TOXIC SUBSTANCES

ANNUAL LIST

1971



U. S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE

Health Services and Mental Health Administration

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National Institute for Occupational Safety and Health

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INTRODUCTION

The Occupational Safety and Health Act of 1970, Public Law 91-596, requires that "the Secretary of Health, Education, and Welfare shall publish within six months of enactment of this Act and thereafter as needed, but at least annually, a list of all known toxic substances by generic family or other useful grouping, and the concentrations at which such toxicity is known to occur." The appended list fulfills the requirement of the Section, 20(a)(6) of the Act, and in addition supplies reference to the scientific literature on the sources of the toxicity data. Thus, the "List" format consists of three sections, the chemical name of the toxic substance in capital letters, arranged alphabetically, its toxic dose and effects for man and/or animal, and the literature references.

In compiling this list, use has been made of the world literature. Original sources are given in most cases. In many cases, secondary sources (e.g. Handbook of Toxicology and the Merck Index) were cited. Occasionally the references cited are incomplete but are included because the incomplete citation may assist interested parties in locating the original report. This was believed preferable to omission of the chemical from the List. Substances generally recognized by their common or trade names frequently appear as such and may be cross-referenced to their chemical names with associated toxicity data.

While reports of the toxicity of chemicals to man were sought for every chemical, few were found. However, of those found, definitive and quantitative information of the exposure of man was inadequate and, thus, not eligible for the "List". This type of information is usually estimated from industrial, domestic, agricultural or other accidental exposures or from forensic studies. Therefore, data which apply to man represent a small fraction in this "List".

Because of the severe time restrictions imposed by the Act, the first issue of the List is incomplete in several respects. Time was insufficient 1) to thoroughly search the literature and other data sources to assure that the best and latest information was found or to verify the accuracy of all original data or 2) to extract from a Medlar's Search the carcinogenic data pertinent to the "List". In this context attention is called to the Public Health Service Publication No. 149 (1951), Compounds Which Have Been Tested for Carcinogenic Activity. This volume, together with its supplements (1957, 1969), represents a valuable source of information for materials with demonstrated tumorogenic or carcinogenic activity. No effort to duplicate this extensive PHS listing was made for this "List".

During ensuing years, the annual revisions prescribed by the Occupational Safety and Health Act will permit the achievement of a more complete and useful listing. While this list should be viewed as a compendium of chemicals with demonstrated and reported toxicity for man and other animals, the absence of any chemical from this "List" does not imply that such a chemical is devoid of toxicity or hazard.

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• DEFINITIONS

For the purpose of preparing the Toxic Substances List, the following definitions were used:

TOXIC SUBSTANCE – A toxic substance, relative to chemicals included in this "List" and exclusive of radioactive substances not included, is one that demonstrates the potential to induce cancer, to produce short and long term disease or bodily injury, to affect health adversely, to produce acute discomfort, or to endanger life of man or animal resulting from exposure via the respiratory tract, skin, eye, mouth or other routes in quantities which are reasonable for experimental animals or which have been reported to have produced toxic effects in man.

NONTOXIC – Conversely, a substance is considered nontoxic when experience and/or experiment fails to result in physiologic, morphologic or functional changes adversely affecting the health of man or animal according to reasonable and appropriate tests.

LETHAL DOSE – LD50 – Lethal Dose Fifty – A term used to describe a calculated dose of a chemical substance which is expected to kill 50% of an entire population of experimental animals exposed through a route other than respiratory.

LDca – Approximate Lethal Dose – A term used to describe a dose of a chemical substance which has been reported either to produce a lethal effect or to be the maximum dose which could be tolerated without death. It has been used in this list where the original citations have reported an MLD (Minimum lethal dose), LD(lethal dose), Estimated or Approximate LD50, MTD or Max TD (Maximum tolerated dose), LD calculations other than an LD50 (e.g. LD10, LD100), or an estimate of the lethal dose in man or animals.

LC50 – Lethal Concentration Fifty – A term used to describe a calculated concentration which when administered by the respiratory route would be expected to kill 50% of a population of experimental animals during an exposure of four hours.

LCca – Approximate Lethal Concentration – A term used to describe a concentration of a chemical substance which has been reported either to produce a lethal effect or to be the maximum concentration that could be tolerated without death during an exposure of one day. It has been used in this list where the original citations were reported as MLC (minimum lethal concentration), LC(lethal concentration), Estimated or Approximate LC50, MTC and MaxTC (Maximum tolerated concentration), LC calculated other than LC50, (e.g. LC10, LC100) or an estimate of a lethal concentration in man or animals.

TXD – Toxic Dose – Dose of a chemical which has been reported to have produced toxic but nonfatal effects in man.

THD – Therapeutic Dose – A prescribed drug at the usually accepted dosage level which has been reported to produce toxic side effects in man.

TXC – Toxic Concentration – A concentration of a chemical in air which has been reported to have produced potentially harmful effects in man.

LIMITING DOSAGES DEFINING TOXIC SUBSTANCES

In order that the "Toxic Substances List" may have practical usefulness as a guide to hazardousness, upper limits of dose, concentration and exposure have been established at conservative levels. This is because all substances when administered to man or animal at sufficiently high concentration and exposure time may prove injurious. Reasonable upper limit values are set forth in Table I.

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In the toxicity data list, responses to acute exposure predominate for the following reasons:

1) most of the extant and definitive toxicity data is in this form,

2) although the acute toxicity doses do not necessarily characterize the toxicity of those substances for which chronic effects predominate, the upper limit values selected are sufficiently large so as to include most of those substances whose toxicity is usually manifested after prolonged exposure.

TYPES OF TOXIC SUBSTANCES – For the purpose of the ''List,'' all known toxic substances were interpreted to include all mined, manufactured or synthesized inorganic and organic substances, including drugs, food additive, pesticides, as well as refined substances of natural origin, provided their toxicity conformed to the limiting dosages shown in Table I. Pesticides (rodenticides, insecticides, herbicides, etc., have been noted P.).

The listed substances are assumed to be pure because the reported toxic effects have been attributed solely to the item as described in the original source. Excluded from the ''List'' were unpurified extracts of animal or vegetable origin, and trade-name substances representing compounded mixtures, such as those found as commercially formulated products. These exclusions were necessary because of the difficulties in assessing the contribution to the toxicity of each component of a mixture, as well as the interaction of two or more components to facilitate, retard or sum toxic effects.

TYPES OF TOXIC EFFECTS. All ''Toxic Concentrations'' appearing in the ''List'' were derived from studies of the toxicologic effects of individual chemicals. The type of effect or toxicologic endpoint recorded in the ''List'' for experimental animals is lethal, teratogenic, mutagenic and for humans is any toxic effect reported by the source, acute or chronic.

UNITS OF DOSE. All ''Toxic Concentrations'' of solid and liquids are listed as milligrams per kilogram of body weight, and concentrations of contaminant in air are listed as parts of vapor or gas per million parts of air by volume (ppm) or if a solid or liquid, as milligrams per cubic meter of air (mg/M). Where an original source listed dose measurements in volume units, the density of the chemical was assumed to be one thousand milligrams per milliliter and converted to milligrams for the ''List.''

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KEY TO ABBREVIATIONS USED IN THE TOXIC SUBSTANCES LIST

ROUTE OF ADMINISTRATION

iv	intravenous
sc	subcutaneous
ip	intraperitoneal
ic	intracerebral
or	oral or intragastric
id	intradermal
sk	application to the intact skin
oc	ocular
ih	inhalation
im	intramuscular

ANIMAL SPECIES

brd	bird (other than those specified)
cat	
ckn	chicken
dog	
dck	duck
frg	frog
grb	gerbel
gpg	guinea pig
ham	hamster
man	
mky	monkey
mus	mouse
pig	
pgn	pigeon
qal	quail
rbt	rabbit
rat	
sql	squirrel
trk	turkey

UNITS

mg	milligram
kg	kilogram
ml	milliliter
ppm	parts per million
M	cubic meter (M^3)

TOXIC EFFECT

TFX	toxic effects
SFX	side effects
COR	corrosive to (skin, GI or other) tissue
IRR	irritant
CUM	cumulative effect
CAR	carcinogenic
TER	teratogenic
MSK	musculo-skeletal
PNS	peripheral nervous
MMI	mucous membrane
CVS	cardiovascular system
ET	experimental teratogen
EM	experimental mutagen
EC	experimental carcinogen

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EFFECTS ON MAN

TFX toxic effects experienced by man as a result of an over-exposure to a drug or chemical (used with TXD, TXC, LDca or LCca in relation to human data) .

SFX side effects

CNS central nervous system effects, including headache, tremor, convulsions, hypnosis, drowsiness

SKN skin effects including erythema, rash, sensitization, petechial hemorrhage

RBC effects on the erythrocytes, including the several anemias

WBC effects on the leucocytes, including any change in number or form

BCM effects on the clotting mechanism of blood

PUL effects on the pulmonary system, respiration and respiratory pathology

GIT gastrointestinal tract

EYE effects on eyes, including irritation

ALR allergic systemic reactions

SYS effects on metabolic and excretory processes of the liver and kidney

BPR effects on blood pressure, hypo- or hyper-responses

DDP drug dependence

GLN effects on any of the endocrine glandular systems

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MONS

SUBSTANCE	TOXIC CONCENTRATION	REFERENCE
2-BIPHENYLARSONIC ACID,MONOSODIUM SALT		
	or LDca 15 mg/kg rat	CBCCR 5,13,53
BIPHENYL,p,p'-BIS-(alpha THIOL CARBAMYL-ACETAMIDO)-		
	ip LD50 200 mg/kg mus	CUBL -,38,62
BIPHENYL,3-BROMO		
	ip LDca 500 mg/kg mus	CBCCT 6,217,54
3-BIPHENYL CARBOXYLIC ACID		
	ip LDca 500 mg/kg mus	CBCCT 7,389,55
4-BIPHENYL CARBOXYLIC ACID,4'-AMINO,2-DIETHYL AMINO-ETHYLESTER		
	sc LDca 200 mg/kg gpg	JPET 72,146,41
BIPHENYL,CHLORINATED derivatives,42% Cl		
	ih TXC 10 mg/m man	TLV
	TPI: IRR,SIS,SKN man	TLV
4,4'-BIPHENYL DICARBOXYLIC ACID		
	ip LD50 500 mg/kg mus	CUBL -,25,62
3,3'-BIPHENYL DICARBOXYLIC ACID,6,6'-DIAMINO-,BIS(2-DIETHYLAMINOETHYL) ESTER		
	sc LDca 150 mg/kg gpg	JPET 72,146,41
2,3',4,5',6-BIPHENYLPENTOL,DIHYDRATE		
	ip LDca 500 mg/kg mus	CBCCT 1,48,49
4-BIPHENYLSULFONIC ACID,SODIUM SALT		
	ip LDca 18 mg/kg mus	CBCCT 7,687,55
2-(4-BIPHENYLYL) BUTYRIC ACID		
	ip LD50 348 mg/kg rat	AI
2,2'-(4,4'-BIPHENYLYLENE) BIS(2-HYDROXY-4,4-DIMETHYLMORPHOLINIUM BROMIDE)		
	ip LD50 0.065 mg/kg mus	JPET 127,236,59
(4,4'-BIPHENYLYLENEBIS(IMINOCARBONYLMETHYLENE))BIS((2-HYDROXYETHYL) DIMETHYLAMMONIUM BROMIDE)		
	ip LD50 mg/kg mus	JPET 127,236,59
1,1-(4,4'-BIPHENYLYLENEBIS(2-OXOETHYLENE)) BIS(3-(HYDROXYMETHYL)-PYRIDINIUM BROMIDE)		
	ip LD50 0.7 mg/kg mus	JPET 127,236,59
1,1'-(4,4'-BIPHENYLYLENEBIS(2-OXOETHYLENE)) BIS(2-(HYDROXYMETHYL)-PYRIDINIUM BROMIDE)		
	ip LD50 2 mg/kg mus	JPET 127,236,59
4,4'-BIPIPERIDINE,1,1'-BIS(2-CHLOROETHYL)		
	ip LDca 30-35 mg/kg mus	S 153,1000,66
2,2'-BIPYRIDINE		
	or LDca 250 mg/kg rat	CBCCR 5,22,53

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SUBSTANCE	TOXIC CONCENTRATION	REFERENCE
DIETHYL-2-CHLOROVINYL PHOSPHATE	or LD50 32 mg/kg mus	PE 2,636,59
DIETHYL-1-(2,4-DICHLOROPHENYL)-2-CHLOROVINYL PHOSPHATE	or LD50 15 mg/kg rat	TAP 14,515,69
O,O-DIETHYL-S-(2,5-DICHLOROPHENYLTHIOMETHYL) PHOSPHOROTHIOLOTHIONATE	or LD50 65 mg/kg rat P	PCOC -,877,- PCOC -,877,-
O,O-DIETHYL-S-beta-DIETHYLAMINOETHYLPHOSOPHOROTHIOLATE HYDROGEN OXALATE (75%)	or LD50 3.3 mg/kg rat P	PCOC -,1120,- PCOC -,1120,-
5,5-DIETHYLDIHYDRO-2H-1,3-OXAZINE-2,4(3H)-DIONE	see: DIETHADIONE	
DIETHYL DITHIO BIS (THIONOFORMATE)	or LD50 600 mg/kg rat P	PCOC -,578,- PCOC -,578,-
3-O,O DIETHYL,DITHIO PHOSPHONYLMETHYL-6-CHLORO, BENZO-OXAZALONE	or LD50 108 mg/kg rat	GTPZ 14,46,70
DIETHYLENE GLYCOL BIS (ALLYL CARBONATE)-	ip LD50 270 mg/kg mus	JPET 90,338,47
DIETHYLENE GLYCOL, DI(3-AMINOPROPYL) ETHER	or LD50 4290 mg/kg rat	AIHAJ 30,470,69
DIETHYLENE GLYCOL DIBENZOATE	or LD50 2830 mg/kg rat	AIHAJ 23,95,62
DIETHYLENE GLYCOL MONOSTEARATE	ip LDca 200 mg/kg mus	CUEL -,27,62
DIETHYLENEIMINOSULFOXIDE	ip TXD 2.5 mg/kg/5 day rat TPX: EH rat	BJP 14,149,59 BJP 14,149,59
1,3-DI(ETHYLENESULFAMOYL) PROPANE	ip TXD 1.8 mg/kg/5 day rat TPX: EH rat	BJP 14,149,59 BJP 14,149,59
DIETHYLENE THIAMINE	or LD50 2080 mg/kg rat	JINT 31,61,49
DIETHYLENETRIAMINE, N-CYANOETHYL	or LD50 4550 mg/kg rat	AIH 17,129,58
DIETHYLENETRIAMINE, N-2-HYDROXYETHYL	[illegible] 4420 mg/kg rat	AIHOB 1,119,51

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SUBSTANCE	TOXIC CONCENTRATION	REFERENCE
DIPHENALDEHYDE	or LD50 2830 mg/kg rat	IHFACTS -,6,67
DIPHENAMID	or LD50 700 mg/kg rat	HI
DIPHENAMIDE (BOW)	or LD50 974 mg/kg rat	TAP 18,185,71
DIPHENATRILE	see: DIPHENYLACETONITRILE.	
DIPHENETHYLAMINE, 3,3',4,4',-BIS(METHYLENE-DIOXY)-,HYDROCHLORIDE	ip LDca 125 mg/kg mus	CBCCT 7,393,55
DIPHENHIDRAMINE	or LD50 500 mg/kg rat ip LD50 84 mg/kg mus	HI JPET 104,115,52
DIPHENHIDRAMINE HCl	or LD50 856 mg/kg rat	TAP 18,185,71
DIPHENIC ACID, 5,5'-DIAMINO-,BIS (2-DIETHYLAMINOETHYL)ESTER	sc LDca 50 mg/kg gpg	JPET 72,146,41
DIPHENIDOL	or LD50 815 mg/kg rat	P 5,265,63
DIPHENOXYETHYL-PHENYL-beta-CHLOROETHYLAMINE	sc LD50 25 mg/kg mus	JPET 101,379,51
DIPHENOXYLATE	or THD .071 mg/kg mus SPH: GIT, CNS mus	HI HI
DIPHENYL	or LD50 2200 mg/kg rat	HI
DIPHENYLACETONITRILE	or LD50 3500 mg/kg rat	PI
2-DIPHENYLACETYL-1,3-INDANDIONE	or LDca 15 mg/kg cat P	PCOC -,429,- PCOC -,429,-
DIPHENYLAMINE, 4-[BIS(2-CHLOROETHYL)AMINO]-4-HYDROXY-3,5DIMETHYL	ip LD50 104 mg/kg rat	BP 13,969,64
DIPHENYLAMINE, 4'-[BIS(2-CHLOROETHYL)AMINO]-4-HYDROXY-3-METHYL-	ip LD50 66 mg/kg rat	BP 13,969,64
DIPHENYLAMINE, 4,4'-DIAMIDINO-,DI-HCl	ip LD50 100 mg/kg mus	CHRL -,-,62

SUBSTANCE	TOXIC CONCENTRATION	REFERENCE
EPIPROPIDINE	iv LD50 74 ug/kg mus	HX
EPN	see: O-ETHYL-O-p-NITROPHENYL BENZETHIOPHOSPHATE	
1,2-EPOXY-3-CHLOROPROPANE	or LD50 90 ug/kg rat	HT
1,4-5,8-(EPOXYETHANO)-NAPHTHALENE-5b,7,8,9,9-HEXACHLORO-1,4,4a,5,8,8a-HEXAHYDRO	or LD50 68 ug/kg rat	SCC 59,-,61
1,2-EPOXYPROPANE	see: PROPYLENE OXIDE	
2,3-EPOXY-1-PROPANOL	see: GLYCIDOL	
EPOXY RESIN from EPICHLORHYDRIN and PHENYLALKENE(EA)	or LD50 2100 ug/kg mus	INPKV 10,110,68
EPOXY RESIN (EPICHLORONYDRIN and DIETHYLENE GLYCOL)	or LDca 2100 ug/kg mus	INPKV 10,110,69
EPTAM	see: ETHYL DI-n-PROPYLTHIOLCARBAMATE	
ERADEX	see: 2,3-QUINOXALINEDITHIOL CYCLIC TRICARBONATE	
ERBIUM CHLORIDE	ip LD50 226 ug/kg mus	AEH 5,437,62
ERBIUM CHLORIDE CITRATE COMPLEX	ip LD50 122 ug/kg mus	AEH 5,437,62
ERBIUM CHLORIDE EDETATE COMPLEX	ip LD50 134 ug/kg gpg	AEH 5,437,62
ERBIUS NITRATE-HEXAHYDRO	ip LD50 230 ug/kg rat	TAP 5,750,63
ERBIUM OXIDE	ip LDca 600 ug/kg rat	CURL 34,47,60
ERBON	see: 2(2,4,5-TRICHLOROPHENOXY) ETHYL, 2, 2, DICHLOROPROPIONATE	
ERGOBASINE	sc LDca 0.5 ug/kg rat	SB 119,1302,35

SUBSTANCE	TOXIC CONCENTRATION	REFERENCE
ETHYLENE GLYCOL MONO-n-PROPYL ETHER	ih LCca 2000 ppm rat	JIHT 31,348,49
ETHYLENE GLYCOL MONOSTEARATE	ip LDca 200 mg/kg rat	CUBL -,27,62
ETHYLENE GYLCOL	or LD50 13.7 mg/kg man	AF 4,643,54
ETHYLENE IMINE	ih LCca 62 ppm rat ip TID 6 mg/kg man TFX: EB man	JIHT 32,343,49 GE 4,-,68 GE 4,-,68
ETHYLENEDIETHANESULFONATE	ip TID 200 mg/kg (13th day of preg) rat TID: ET rat	JRF 17,325,68 JRF 17,325,68
ETHYLENE,NITRO	ih LCca 500 mg/M	NDHC -,15,83
ETHYLENE OXIDE	ih LCca 4000 ppm rat iv LDca 444 mg/kg dog P	JIHT 31,348,49 HT PCOC -,504,-
ETHYLENE,POLYMERS	ih LC50 700 mg/M rat	AIHAJ 24,168,63
ETHYLENE,TETRACHLORO-	or LD50 200 mg/kg rat	AIHAJ 30,470,69
ETHYLENE,TRICHLORO-	or LD50 4920 mg/kg rat	AIHAJ 30,470,69
ETHYL ETHER	or LD50 3560 mg/kg rat	AIHAJ 23,95,62
ETHYL ETHER,PERFLUOROISOBUTENYL	or LD50 164 mg/kg man	HS 29,17,64
3-ETHYL-2-(5-(3-ETHYL-2-BENZOTHIAZOLINYLIDENE)-1,3-PENTADIENYL) BENZOTHIAZOLIUM IODIDE	see: DITHIAZANINE IODIDE	
ETHYL FORMATE	ih TXC 330 ppm man TFX: IRR man	TLV TLV
5-ETHYLMETANYDRO-1H-AZEPINE-1-CARBOTHIOATE	or LD50 720 mg/kg rat P	PCOC -,833,- PCOC -,833,-

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SUBSTANCE	TOXIC CONCENTRATION	REFERENCE
POLYOXYETHYLENE DODECANOL		
	or LD50 1170 mg/kg mus	TAP 2,133,60
	or LD50 4150 mg/kg rat	TAP 2,133,60
	iv LD50 390 mg/kg rat	TAP 2,133,60
POLYPROPYLENE GLYCOL		
	ip LD50 113 mg/kg mus	JPET 103,293,51
POLYSULFIDES,BIS(2-HYDROXYPHENOL)		
	or LDca 3160 mg/kg rat	HCC 1184,10,67
POLYVINYL SULFATE,POTASSIUM SALT		
	sc LD50 78 mg/kg mus	JOCHC 5,128,56
POPPIPORYCIN		
	ip LD50 44 mg/kg mus	CCB 30,9,63
POTASAN		
	see: 7-HYDROXY-4-METHYL COUBARIN, DIETHOXY THIOPHOSPHORIC ACID ESTER	
POTASSIUM BOROHYDRIDE		
	or LDca 160 mg/kg rat	BSSCB -,724,-
POTASSIUM ACETATE		
	or LD50 3250 mg/kg rat	AIHAJ 30,470,69
POTASSIUM ARSENITE		
	or LD50 14 mg/kg rat	APDO 15,122,51
POTASSIUM CARBONATES		
	or LD50 1870 mg/kg rat	AIHAJ 30,470,69
POTASSIUM CHLORIDE		
	or LDca 2430 mg/kg rat	JPET 35,1,29
POTASSIUM CHROMATE		
	sc LDca 12 mg/kg rbt	HH 33,15,20
POTASSIUM COLUMBATE		
	or LD50 3000 mg/kg rat	AIHOB 1,637,59
POTASSIUM CYANATE		
	or LD50 841 mg/kg mus P	PCOC -,925,- PCOC -,925,-
POTASSIUM CYANIDE		
	or LD50 10 mg/kg rat	TAP 11,327,67
POTASSIUM FLUORIDE		
	or LD50 245 mg/kg rat	UHAEP 1,73,51

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SUBSTANCE	TOXIC CONCENTRATION	REFERENCE
SODIUM BISULFITE		
	iv LD50 115 mg/kg rat	HI
	P	PCOC -,1011,-
SODIUM CACODILATE		
	sc LDca 500 mg/kg rat	HT
SODIUM CARBONATE		
	or LD50 4200 mg/kg rat	TAP 6,726,69
SODIUM CHAOLHOOGRATE		
	iv LDca 200 mg/kg rat	HT
SODIUM CHLORATE		
	ip LD50 550 mg/kg mus	CR 257,791,63
SODIUM CHLORIDE		
	ip LDca 5000 mg/kg rat	HT
SODIUM cis-3-CHLOROACRYLATE		
	or LD50 320 mg/kg rat	PCOC -,1017,-
	P	PCOC -,1017,-
SODIUM CHROMATE		
	sc LDca 283 mg/kg rat	HI
SODIUM CITRATE(mono)		
	ip LD50 1760 mg/kg rat	HI
SODIUM CITRATE(Di)		
	ip LD50 2620 mg/kg rat	HT
SODIUS CITRATE(Tri)		
	ip LD50 1760 mg/kg rat	HT
SODIUM CYANATE		
	ia LD50 310 mg/kg rat	HT
SODIUM CYANIDE		
	or LD50 15 mg/kg rat	AIHAJ 30,470,69
	sc LDca 10 mg/kg mus	HT
	P	PCOC -,1023,-
SODIUM DICHLOROISOCYANURATE		
	or LD50 1670 mg/kg rat	RCC
	P	PCOC -,335,-
SODIUM-2,4-DICHLOROPHENOXYETHYL SULFATE		
	or LD50 730 mg/kg rat	PCOC -,284,-
	P	PCOC -,284,-
SODIUM DIMETHYL DITHIOCARBAMATE		
	or LD50 1000 mg/kg rat	PCOC -,1029,-
	P	PCOC -,1216,-

SUBSTANCE	TOXIC CONCENTRATION	REFERENCE
1,2,3-TRIAZOLE-N,N-DIISOBUTYL-5-METHYL-1-PHENYL	or LDca 2000 mg/kg cat	JPET 73,312,41
1,2,4-TRIAZOLE,4-PHENYL	or LD50 134 mg/kg rat	JAPA 47,778,58
1,2,3-TRIAZOLE,N,N-5-TRIMETHYL-1-PHENYL	or LD50 500 mg/kg cat	JPET 73,312,41
vicinal-TRIAZOLO[4,5-d]PYRIMIDINE-5,7-(4H,6H)-DIONE	ip LDca 200 mg/kg mus	CUBL 37,96,60
vicinal-TRIAZOLO[4,5-d]PYRIMIDINE-5,7-(4H,6H)-DIONE-2-THIO	ip LDca 200 mg/kg mus	CUBL 37,96,60
TRIBROMOETHANOL	or LDca 150 mg/kg cat	HI
2,4,6-TRIBROMOPHENOL	or LD50 200 mg/kg rat ip LD50 24 mg/kg mus	HI AG 28,-,64
3,5,6-TRIBROMO-2-METHYL-HYDROQUINONE	iv LD50 220 mg/kg mus	BJP 22,221,64
2,4,6-TRIBROMO-3-METHYLPHENOL	iv LD50 170 mg/kg mus	BJP 22,221,64
2,4,6-TRIBROMO-5-METHYL-RESORCINOL	iv LD50 600 mg/kg mus	BJP 22,221,64
TRI-sec-BUTYL BORATE	or LD50 2100 mg/kg mus	BBBCB -,706,-
TRI-n-BUTYL BORATE	or LD50 2150 mg/kg mus	BBBCB -,706,-
TRIBUTYL PHOSPHATE	or LDca 3000 mg/kg rat	IHT -,1915,-
TRICHLOROBENZOIC ACID	or LD50 1644 mg/kg rat P	PCOC -,1164,- PCOC -,1164,-
TRICHLORO-BIS-(4-CHLOROPHENYL) ETHANE	or TDO 16 mg/kg man or LD50 150 mg/kg rat TFX: CNS man P	TLV PCOC -,347,- TLV PCOC -,347,-
1,1,1-TRICHLORO-2,2-BIS(para-CHLOROPHENYL) ETHANE	see: TRICHLORO-BIS-(4-CHLORO-PHENYL) ETHANE TFX: CNS man	TLV

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MUNS 092888

JEE	Journal of Economic Entomology
JEEB	Journal of Embryology and Experimental Morphology
JEM	Journal of Experimental Medicine, New York
JEZ	Journal of Experimental Zoology, Philadelphia, Pa.
JFATB	Journal of the Faculty of Argriculture, Tottori Univ.
JIH	Journal of Industrial Hygiene
JIHT	Journal of Industrial Hygiene and Toxicology, Cambridge, Mass.
JJ	Japanese Journal of Experimental Medicine, Tokyo
JJP	Japanese Journal of Pharmacology
JLCM	Journal of Laboratory and Clinical Medicine, St. Louis, Mo.
JMC	Journal of Medicinal Chemistry, Washington, D.C.
JMPC	Journal of Medicinal and Pharmaceutical Chemistry, New York
JN	Journal of Nutrition, Philadelphia, Pa.
JNCI	Journal of the National Cancer Institute
JND	Journal of New Drugs, Albany, New York
JNMS	Journal of the Nippon Medical School, Nippon Ika Daigaku Zassh: Tokyo
JOC	Journal of Organic Chemistry, Washington, D.C.
JOCSC	Journal of the Osaka City Medical Center, Osaka, Japan
JOH	Journal of Occupational Medicine, Pitman, New Jersey
JOMA	Journal of the Oklahoma State Medical Association, Oklahoma City, Okla.
JP	Journal of Physiology
JPB	Journal of Pathology and Bacteriology
JPET	Journal of Pharmacology and Experimental Therapeutics, Baltimore, Md.
JPP	Journal of Pharmacy and Pharmacology, London

JPS	Journal of Pharmaceutical Sciences, Washington, D.C.
JRF	Journal of Reproduction and Fertility
JRFR	Journal of Reproductive Fertility
JRMS	Journal of the Royal Microscopical Society, Oxford, England
JSCC	Journal of the Society of Cosmetic Chemists, Oxford, England
KFVSIGZ	Khim. Faktory Vaesh.Sredy Ikh. Gig. Znacheniie, Moscow
KR	Kauchuk i Rezina, Moscow
KW	Klinische Wochenschrift, Berlin
KWI	Klinische Wissenschaftschrift, Berlin
HZ	Khigiena i Zdraveopazvane, Sofia
L	Lancet, London
LI	Laboratory Investigation
LIH	Laboratories of Industrial Medicine, Eastman Kodak Cospany, Rochester, New York
LS	Life Sciences
M	Munkaugedelus, Budapest
MIMUR	Mikrobiologichnii Zhurnal, (Kiev) Akademiya Nauk Ukrains'koi RSR, USSR
MCC	Monsanto Co., St. Louis, Mo.
MI	Stecher, P.G., The Merck Index- An Encyclopedia of Chemicals and Drugs, 8th Ed. Rahway N.J., Merck and Co. 1968
MJOU	Medical Journal of Osaka University, Osaka, Japan
ML	Medicina del Lavoro, Milan, Italy
MM	Minerva Medica, Turin, Italy
MMPK	Mater-Mauch-Pratt Conf. Molodylch Gig. Sanit, Vrachei, USSR
MOP	Sollman, T., A Manual of Pharmacology and Its Applications to Therapeutics and Toxicology. 8th Ed. Philadelphia, W. B. Saunders 1957

NRCC	National Research Council of Canada, Ottowa
NSA	Nuclear Science Abstracts, AEC, Washington, D.C.
NSAEPP	Naunyn-Schmiedebergs Archiv fuer Experimentelle Pathologie und Pharmakologie, Berlin
NTG	Nederlands Tijdschrift voor Geneeskunde, (also: Nederlandsche Maatschappij tot Bevordering Geneeskunst Tidschrift), Haarlem, Netherlands
NYZ	Nippon Yakurigaku Zasshi, Kyoto, Japan
O	Oncology; Journal of Clinical and Experimental Cancer Research, Formerly Oncologia, Basel, Switzerland
OCDS	Olin Mathieson Chemical Data Sheet, Little Rock, Ark.
OHR	Occupational Health Review, Ottova, Canada
OIZ	Osaka Medical Journal, (Osaka Igaku Zasshi), Osaka Japan
OSDIZ	Osaka Shiritsu Daigaku Igaku Zasshi, Osaka, Japan
OY	Oyo Yakuri, Sendai, Japan
P	Pharmacologist, Bethesda, Md.
PA	Proceedings of the Fifth Annual Conference on Atmospheric Contamination in Confined Spaces
PAACR	Proceedings of the American Association of Cancer Research
PC	Bulletin of the Poison Control Center, Bethesda, Md.
PCC	Pennsalt Chemicals Corporation, Philadelphia, Pa.
PCOC	Pesticide Chemicals Official Compendium, Association of the American Pesticide Control Officials, Inc., Topeka, Kansas 1966
PFBIF	Proceedings of the Fifth British Insecticide and Fungicide Conference
PG	Proctor and Gamble Company, Ivorydale, Ohio
PH	Pharmazie, Berlin
PHR	Public Health Reports, Washington, D.C.
PI	Pesticide Index, Edit. by: Frear, E.B., College Science Publications, State College, Pa. 1969

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TCIT	Elkins, H.B., The Chemistry of Industrial Toxicology, 2nd ed., New York, Wiley, 1959
TDCC	The Dow Chemical Company, Midland, Michigan
TEP	Teratology
TFVP ILNZB	Toksikologiya i Farmakologiya Yadokhimikatov, Primenyaemykh V Sel'skom Khozyaistve, Minsk, 1961, USSR
TGA	Proceedings of the Scientific Section of the Toilet Goods Association, Washington, D.C.
TGPNEP	Toksikologiya Gig. Prod. Neftekhim. Neftekhim. Proizvod
THIS	Lehman, K.B., Toricology and Hygiene of Industrial Solvents, (Transl. by E. King and H. Smythe, Jr.) Baltimore, Williams and Wilkins Co., 1943
TIC	Elkins, H., The Chemistry of Industrial Toxicology
TIFANKSSR	Trudy Instituta Fiziologii, Akademiya Nauk Kazakhskoi SSR, Alma Ata, USSR
TLTL	The Eli Lilly Company (Toxicology Laboratory Report), Greenfield, Indiana
TLV	Documentation of Threshold Limit Values for Substances in Workroom Air, Cincinnati, Ohio, Amer. Conf. of Governmental Industrial Hygienists, 1971
TNIS	Browning, Toxicity and Metabolism of Industrial Solvents, London, Elsevier, 1965
TNKAO	Trudy Nauchnoi Konferentsii Aspirantov i Ordinatorov, Moscow Medical Institute, Moscow
TNKVVRSP	Toksikologiya Novykh Khimicheskikh Veshchestv, Unedryaemykh Nefti, Smazochnyu Prom., edit: Izrael'son, Z.I., Moscow Meditsina, 1968 USSR
TNPKV	Toksikologiya Novykh Promyshlennykh Khimicheskikh Veshchestv, Moscow
TOIM	Browning, E., Toricity of Industrial Metals, London, Buttervorths, 1961
TPFI	Trudy Permskogo Farmatseuticheskoge Instituta
TPIFC	Sagers, R. Y., Toxic Properties of Inorganic Fluorine Compounds, London, Elsevier, 1969
TR	Tokyo Toritsu Eisei Kenkyusho Nempo, Tokyo

TOSIS	Toksikologiya Nedkikh Metablov, Ikh Soedin, 1963, USSR
TSKB	Tanabe Seiyaku Kenkyu Nenpo, Osaka, Japan
TUSISPZ	Trudy, Ufimskii Neftyanoi Nauchno-Issledovatel'skii Institut., Ufa, USSR
TVSI	Trudy, Voronezhskii Gosudarstvennyi Neditsinskii Institut, Voroneth, USSR
TVSIITS	Trudy, Vsesoyuznyi Nauchno-Issledovatel'skii Institut Veternarnoi Sanitarii, Moscow
UCC	Union Carbide Corporation, New York
UCDS	Union Carbide Data Sheet, New York
UCPP	University of California Pub. in Pharmacology
UR	University of Rochester, Unpublished Data, Rochester, New York
URAEP	University of Rochester, Atomic Energy Project, Quarterly Report, New York
USB	Uspekhi Sovremennoi Biologii, Moscow, USSR
USBCC	U.S. Borax and Chemical Company, New York
USC	National Technical Information Service, Springfield, Va. (Formerly U.S. Clearinghouse for Scientific and Technical Information)
USPHB	U.S. Public Health Bulletin
V	Voeding, The Hague, Netherlands
VAA	Virchow's Archiv A.
VAPA	Virchows Archiv fuer Pathologische, Anatomie und Physiologie und fuer Klinische Medizin, Berlin
VCC	Velsicol Chemical Corp., Report, Chicago, Illinois April 16, 1971
VD	Vrachebnoe Delo, Kiev, USSR
VGTPPE	Voprosy Gigieny Truda i Professional'nykh Patrol
VICC	Vineland Chemical Company, Vineland, New Jersey
VKG	Voprosy Kommunalnoi Gigieny, Kiev USSR
VO	Voprosy Onkologii, Leningrad, USSR

Exhibit 8

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Pete Benville, Fish-Pesticide Research Laboratory, Bureau of Sport Fisheries and Wildlife, Route #1, Columbia, Missouri 65201

Toxicity of Aroclors® to Aquatic Organisms

Fish: Tests to determine the chronic toxicity of Aroclors® to fish are continuing. Aroclors® 1242, 1248, and 1254 were about equally toxic to yellow perch (30-day TL50 = 72 to 92 µg/l), while Aroclor® 1260 was less than half as toxic.

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Invertebrates

Preliminary static bioassays with individual PCB isomers were begun using scud (Gammarus pseudolimnaeus). These organisms were selected as the amounts of pure isomers available did not permit bioassays using larger organisms.

No. Cl	PCB Component	TL50 (mg/l) 24 hr	96 hr
2	2,4'-dichlorobiphenyl	0.15	0.12
2	4,4'-dichlorobiphenyl	0.16	0.10
3	2,3,4'-trichlorobiphenyl	0.10	0.07
5	2,4,5,2',5'-pentachlorobiphenyl	0.43	0.21
6	2,4,6,2',4',6'-hexachlorobiphenyl	0.20	0.15
4	mixture of 3, decachlorobiphenyls	0.30	0.11