TEDP (tetraethyl dithiono pyrophosphate)	0.2	mg/M^3
	TEPP (tetraethyl pyrophosphate)	0.05	mg/M^3
§	*p*-Tertiary butyl toluene	10	ppm
§	Tetrahydrofuran	75	ppm
§	Tetranitromethane	1	ppm
	Titanium dioxide	15	mg/M^3
§	Trifluoromonobromomethane	1,000	ppm
	Vanadium		
	(V_2O_5 dust)	0.5	mg/M^3
	(V_2O_5 fume)	0.1	mg/M^3
§	Zirconium	5	mg/M^3

Beryllium: During the past few years, several papers have appeared in the literature which report a limit of 2γ per cubic meter of air for beryllium. Among these is the paper by Van Ordstrand, H. S.: Berylliosis, *A. M. A. Arch. Indust. Hyg.* 10: 232-234 (Sept.) 1954, and one by Sterner, J. H., and Eisenbud, M.: Epidemiology of Beryllium Intoxication, *A. M. A. Arch. Indust. Hyg.* 4:123-151 (Aug.) 1951. Conflicting data from industrial experience has caused the Committee to postpone the suggestion of a Threshold Limit for this material. It is apparent that more epidemiologic work is needed for the establishment of a definite value.

Reference material has been prepared on each of the above substances and, though in some instances rather meager, is available for distribution. The committee would welcome suggestions of substances to be added and also comments, additional references, or reports of experience with these materials.

William L. Ball
L. T. Fairhall
Kingsley Kay
H. E. Stokinger
A. J. Vorwald
Louis F. Weller
Allan L. Coleman, *Chairman*

APC 001313

Re: ALUMINIZED CLOTH

We have had the occasion to study an aluminized cloth produced by the Minnesota Mining and Manufacturing Company. The coating is produced by a new process in which most of the original properties of the cloth are maintained. We have been impressed by the material and believe that the aluminized duck made into aprons and sleeves can be an effective shield for radiant heat.

3-M was contacted for a list of protective clothing fabricators who use their material. The following companies were given:

Wheeler Protective Apparel, Inc.
224 West Huron Street
Chicago 10, Illinois

Industrial Gloves Co.
Danville, Illinois

Industrial Safety Specialties Co., Inc.
Eighth & Chestnut Streets
Perkasie, Pennsylvania

Mine Safety Appliances
201 N. Braddock Avenue
Pittsburgh 8, Pa.

Safety Clothing & Equipment Co.
1990 E. 69th Street
Cleveland 3, Ohio

American Optical
Southbridge, Mass.

Literature has been received from the above companies and while all market face shields and aluminized asbestos, only the Safety Clothing & Equipment Co. and the Mine Safety Appliances furnish clothing made from aluminized duck.

It is suggested that those with radiant heat problems consider the use of the above material.

L. V. C.

Beecher [17] also found the difference between placebo and morphine more striking with 5% carbon dioxide inhalation than with inhalation of room air. A partial explanation for this fact is that the depression of the respiratory center is manifested first by a decrease in its reserve, as measured by its ability to respond maximally to the driving force of an increased pressure of carbon dioxide in the arterial blood. A second factor of importance, demonstrated by Loeschcke and associates [18] is the increase in alveolar and arterial pressure of carbon dioxide that occurs after a dose of morphine. This acts in a compensatory fashion by increasing the stimulus to the respiratory center and thus masking the effect of the drug in patients breathing room air. A third possibility comes to mind, however. Ordinary respiration is subject to a certain amount of voluntary control. The greater variability in respiratory rate and minute volume between subjects when breathing room air than between the same subjects breathing 5% carbon dioxide [17] suggests that the use of a powerful involuntary respiratory stimulus may override voluntary factors and thus reduce the variance due to nondrug factors.

Because of simplicity of measurement, it is customary in many laboratories to report respiratory minute volume in such studies, although effective alveolar ventilation is actually the information desired. The use of respiratory minute volume rather than effective alveolar ventilation seems partially justified by the failure to find significant changes in respiratory rate after administration of morphine in the doses used. Although this lends support to the use of this parameter as a valid index of respiratory depression, the technique may lead to an underestimation of the depressant effects of morphine. If the dead space does not change significantly, the per cent decrement in effective alveolar ventilation would be even greater than the decrement in respiratory minute volume, since the percentage of this volume contributed by dead space would be greater after administration of morphine than after administration of a placebo.

SUMMARY AND CONCLUSIONS

A study of pain relief in 122 patients after operation revealed only slight increase in potency and duration of analgesia of morphine when the dose was raised from 10 to 15 mg. The side-action liability and respiratory effects of these two doses were studied in 10 healthy volunteers. In this latter group, a trend was observed toward greater respiratory depression with the larger dose, and a significantly higher incidence of troublesome side-effects was recorded. A review of the literature indicates that 15 mg. doses of morphine are probably unnecessary to relieve pain in the majority of patients receiving this drug and are apparently more productive of undesirable side-effects than 8 to 10 mg. doses. In view of these findings the routine use of 15 mg. seems unwarranted. The optimal dose appears to be 10 mg. per 70 kg. of body weight.

17. Keats, A. S., and Beecher, H. K.: Analgesic Potency and Side Action Liability in Man of Heptazone, WIN 1161-2, 6-Methyl Dihydromorphine, Metopon, Levo-isomethadone and Pentobarbital Sodium, as a Further Effort to Refine Methods of Evaluation of Analgesic Drugs, J. Pharmacol. & Exper. Therap. 105: 109 (June) 1952.

HAZARDOUS EXPOSURE TO SOME SO-CALLED SAFE SOLVENTS

James P. Hughes, M.D., Cincinnati

There is scarcely an industrial plant or a business that does not use some solvents. The kinds and the quantities vary from the can of type cleaner in the secretary's desk to tank car loads of less familiar substances used as degreasing agents in the metal trades or as vehicles in the manufacture of chemicals. There are hazards in the handling of all solvents because of their appreciable volatility. Some danger may be recognized by the user, but flammability and explosiveness are more likely to be considered than physiological action.

The selection of a solvent for a specific purpose depends on technological factors, such as required action, volatility, handling practice (including vapor recovery), the tendency of the substance to leave a residual film on metal surfaces, cost, and availability. The safety aspect may be introduced as a last consideration but, perhaps, only in terms of risk of fire or explosion. The final choice usually is a compromise. While none of the criteria for selection can be ignored, only rarely is it possible to meet all of the demands made. The purchasing agent may suggest a low cost petroleum distillate, the fire chief may want carbon tetrachloride, and the safety engineer may propose a new preparation of dubious composition labeled "Safety Solvent—Nontoxic." No one will be completely satisfied, and the industrial hygiene adviser may be least satisfied of all. A situation threatening to health now may arise. One solvent may be accepted without question as being "safe" from the point of view of toxicity and then handled quite carelessly; another, recognized as being relatively toxic and requiring some control measures may be inadequately controlled. Trouble can occur in either of these situations as suggested by some recently observed episodes.

PULMONARY EDEMA CAUSED BY EXPOSURE TO METHYLENE CHLORIDE

CASE 1.—A Negro male laborer, aged 19, was admitted to Cincinnati General Hospital because of shortness of breath, cough, and substernal pain of eight hours' duration. On his first day of employment in a metal parts assembly shop, he had been given the job of degreasing small copper gaskets by dipping them into an open drum of methylene chloride. He stated that the solvent bath "felt like ice water" on his bare hands. He had smarting of the eyes on bending over the drum, and he noted an oppressive odor. The work area was found to be in a small, dark, brick garage. There was no exhaust ventilation or mechanical equipment of any kind for the movement of air. During the latter part of the shift this boy complained of excessive fatigue, weakness, sleepiness, lightheadedness, chilly sensations, and nausea.

From the Kettering Laboratory, Department of Preventive Medicine and Industrial Health, and Department of Internal Medicine, University of Cincinnati College of Medicine.

Read at the 15th Annual Meeting of the American Industrial Hygiene Association, Chicago, April 29, 1954.

APC 001315

He went home after a total of four hours of work. He fell asleep at once and on waking two hours later felt very weak, short of breath, and had a dry, nonproductive cough. He had substernal pain on coughing and deep breathing.

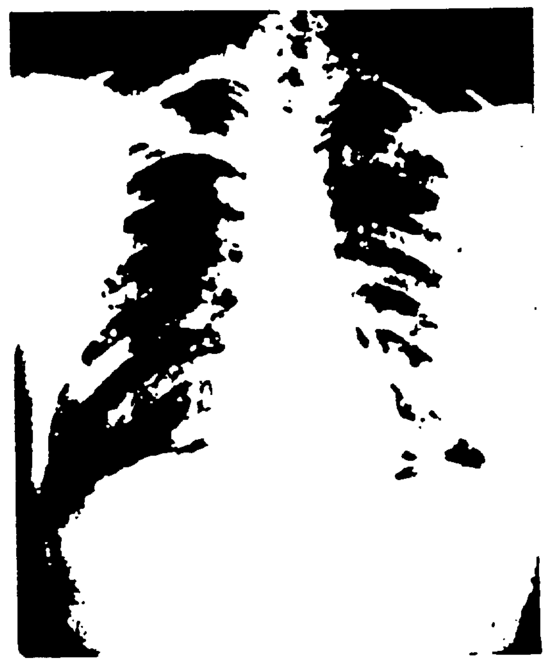
On admission to the hospital his temperature was 100 F, pulse rate 100, and respiratory rate 42. There was mild respiratory distress. Rales were heard at the base of the right lung and occasionally elsewhere over the chest. On a roentgenogram of the chest there was diffuse, fuzzy infiltration distributed bilaterally throughout both lung fields, characteristic of pulmonary edema (see figure). There was no conjunctivitis or irritation of the skin. The patient was treated with 100,000 units of penicillin intramuscularly every eight hours but did not require the administration of oxygen. Within 12 hours after admission and 18 hours after the last exposure, there was total relief of symptoms; the temperature, pulse rate, and respiratory rate were normal. Faint inspiratory and expiratory rales were still heard at the base of both lungs, but these had disappeared a few hours later. The results of complete blood cell count, urinalysis, blood culture, and blood urea nitrogen determination remained normal. Chest roentgenograms made after intervals of three and five days were normal, and the patient was then discharged from the hospital.

Methylene chloride, also called dichloromethane, CH_2Cl_2, has come into increasing industrial use as a paint remover, refrigerant, and, less extensively, as a degreasing solvent. It has a pronounced narcotic action, but it is more irritating to the respiratory system and more excitatory than is chloroform.[1] In industrial use only slight acute effects had been reported until 1952 when Moskowitz and Shapiro reported the clinical histories of four men exposed to a high concentration of methylene chloride vapor in a plant where an oleoresin was extracted from vegetable material.[2] There was loss of consciousness in all of those exposed, with one immediate death and some irritation of the upper respiratory tract of short duration in the others.

Methylene chloride had been described by Browning as "practically harmless" in ordinary use.[1] When the local vendor of the solvent was advised of the illness of the boy referred to above he stated vigorously that some other solvent must have been used, since methylene chloride is so "safe." As a matter of fact, this was found to be the only volatile substance in the shop. The suggested maximum tolerable concentration of methylene chloride under conditions of regular industrial employment is 500 ppm. Nevertheless, it should be recognized that this solvent is capable of acting as a pronounced respiratory irritant. The probability of some absorption of the solvent through the skin, in addition to the inhalation of vapor, must be considered as a contributing factor in this case. The halogenated hydrocarbons are excreted chiefly through the lungs, regardless of the mode of absorption. Pulmonary irritation may occur as a result of the excretion, as well as the absorption, of these substances.

ACUTE HEPATITIS FOLLOWING EXPOSURE TO TETRACHLOROETHYLENE

CASE 2.—A white male 25-year-old sales trainee of a chemical company was admitted to a hospital in another city in April, 1953, because of jaundice, weakness, and anorexia. The onset of symptoms had occurred 10 days earlier, with nausea, vomiting, dark urine, light brown stools, and deepening jaundice. For six months prior to the onset of symptoms he had worked on maintenance and repair of solvent circulating systems in dry cleaning establishments. For a period of 11 weeks up to the time that he became ill he had worked regularly on tetrachloroethylene units. His job duties included the refilling of systems with solvent, mechanical repairs, and test running of units. When emergency repairs were necessary he often worked 12 to 16 hour shifts and sometimes over week ends without regular days off. Exposure to the solvent, both as liquid and vapor averaged over eight hours per day. When lines were repaired some of the solvent drained out onto the floor. The servicemen often worked near these spills. The cleaning plants usually were hot, humid, and poorly ventilated. No gloves or other personal protective equipment were used. On one occasion this man had spilled a pail of tetrachloroethylene over his shirt and trousers. He noted a burning and tingling sensation of the skin until he changed his garments several hours later. On two or three occasions he became lightheaded when the concentration of vapor seemed especially heavy but returned to work after a short period in fresh air. The odor of tetrachloroethylene became increasingly distasteful to him during this period. For two weeks before the onset of illness there was excessive fatigue and unusual difficulty in rising in the morning.



Roentgenogram of the chest of man exposed to methylene chloride (case 1).

The medical history was not significant except that the patient had received one intramuscular injection of penicillin in the treatment of a brief episode of nausea and vomiting on Feb. 7, 1953, 10 weeks prior to the onset of this illness. He rarely drunk any type of alcoholic beverage and never to the point of intoxication. On admission to the hospital he was jaundiced. The results obtained from tests of liver function were grossly abnormal and suggestive of hepatocellular dysfunction. He made an uneventful recovery, but when he was examined four weeks later there was still some evidence of impaired liver function. The results of hemogram and urinalysis were within normal limits.

He was removed from work on systems designed for the use of chlorinated hydrocarbon solvents but continued in the job of sales and maintenance work on other types of solvent units. Ten months after the acute illness, he reported that on one or

1. Browning, E.: Toxicity of Industrial Organic Solvents, New York, Chemical Publishing Company, Inc., 1953.
2. Moskowitz, S., and Shapiro, H.: Fatal Exposure to Methylene Chloride Vapor, A. M. A. Arch. Indust. Hyg. 6:116 (Aug.) 1952.
3. Threshold Limit Values for 1954, Adopted at the Meeting of the American Conference of Governmental Industrial Hygienists, Chicago, 1954, A. M. A. Arch. Indust. Hyg. 9:530 (June) 1954.

APC 001316

two occasions when he had worked briefly near a tetrachloroethylene system he had experienced nausea immediately on detecting the faint odor of the solvent.

Tetrachloroethylene, CCl_2:CCl_2, also called perchlorethylene, is usually placed lowest in toxicity in the ascending series of chlorinated hydrocarbons used as dry cleaning agents.' Until recently no unchallenged cases of toxic effects from its industrial use had been reported. Coler and Rossmiller have now presented some clinical observations as being suggestive of impairment of liver function in three men of a group of seven engaged part time in the degreasing of small steel disks in a tank containing tetrachloroethylene.[4] Complaints of headache, nausea, lightheadedness, fatigue, staggering gait, and mental confusion were said to have been common among these men. Concentrations of tetrachloroethylene in the atmosphere of the workroom were reported to average from 232 to 285 ppm parts of air.

In our patient little or no precaution had been taken to avoid inhalation of solvent vapor or contamination of the skin since tetrachloroethylene was regarded as being "practically nontoxic." Symptoms of narcotic effect on several occasions preceded the episode of acute illness characterized by jaundice. It seemed clear that this man had absorbed tetrachloroethylene in substantial amounts. The temporal relationship of the onset of acute hepatitis to repeated hazardous exposures suggests that solvent intoxication was either the sole causative factor in the illness or a contributory factor in rendering the liver susceptible to attack by an infectious agent.

These two cases show injury to workmen resulting from the permission of inexcusably careless handling of compounds of a relatively low order of toxicity, but difficulties also may arise in dealing with solvents accepted as highly toxic when the measures provided for the control of exposure to them are either inadequate or unenforceable.

NAUSEA AND VOMITING CAUSED BY EXPOSURE TO CARBON TETRACHLORIDE

CASE 3.—A white female laboratory technician, aged 26, reported to the bureau of industrial health of the Cincinnati Health Department that she had just become ill on the job while handling carbon tetrachloride. She complained of nausea and headache and had been unable to take her lunch. She was employed in the quality control laboratory of a manufacturer of roofing materials. A principal job duty was the solvent extraction of asphalt from samples of roofing paper. This was done according to a standard specification by boiling strips of the asphalt-impregnated paper in a 1,000 ml. beaker of carbon tetrachloride on an electric hot plate inside an enclosed hood equipped with an exhaust fan. The strips in the beaker were agitated at intervals of two or three minutes during the 20 minute extraction period. Extracted material and spent solvent were poured off into a drain inside the hood once or twice during each extraction and the beaker was refilled. A glass sliding panel on the front of the hood was raised for this purpose. Temperature and humidity in the laboratory room were controlled by air conditioning.

The girl had worked on this job for a period of two years. Shortly after being hired, on a day when the odor of carbon tetrachloride was strongly perceptible, she had had headache, nausea, and vomiting, causing her to lose three days from work. One year later a similar episode occurred, and again she was off work for several days. She now experienced nausea on days when outside wind velocity was so great as to interfere markedly with the action of the hood exhaust fan. The illness reported to the health department had its onset on such a day. There was improvement after being outside the laboratory for several hours, although headache persisted during the evening.

CASE 4.—A white female laboratory technician, aged 22, employed on the same job as the woman in case 3, complained of nausea and belching and was unable to take her lunch on this day. While she had never been so ill as to remain off work, she did report mild nausea when she detected a heavy odor of carbon tetrachloride in the laboratory. This occurred on the average of once weekly.

An inspection of the laboratory was made a few hours after the report was received. There was said to have been little change in conditions since the onset of symptoms in the technicians. Samples of air collected at the breathing zone of workers standing at the hood contained carbon tetrachloride in average concentrations of from 30 to 344 ppm.

Air movement at the opening face of the hood varied in velocity from zero to 20 ft. per minute. It was determined that the exhaust fan was totally ineffectual in removing contaminated air from the hood under certain recurring conditions of outside wind velocity and direction, such as occurred on the day of our inspection. At these times positive pressure was created inside the hood, the direction of air flow was reversed, and contaminated air entered the workroom when the front panel was raised. Recommendations were made for redesigning the exhaust system with the erection of a short stack to carry off the vapor. Periodic determinations of the effectiveness of the proposed changes and added precautions in the handling of carbon tetrachloride by the technicians were suggested. Substitution of a less toxic solvent was not possible because of standardization of the extraction technique.

Carbon tetrachloride, a highly toxic substance, was being used in these cases under conditions erroneously regarded as entirely safe. These two cases are reported for the purpose of emphasizing that complete safety in the handling of this treacherous solvent can be assured but rarely, and never when provisions for the protection of personnel are inadequate or unenforceable. In general, the principle of substitution of a less toxic material should be followed whenever possible.

TOXIC AMBLYOPIA CAUSED BY EXPOSURE TO METHANOL

CASE 5.—A Negro laborer, aged 39, was admitted to Cincinnati General Hospital completely blind, complaining of vomiting, abdominal cramps, and severe headache of two days' duration, with increasing loss of vision as the other symptoms had subsided. The onset occurred 48 hours after a Saturday night drinking bout during which he had consumed at least one-half pint of a mixture of wine and about an equal part of a clear, colorless liquid that he had drained from a metal drum at his place of employment.

On admission to the hospital he was not acutely ill. There was slight injection of the conjunctiva. The pupils were dilated equally, measuring 6 mm. in diameter. Neither reacted to light except for occasional slight hippus on strong stimulation, but both contracted briskly on convergence. There was slight marginal blurring of the optic disks. The retina was normal except for the peripapillary regions, which were slightly edematous, with reduced transparency and obscuring of the deeper blood vessels. The carbon dioxide capacity of the plasma was 45 vol. % and the concentration of chlorides 476 mg. per 100 cc. The results of tests of liver function were within normal limits, the hemogram was normal. There were numerous hyalin casts in the urinary sediment on admission and only a few on subsequent days. The urine had a pH of 5.6. A specimen was tested for the presence of formic acid by a gallic acid method before and after reduction of portions of the distillate to formaldehyde. Formic acid was found to be present in high concentrations.

The patient worked at a plant engaged in the reconditioning of metal drums. He had drained off liquid from the bottom of a returned drum, thinking it to be grain alcohol. The drum was found to have contained a lacquer thinner composed of "hydrocarbons 50%, mixed alcohols 25%, and butanes or esters 25%." Three other men also had drunk some of the adulterated wine

4. Coler, H. R., and Rossmiller, H. R.: Tetrachlorethylene Exposure in a Small Industry, A. M. A. Arch. Indust. Hyg. 8:227 (Sept.) 1953.

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One of these, the patient in case 6, was admitted to the hospital at the same time with loss of vision and acidosis and the other two were said to have had nausea and vomiting. The patient admitted that it was common practice for employees to drink material from returned drums, although this was in violation of company rules. He was discharged improved, except for loss of vision, on the ninth hospital day. Three months later he still could barely perceive movement in bright light, and both optic disks were markedly atrophied.

CASE 6.—A Negro janitor, aged 30, when brought to Cincinnati General Hospital was acutely ill, with impaired vision of two days' duration. On the previous Saturday and Sunday he had drunk large amounts of the lacquer thinner described in case 5. The onset of symptoms occurred with severe headache on Monday afternoon. A few hours later he began to vomit. He became mentally confused, restless, and then disoriented. There was progressive dimming of vision on Monday night and Tuesday. On admission to the hospital Wednesday morning he was unable to perceive light. The conjunctivas were slightly injected. The pupils were widely and equally dilated and did not react to light. On funduscopic examination there was slight edema of the retinas at the periphery of both optic disks and maculas. The carbon dioxide capacity of the plasma was 20.8 vol. %, the concentration of chlorides was 508 mg. per 100 cc., and the blood had a pH of 7.28. The results of tests of liver function were within normal limits. The hemogram was normal. The urine had a pH of 6, and a trace of albumin was found. There were no casts in the sediment and no reducing substances by the Benedict test. Sodium bicarbonate was administered intravenously over a period of 12 hours, with considerable clinical improvement. By the third hospital day the patient was fully oriented. There was no light perception by the right eye and only slight perception by the left. The right pupil was fixed, and the left reacted sluggishly to light; he was unable to converge. The fundi were unchanged. An electrocardiogram on the fourth hospital day had a T wave of low voltage in leads 1 and 2, with inversion of the T wave in leads 3, V, V, V, interpreted as indicating nonspecific myocardial damage. A needle biopsy of the liver was taken on the sixth hospital day, nine days after ingestion of the alcohol. This was reported as showing a few foci of nonspecific liver cell necrosis. The patient was discharged on the ninth hospital day. On examination five weeks later his vision was 5/200 in each eye. He was barely able to find his way through doors and to avoid large objects. There was now pronounced optic atrophy with deep cupping of both disks.

CASE 7.—A Negro laborer, aged 53, was brought to the Cincinnati General Hospital receiving ward because of the sudden onset of loss of vision. He stated that he had been in good health until the day before, when he had nausea, fever, chills, weakness, lightheadedness, excessive thirst, and mild shortness of breath on exertion. On wakening the following morning he was unable to perceive light with the left eye and only partially with the right. While the other symptoms improved during the next 48 hours, he gradually lost remaining vision in the right eye. He was admitted to the hospital for study eight days after the onset of symptoms. He was now able to perceive light for the first time in four days. The pupils were equal, markedly dilated and did not react to light or accommodation. The ocular fundi were of normal appearance.

The patient at first denied the ingestion of methanol or any other unusual substance, but stated that he often drank whisky over week ends, ordinarily "X" brand, and had last had a drink two days before the onset of symptoms. He had been employed for 15 years in the operation of a wash tank in which used metal drums were dipped in sodium hydroxide as a first step in reconditioning. The drums were received from local industrial plants and usually had contained some chemical compound. Eight other men engaged in the same work apparently were in good health. The manager reported that, while it was strictly against plant rules, it was common practice for workmen to drain the residuum from drums that had an alcoholic odor. The patient was last observed to do this one month before the onset of illness when he filled a bottle from a drum and drank a portion of it. Near this man's work station at the plant an empty whisky bottle labeled "X" brand was found.

Over a period of 12 months there was gradual improvement of visual acuity to maximum uncorrected vision of 20/70 right eye and 4/200 left eye, with residual evidence of optic atrophy more marked on the left side.

Methanol poisoning arising out of industrial exposure is secondary in importance to that due to ingestion of adulterated liquors. A few validated cases of poisoning of workmen following the inhalation of the vapor of methanol or absorption of the liquid through the skin have been reported. Even some of these bear the suspicion that the solvent may have been ingested as well. The chief danger of its use in industry still is the temptation to drink it. The cases described here, while not compensable as being due to occupational disease or injury, might have been prevented by closer control of solvent handling. The two unrelated episodes of typical methanol poisoning with blindness in men engaged in the reconditioning of metal drums have led me to regard the disorder as an unusual risk of this occupation, related to the temptation to drink from chemical containers that have the odor of alcohol. In all cases of Monday morning blindness Saturday night drinking habits should be considered and industrial sources of methanol investigated.

SUMMARY

There is danger in the handling of all solvents, although fire and explosion are feared more commonly than are hazards to health. The selection of a solvent for a specific industrial use is a compromise between technological requirements and considerations of safety. Significant absorption of organic solvents by workmen may occur as a result of either one of two errors: the acceptance of inexcusably careless handling of compounds of relatively low toxicity or the provision of inadequate control measures in dealing with more toxic ones. Instances of pulmonary edema following exposure to methylene chloride and of acute hepatitis in a man exposed to tetrachloroethylene are described as examples of the first type of error. The second is illustrated by the report of cases of illness due to exposure to the vapor of carbon tetrachloride and blindness from the ingestion of methanol obtained at work.

Eden and Bethesda Aves. (19).

The Biological Approach to Immunity.—In a world that is full of microorganisms capable of infecting living tissues, it is a positive necessity for survival that most experiences of infection by any given microbe should be followed first by recovery and secondly by a persisting insusceptibility to an attack of the same disease. . . . Perhaps the important factor in the development of the particular types of immune reaction with which we are familiar in man was the evolution of his mammalian ancestors for the most part as relatively solitary arboreal animals in tropical jungles. In such environments it seems likely that the major type of pathogen that would be encountered would be those protozoa and viruses spread by insect—especially mosquito—vectors. It is not improbable that the type of immunity characteristic of human beings is essentially something evolved to deal effectively with infection by mosquito-borne viruses of the yellow-fever type. . . . At least we can be sure that immunity is a mechanism that has been evolved to deal with the entry of foreign microorganisms into the body, and that it has been perfected by the normal process of selective survival.—Sir Macfarlane Burnet, M.D., The Newer Approach to Immunity in Its Bearing on Medicine and Biology, *British Medical Journal*, July 24, 1954.

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C O P Y

April 27, 1955

from: J. T. HOBBS
INDUSTRIAL HYGIENE COMMITTEE
ALCOA FABRICATING PLANTS

to: DR. LESTER V. CRALLEY
INDUSTRIAL HYGIENE DEPARTMENT
PITTSBURGH

Re: CONTROLLED ATMOSPHERE GENERATING UNITS

Not long ago we had an unfortunate experience at the Alcoa North Plant which could have had serious consequences. We felt that it would be worthwhile to give you a general account of the incident in the hope that the information might be of benefit to other plants.

Two brick masons entered the combustion chamber of a controlled atmosphere generating unit to make repairs. They did not open all available ventilating parts or provide any forced ventilation of the chamber. The men were overcome presumably by residual CO or CO_2 gases. Luckily, both were removed from the chamber quickly and given treatment at first aid.

Henceforth, at Alcoa no one will enter these chambers without opening all parts and providing forced circulation. An attendant will always be on hand outside the chamber to provide immediate aid if necessary.

Best personal regards.

J. T. HOBBS

JTH:MP

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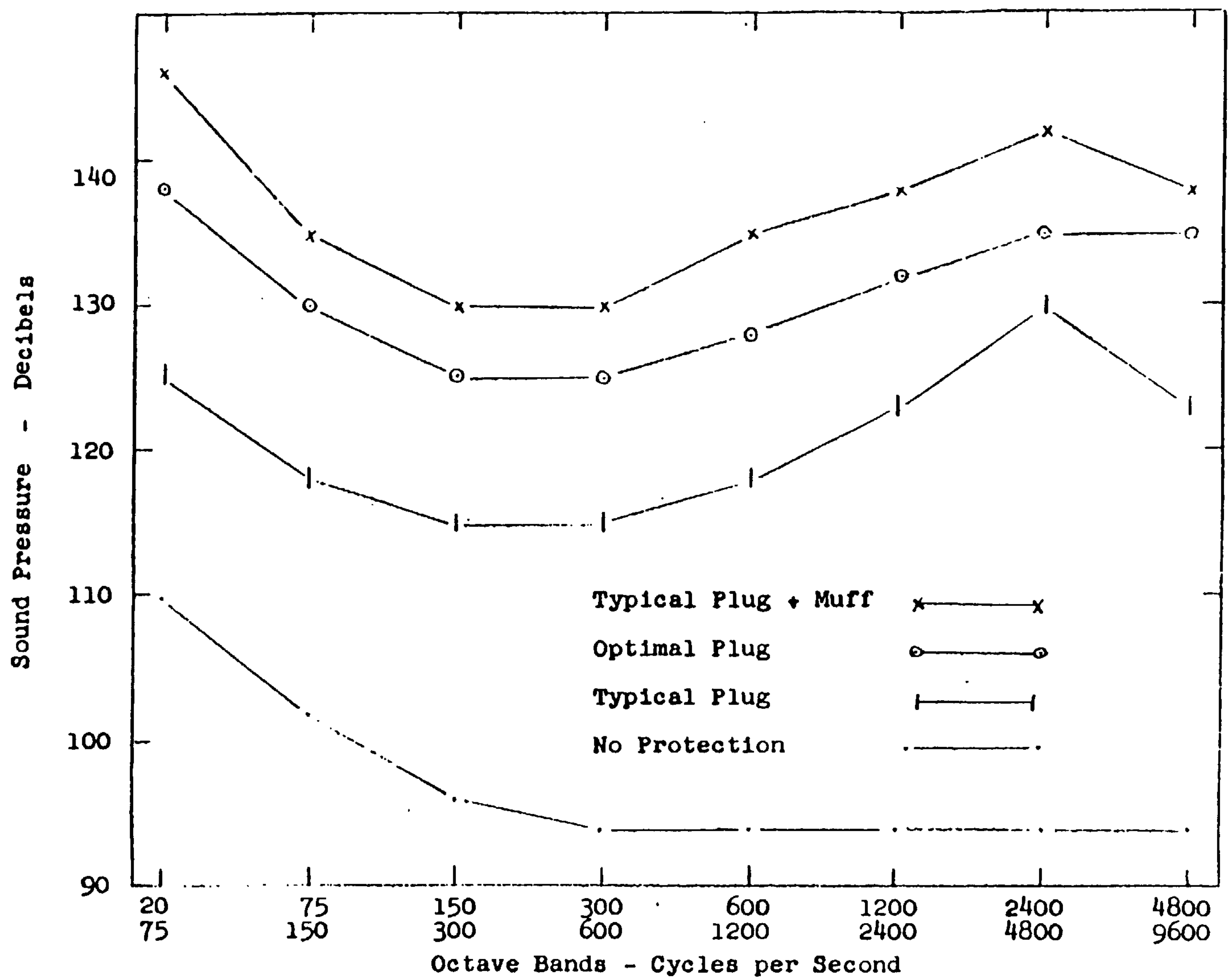

DAMAGE RISK CRITERIA AND ITS MODIFICATIONS BY PROTECTIVE DEVICES
(von Gierke, "Personal Protection." A.I.H.A.Quart. 15, #1, 44, Mar.1954)