

FIFTH ANNUAL REPORT ON CARCINOGENS 1989

U.S. DEPARTMENT OF
HEALTH AND HUMAN SERVICES
Public Health Service

National Toxicology Program

Pursuant to Section 301(b) (4)
of the Public Health Service Act
as Amended by Section 262, PL 95-622

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U.S. DEPARTMENT OF COMMERCE
SPRINGFIELD, VA 22161



BOR 000430

FIFTH ANNUAL REPORT ON CARCINOGENS 1989

**U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Public Health Service
National Toxicology Program**

Prepared for the
NATIONAL INSTITUTE OF ENVIRONMENTAL HEALTH SCIENCES
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Under Contract Number
N01 ES 3 5025

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BOR 000431

TABLE OF CONTENTS

	<u>Page</u>
I. EXECUTIVE SUMMARY	ii
II. INTRODUCTION	v
III. SUBSTANCES LISTED	
A. List of Substances	1
B. Substances	
1. Known Carcinogens	8
2. Reasonably Anticipated to be Carcinogens	114
C. Occupational Exposures Associated with a Technological Process	619
D. References	638
IV. TABLES	
Table 1. Chemicals Nominated to the NTP for In-Depth Toxicological Evaluation or Carcinogenesis Testing in Fiscal Years 1984-1987	672
Table 2. Status Changes of Compounds in Table 2 of First, Second, Third, and Fourth Annual Reports on Carcinogens	687
Table 3. CDC/NIOSH Response to Inquiries about Carcinogens Listed in the <i>Fifth Annual Report on Carcinogens</i>	698
V. APPENDICES	
A. Glossary	706
B. Acronyms and Abbreviations	717
C. Units of Measurement	720
VI. CAS NUMBER INDEX	721
VII. LIST OF PARTICIPANTS	728
VIII. REGULATIONS	730
IX. DELISTED CHEMICALS	745

NOTE TO THE READER

Listing of a substance in the *Annual Report on Carcinogens* is mandated by Public Law 95-622 and is for informational purposes. The evaluation of substances listed in the *Annual Report* is performed by scientists from the National Toxicology Program and other Federal health research and regulatory agencies. This listing is the first step in hazard identification, is qualitative in nature, and represents only one step in the total risk assessment process. The evaluation of the degree of potential human risk from the substances included in the *Annual Report* requires a wider analysis than has been made in preparing this document. That is properly the purview of the Federal, State, and local health regulatory and research agencies authorized to implement the laws relating to carcinogens.

For the purpose of this Report, "known carcinogens" are defined as those substances for which there is sufficient evidence of carcinogenicity from studies in humans to indicate a causal relationship between the agent and human cancer. "Reasonably anticipated to be carcinogens" are those substances for which there is limited evidence of carcinogenicity in humans and/or sufficient evidence of carcinogenicity in experimental animals. Sufficient evidence in animals is demonstrated by positive carcinogenicity findings in multiple strains and species of animals, in multiple experiments, or to an unusual degree with regard to incidence, site or type of tumor, or age of onset. Only substances for which the evidence of carcinogenicity has been peer-reviewed are evaluated for possible inclusion in the *Annual Reports*.

Anyone who is aware of published data that may alter the listing of a substance in the *Annual Report* is encouraged to make this information available to the National Toxicology Program.

Although every effort is made to prepare the *Annual Report* as accurately as possible, mistakes may occur. Readers are requested to communicate any errors to *Annual Reports on Carcinogens*, c/o National Toxicology Program, P.O. Box 12233, Research Triangle Park, North Carolina 27709, in order that corrections can be reported in future *Annual Reports*.

I. EXECUTIVE SUMMARY

Fifth Annual Report on Carcinogens

BOR 000434

EXECUTIVE SUMMARY

The *Fifth Annual Report on Carcinogens*, prepared by the National Toxicology Program (NTP), U.S. Public Health Service, is issued by the Secretary of the Department of Health and Human Services (DHHS), pursuant to Public Law 95-622 of November 9, 1978.* This law requires the Secretary to publish an annual report that contains "a list of all substances (i) which either are known to be carcinogens or which may reasonably be anticipated to be carcinogens and (ii) to which a significant number of persons residing in the United States are exposed;..." Annual Reports should also provide available information on the nature of exposures, the estimated number of persons potentially exposed, and the extent to which the implementation of Federal regulations decreases the risk to public health from exposure to these substances.

For the purpose of this Report, "known carcinogens" are defined as those substances for which the evidence from human studies indicates that there is a causal relationship between exposure to the substance and human cancer. Substances "which may reasonably be anticipated to be carcinogens" are defined as those for which there is limited evidence of carcinogenicity in humans or sufficient evidence of carcinogenicity in experimental animals.

Substances in the above categories, for which potential exposure of persons residing in the United States has been demonstrated, are included in the Report. In the *Fifth Annual Report*, attempts are made to list substances that are currently being used, or for which there is some evidence for continuing exposures in the workplace or in the general environments of persons residing in the United States. In Section IX, there is a list of chemicals now banned or no longer produced in the United States, and/or for which there is no evidence for continuing exposure of persons residing in the United States. These chemicals have formerly appeared in Annual Reports, and information about them is provided in these earlier editions for all who are interested. The *Fifth Annual Report* does not contain all known or reasonably anticipated carcinogens. Additional substances with identified carcinogenic properties as defined above will be included in subsequent Annual Reports.

Several problems are encountered in developing the information required for the *Annual Report on Carcinogens*. Estimating the number of people potentially exposed to a substance and identifying the nature, route, and intensity of this potential exposure are difficult tasks. It is often impossible to obtain accurate production volumes and use patterns for most chemicals. The information that is being collected by the U.S. Environmental Protection Agency under the Toxic Substances Control Act, at least that part which is public record, may assist in obtaining more recent and accurate data on domestic production and importation of substances in the Reports. In addition, data compiled from the National Occupational Exposure Survey (NOES) conducted by the National Institute for Occupational Safety and Health (NIOSH) from 1980 to 1983 provides new information on the numbers of workers

* Section 262, Paragraph (4).

Section V is a glossary of frequently used terms, a list of commonly used acronyms, and some common units of measurement. Section VI is an index of Chemical Abstracts Service (CAS) registry numbers for chemical substances, and the page number where the substance appears in the *Fifth Annual Report*. Section VII is a list of participating agencies and their staff who collaborated in the preparation of the *Fifth Annual Report*, and Section VIII contains a cumulative list of the Code of Federal Regulations and Federal Register citations for this Report.

Corrections or suggestions for the Report, as well as any additional information that the reader may have, should be sent to Annual Reports on Carcinogens, c/o National Toxicology Program, P.O. Box 12233, Research Triangle Park, North Carolina 27709.

Summaries of this Report may be obtained from the Public Information Office, National Toxicology Program, B2-04, P.O. Box 12233, Research Triangle Park, North Carolina 27709. Copies of the complete Report are available for a fee from the National Technical Information Service, 5285 Port Royal Road, Springfield, Virginia 22161.

II. INTRODUCTION

Fifth Annual Report on Carcinogens

iv-a

BOR 000437

INTRODUCTION

Cancer is the second most common cause of death in the United States. One in every four Americans will suffer from cancer sometime during their lifetime; one in every five will die from cancer. In 1984, more than 450,000 Americans died of cancer (NCHS, 1986). In addition to the physical and emotional suffering caused by cancer, this disease may cost the Nation as much as \$39 billion each year in lost production and income, medical expenses, and research resources. For these reasons, the American public is concerned about cancer and cancer hazards, especially about ways to prevent the occurrence or decrease the incidence of cancers.

Contrary to popular belief, cancer is not one but many diseases which may have different causes. Many scientists believe that from one-third to two-thirds of all cancers may be associated with the environment in which we live and work. In this context, the environment is understood as "anything that interacts with humans, including substances eaten, drunk, and smoked; natural and medical radiation; workplace exposures; drugs; aspects of sexual behavior; and substances in air, water, and soil (OTA, 1981)." Some cultural and behavioral patterns, apart from defined habits of smoking and alcohol consumption, may significantly influence the development of tumors in the gastrointestinal tract, breast, uterus, and prostate. These aspects of social environment, personal behavior, and habits are sometimes called "lifestyle." Although we rarely know the environmental factors and conditions which are responsible for the development of specific cancers, in some cases we are beginning to have some understanding. For example, we now know that the way foods are prepared and cooked, or how they are stored and preserved, can greatly affect the incidence of cancers in any population. It is the hope of many scientists in these fields that much of the cancer associated with the environment may be avoidable -- perhaps by some changes in "lifestyle."

Development of cancer also depends on "host factors." Host factors are attributes of human organisms associated with individual differences in the risk of developing a specified cancer. A host factor may be associated with reduced risk of a cancer, not only with increased risk (Cole, 1982). Examples of host factors are immunological and endocrine functions, nutritional status, genetic constitution, age, and sex, all of which can interact with one another and with the way the host handles the carcinogen -- i.e., how the host absorbs, distributes or stores, metabolizes, and excretes the carcinogen (Bartsch & Armstrong, 1982).

Americans, concerned with the relationships between their environment and cancer, have asked for information about substances that cause or might cause cancer.

Section 262 of Public Law 95-622 of November 9, 1978* reflects the requests for this information. Paragraph (4) of this section stipulates that

* Community Mental Health Centers Act, Amendments.

Participants

Within the Department of Health and Human Services, the responsibility for preparing these Annual Reports has been given to the National Toxicology Program. Agencies participating in this effort through the NTP Working Group for the Annual Reports on Carcinogens are:

Centers for Disease Control/National Institute for Occupational Safety and Health (CDC/NIOSH)

Consumer Product Safety Commission (CPSC)

U.S. Environmental Protection Agency (EPA)

Food and Drug Administration (FDA)

National Institutes of Health/National Cancer Institute (NIH/NCI)

National Institutes of Health/National Institute of Environmental Health Sciences (NIH/NIHES)

National Institutes of Health/National Library of Medicine (NIH/NLM)

U.S. Department of Labor/Occupational Safety and Health Administration (DOL/OSHA)

Four of these agencies -- CPSC, EPA, FDA, and OSHA -- are responsible for regulating hazardous substances and limiting the exposure to and use of such substances.

Most of the information in each entry of the Annual Report on Carcinogens on "Use", "Production", and "Exposure" is provided by participants from the regulatory agencies given above.

Identifying Carcinogens

For many years, government research agencies, industries, universities, and other research organizations have studied various substances to ascertain those that might cause cancer. Other Federal agencies have been developing information on possible exposure and potential hazards and making rules and regulations to control substances which have been identified as carcinogens.

* DHHS member agencies participating in NTP are NIH/NCI; NIH/NIHES; FDA/National Center for Toxicological Research (FDA/NCTR); CDC/NIOSH; and Agency for Toxic Substances and Disease Registry (ATSDR).

2) Reasonably anticipated to be carcinogens:

- A. There is "limited evidence of carcinogenicity" from studies in humans, "which indicates that causal interpretation is credible, but that alternative explanations, such as chance, bias or confounding, could not adequately be excluded," or
- B. There is "sufficient evidence of carcinogenicity" from studies in experimental animals "which indicates that there is an increased incidence of malignant tumors: (a) in multiple species or strains, or (b) in multiple experiments (preferably with different routes of administration or using different dose levels), or (c) to an unusual degree with regard to incidence, site or type of tumor, or age at onset. Additional evidence may be provided by data concerning dose response effects, as well as information on mutagenicity or chemical structure."

The reader is reminded that the *Fifth Annual Report on Carcinogens* (and all previous editions) is a condensation of large amounts of data and conclusions made by bodies which peer review the data submitted as evidence about cancer and its relation to specific exposures. As such, the *Fifth Annual Report on Carcinogens* must be less detailed about the actual tests and their drawbacks. The original monographs on each listing are given in the references, and the reader is advised to turn to these for the specific arguments, both pro and con, which went into the listing decision.

Human and Animal Studies

Both human and animal studies, where available, are used in identifying chemicals as possible carcinogens for humans. The strongest evidence for relationships between exposure to any given chemical and cancer in humans comes from carefully conducted epidemiological studies. Good epidemiology studies of cancer must consider the latent period of most cancer development since the exposure to the carcinogen often occurs many years (sometimes 20 to 30 years or more) before the first sign of cancer appears. As an alternative to what is usually missing in epidemiological studies of suspected carcinogens for humans (accurate information about dose and duration of exposure, and interactions of the suspected carcinogen with other chemicals or modifiers), scientists can use well-designed animal studies. In these, the suspected carcinogen is administered to large numbers of animals in (usually at least) two species over a range of doses and times with all parameters chosen to maximize the possibility of producing cancer (e.g., the doses of suspected carcinogen are usually large).

The *Fifth Annual Report on Carcinogens* contains entries on the carcinogenicity of seven metals (arsenic, beryllium, cadmium, chromium, lead, nickel, and thorium). Many different salts or compounds of these metals exist and, with any particular metal, only a few of these have been evaluated in animals for carcinogenicity. However, some general principles may apply. The toxicologic (and carcinogenic) hazard from a metal may often be a property less of the form of the metal administered than of the metal per se, although the toxicity and carcinogenicity (e.g., potency) of any compound can also be a function of its bioavailability. The anion or ligand of the metal often seems to determine the physico-chemical properties which then affect bioavailability characteristics such as solubility, absorption, and distribution to sites believed to be involved in carcinogenesis, etc. In the absence of data (e.g., about bioavailability), all compounds or salts of any metal shown to be carcinogenic in one of its forms may be reasonably anticipated to be carcinogens. This caveat may also apply to the elemental metal (OHEA, 1986).

Ionizing radiation, ultra-violet radiation (including sunlight), tobacco, alcoholic beverages, and some viruses are known or suspected to be carcinogens. They have not been included in this Report (unless acting in conjunction with a chemical) because ionizing radiation is discussed thoroughly in a General Accounting Office Report, and a Surgeon General's Report reviews the overwhelming relationship between tobacco and cancer (GAO, 1981; OSH, 1982). Several publications issued by the National Cancer Institute explain the relationship of alcoholic beverages, ultra-violet radiation, and viruses to cancer (e.g., Shimkin, 1980).

Certain manufacturing processes and mixtures of chemicals have been considered by the International Agency for Research on Cancer (IARC) and have been classified by IARC as sources which are associated with increased incidences of cancer in workers in these settings. Among these are:

1. Boot and Shoe Manufacture and Repair (IARC S.4, 1982; IARC V.25, 1981)
2. Certain Combined Chemotherapy for Lymphomas (IARC S.4, 1982; IARC V.25, 1981)
3. Furniture Manufacture (IARC S.4, 1982; IARC V.1, 1972)
4. Hematite Underground Mining (IARC S.4, 1982; IARC V.1, 1972)
5. Isopropyl Alcohol Manufacturing (Strong-Acid Process) (IARC S.4, 1982; IARC V.15, 1977)
6. Manufacture of Auramine (IARC S.4, 1982; IARC V.1, 1972)
7. Nickel Refining (IARC S.4, 1982; IARC V.2, 1973; IARC V.11, 1976)
8. Rubber Industry (IARC S.4, 1982; IARC V.28, 1982).

This list of substances with key references is then published in the Federal Register for comment. Final decisions on the substances to be included in the Annual Report and on other issues raised are made after the two review groups have evaluated the submitted comments on each of the issues.

Once decisions have been made on the chemicals to be included in the Annual Report, the support contractor prepares the initial draft of the Report, which contains an entry on each of the substances judged to be known carcinogens or reasonably anticipated to be carcinogens. As mandated by Congress, these entries include data on the nature of exposure to the substances and the estimated numbers of persons exposed, and information on the Federal regulations promulgated on the substances; in addition, they contain summaries of the relevant carcinogenicity data. The information on Federal regulations and other Federal activities is supplied by the agencies that serve on the Working Group for the Annual Report on Carcinogens. These agencies also contribute data on levels of exposure to the substances under the use situations for which they have jurisdiction.

Following extensive review by NIEHS scientific staff, the draft Report is revised and submitted first to the Working Group for the Annual Reports on Carcinogens and then to the NTP Executive Committee for evaluation. Modifications suggested by member Agencies are incorporated into the document which is then transmitted to the Secretary, Department of Health and Human Services, for final review, approval, and publication.

Because of increased levels of interest in the Annual Reports on Carcinogens, a further opportunity for public comment was added to the process for preparation of the *Fifth Annual Report on Carcinogens*. An open meeting was held on April 21, 1987, in Washington, DC, to discuss the process by which the Annual Reports on Carcinogens are prepared, and to receive oral and written comments. Seventeen oral presentations were given, all but one of which were supported by written submissions. Fourteen other written comments were submitted by individuals and groups unable to attend the meeting. In response to requests for more information on the process for preparation of the Annual Reports, the above description has been added to this Report and will appear in subsequent Reports.

Estimating Exposure

According to clause (ii) of subparagraph (4)(A), this Report is required to include those substances "to which a significant number of people residing in the United States are exposed." Substances to which only a few people are exposed are not included for the most part. Yet some substances that have been banned or restricted in use are contained in the Report (e.g., safrole, arsenical pesticides, mirex), either because people who were previously exposed remain potentially at risk, or because these substances are still present in the environment.

OSHA has recently taken regulatory action which affects the permissible exposure limits for the following substances: amitrole, beryllium and certain beryllium compounds, chromic acid and chromates including zinc chromate, carbon tetrachloride, DDT (dichlorodiphenyltrichloroethane), 1,4-dichlorobenzene, 1,2-dichloroethane, 1,3-dichloropropene, di(2-ethylhexyl)phthalate, dimethyl sulfate, 1,4-dioxane, epichlorohydrin, ethyl acrylate, hydrazine and hydrazine sulfate, 4,4'-methylenebis(2-chloroaniline), certain nickel compounds, 2-nitropropane, propylene oxide, tetrachloroethylene, 2,4-toluene diisocyanate, o-toluidine and toluidine hydrochloride, and toxaphene. For information on current OSHA regulations for these substances, the reader should obtain 54 FR 2329 (January 19, 1988) or OSHA Publication 3112, Air Contaminants -- Permissible Exposure Limits (29 CFR 1910.1000).

Estimating Risk Reduction

Clause (ii) in subparagraph (4)(C) requires a statement identifying "for each effluent, ambient, or exposure standard established by a Federal agency with respect to a substance contained in the list under subparagraph (A), the extent to which, on the basis of available medical, scientific, or other data, such standard, and the implementation of such standard by the agency, decreases the risk to public health from exposure to the substance;..." This requires quantified information on the amount of protection from cancer that the public receives from established Federal standards.

Estimating the amount of health protection is perhaps the most difficult task in preparing the Annual Reports. One reason is that most Federal laws concerned with reducing cancer risk have been enacted within the last 15 years. Given the long period between the initial exposure to a carcinogen and the onset of disease, it is still too early to evaluate to what extent Federal standards and other regulations have decreased the human cancer risk. Another reason is that information on past exposure levels, which could serve as a baseline for estimating future risk reduction, often is not available or accurate.

The risk -- the probability of developing cancer -- depends on many things, including the intensity, route, and duration of exposure to a carcinogen. Individuals may respond differently to similar exposures, depending on host factors such as age, sex, nutritional status, overall health, and inherited characteristics. Only in a few instances, where studies of long-term human exposures and cancer incidence in restricted environments are available, can risk be estimated with any confidence.

The regulation of asbestos in the workplace provides a good example. In 1969, under the Walsh-Healey Act, which then regulated only firms with government contracts, the standard for permissible exposure was 12 fibers of asbestos per cubic centimeter (cm^3) of air. Under the Occupational Safety and Health Act, this standard was reduced to 5 fibers/ cm^3 in 1972 and to 2 fibers/ cm^3 in 1976. On April 17, 1980, a joint NIOSH/OSHA Working Group recommended the elimination of all nonessential uses of asbestos and the implementation of a public health program to reduce human exposures. On April 10, 1984, OSHA proposed a rule lowering the permissible exposure to 0.2 or 0.5 fibers/ cm^3 (5 micrometers in length) and requiring other provisions for employee protection.

Other Information

Section V is a glossary of terms, acronyms, and units of measurement used frequently in the *Fifth Annual Report*. Section VI is a list of Chemical Abstracts Service (CAS) registry numbers of chemical substances in this Report, and the page number where a profile of the substance appears in the *Fifth Annual Report*. Section VII is a list of participating agencies and their representatives who collaborated in preparing the *Fifth Annual Report*. Section VIII contains a cumulative list of Federal Regulations and Federal Register citations for this report. Section IX is a list of chemicals which have been delisted from the Annual Report because they are now banned or no longer produced in the United States.

IARC. International Agency for Research on Cancer. IARC Monographs on the Evaluation of the Carcinogenic Risk of Chemicals to Humans. Chemicals, Industrial Processes and Industries Associated with Cancer in Humans. Supplement 4. 292 pp. Lyon, France: IARC, 1982.

IARC. International Agency for Research on Cancer. IARC Monographs on the Evaluation of Carcinogenic Risks to Humans. Overall Evaluations of Carcinogenicity. Supplement 7. 440 pp. Lyon, France: IARC, 1987.

NCHS. National Center for Health Statistics. Advance Report of Final Mortality Statistics, 1984. Vol. 35, No. 6. 44 pp. Washington, DC: U.S. Department of Health and Human Services, 1986.

OHEA. "Health Assessment Document for Nickel and Nickel Compounds"; Final Report; especially section 2 (pages 7 and 11); section 5 (page 14); and section 8 (pages 113, 155, and 225). EPA Office of Health and Environmental Assessment, EPA/600/8-83/012ff, September 1986.

OSH. Office on Smoking and Health. The Health Consequences of Smoking: Cancer, a Report of the Surgeon General. Rockville, MD: U.S. Department of Health and Human Services, Public Health Service, 1982.

OTA. Office of Technology Assessment, Congress of the United States. Assessment of Technologies for Determining Cancer Risks from the Environment. U.S. Government Printing Office, Washington, DC, 1981.

Shimkin, M.B. Science and Cancer. NIH Publication No. 80-568, Third Revision. National Cancer Institute, National Institutes of Health. Bethesda, MD: U.S. Department of Health and Human Services, 1980.

III. SUBSTANCES LISTED

Fifth Annual Report on Carcinogens

XX

BOR 000446

A. List of Substances

Fifth Annual Report on Carcinogens

BOR 000447

LIST OF SUBSTANCES*

1. Substances or groups of substances, occupational exposures associated with a technological process, and medical treatments that are known to be carcinogenic.**

	<u>Page</u>
4-Aminobiphenyl	8
Analgesic Mixtures Containing Phenacetin	11
Arsenic and Certain Arsenic Compounds	14
Asbestos	28
Azathioprine	41
Benzene	43
Benidine	50
Bis(chloromethyl)ether and Technical Grade	
Chloromethyl Methyl Ether	56
1,4-Butanediol Dimethylsulfonate (Myleran)	62
Chlorambucil	64
Chromium and Certain Chromium Compounds	67
Coke Oven Emissions	619+
Conjugated Estrogens	79
Cyclophosphamide	82
Diethylstilbestrol	86
Melphalan	91

* Several manufacturing processes or mixtures of chemicals/drugs have been considered by IARC/ARC as carcinogenic. Please see page xi in the Introduction for a discussion and listing of these.

** For the purpose of this Report, "known carcinogens" are defined as those substances for which the evidence from human studies indicates that there is a causal relationship between exposure to the substance and human cancer.

+ This occupational exposure is included in section IIIC.

List of Substances (Contir

Methoxsalen with Ultra-violet A Therapy (PUVA)	I	-
Mustard Gas		
2-Naphthylamine	1	-
Soots, Tars, and Mineral Oils	6	
Thorium Dioxide	1	
Vinyl Chloride	1	

* This occupational exposure is included in section IIIC.

List of Substances (Continued)

2. Substances or groups of substances, and medical treatments which may reasonably be anticipated to be carcinogens.*

	<u>Page</u>
2-Acetylaminofluorene	114
Acrylonitrile	117
Adriamycin	124
Aflatoxins	126
2-Aminoanthraquinone	129
o-Aminoazotoluene	131
1-Amino-2-methylantraquinone	133
Amitrole	135
o-Anisidine Hydrochloride	138
Benzotrichloride	141
Beryllium and Certain Beryllium Compounds	145
Bischloroethyl Nitrosourea	154
1,3-Butadiene	156
Cadmium and Certain Cadmium Compounds	161
Carbon Tetrachloride	174
Chlorendic Acid	181
Chlorinated Paraffins (C ₁₂ , 60% Chlorine)	184
1-(2-Chloroethyl)-3-cyclohexyl-1-nitrosourea (CCNU)	188
Chloroform	190
3-Chloro-2-methylpropene	196
4-Chloro-o-phenylenediamine	198
C.I. Basic Red 9 Monohydrochloride	201
p-Cresidine	203
Cupferron	206
Dacarbazine	208

* For the purpose of this Report, substances "which may reasonably be anticipated to be carcinogens" are defined as those for which there is a limited evidence of carcinogenicity in humans or sufficient evidence of carcinogenicity in experimental animals.

List of Substances (Continued)

	Page
DDT	210
2,4-Diaminoanisole Sulfate	215
2,4-Diaminotoluene	219
1,2-Dibromo-3-chloropropane	223
1,2-Dibromoethane (EDB)	228
1,4-Dichlorobenzene	238
3,3'-Dichlorobenzidine and 3,3'-Dichlorobenzidine Dihydrochloride . . .	244
1,2-Dichloroethane	249
Dichloromethane (Methylene Chloride)	254
1,3-Dichloropropene (Technical Grade)	260
Diepoxybutane	264
Di(2-ethylhexyl)phthalate	267
Diethyl Sulfate	273
Diglycidyl Resorcinol Ether	276
3,3'-Dimethoxybenzidine	278
4-Dimethylaminoazobenzene	281
3,3'-Dimethylbenzidine	284
Dimethylcarbamoyl Chloride	288
1,1-Dimethylhydrazine	291
Dimethyl Sulfate	294
Dimethylvinyl Chloride	298
1,4-Dioxane	300
Direct Black 38	305
Direct Blue 6	308
Epichlorohydrin	311
Estrogens (Not Conjugated): Estradiol-17 β	316
Estrogens (Not Conjugated): Estrone	319
Estrogens (Not Conjugated): Ethinylestradiol	322
Estrogens (Not Conjugated): Mestranol	325
Ethyl Acrylate	328
Ethylene Oxide	331
Ethylene Thiourea	340

List of Substances (Continued)

	<u>Page</u>
Formaldehyde (Gas)	344
Hexachlorobenzene	353
Hexamethylphosphoramide	357
Hydrazine and Hydrazine Sulfate	360
Hydrazobenzene	365
Iron Dextran Complex	369
Kepone® (Chlordecone)	372
Lead Acetate and Lead Phosphate	375
Lindane and Other Hexachlorocyclohexane Isomers	382
2-Methylaziridine (Propyleneimine)	389
4,4'-Methylenebis(2-chloroaniline) (MBOCA)	392
4,4'-Methylenebis(N,N-dimethyl)benzenamine	396
4,4'-Methylenedianiline and its Dihydrochloride	399
Metronidazole	404
Michler's Ketone	406
Mirex	408
Nickel and Certain Nickel Compounds	411
Nitrilotriacetic Acid	422
5-Nitro-o-anisidine	426
Nitrofen	428
Nitrogen Mustard Hydrochloride	431
2-Nitropropane	434
N-Nitrosodi-n-butylamine	438
N-Nitrosodiethanolamine	442
N-Nitrosodiethylamine	445
N-Nitrosodimethylamine	451
p-Nitrosodiphenylamine	458
N-Nitrosodi-n-propylamine	461
N-Nitroso-N-ethylurea	464
N-Nitroso-N-methylurea	467
N-Nitrosomethylvinylamine	471
N-Nitrosomorpholine	474

List of Substances (Continued)

	<u>Page</u>
N-Nitrosonornicotine	477
N-Nitrosopiperidine	480
N-Nitrosopyrrolidine	483
N-Nitrososarcosine	486
Norethisterone	488
4,4'-Oxydianiline	491
Oxymetholone	493
Phenacetin	496
Phenazopyridine Hydrochloride	499
Phenoxybenzamine Hydrochloride	502
Phenytoin	504
Polybrominated Biphenyls	507
Polychlorinated Biphenyls	511
Polycyclic Aromatic Hydrocarbons, 15 Listings	519
Benz(a)anthracene	
Benzo(b)fluoranthene	
Benzo(j)fluoranthene	
Benzo(k)fluoranthene	
Benzo(a)pyrene	
Dibenz(a,h)acridine	
Dibenz(a,j)acridine	
Dibenz(a,h)anthracene	
7H-Dibenzo(c,g)carbazole	
Dibenzo(a,e)pyrene	
Dibenzo(a,h)pyrene	
Dibenzo(a,i)pyrene	
Dibenzo(a,l)pyrene	
Indeno(1,2,3-cd)pyrene	
5-Methylchrysene	
Procarbazine Hydrochloride	527
Progesterone	530
1,3-Propane Sultone	534
β -Propiolactone	537
Propylene Oxide	540
Propylthiouracil	545
Reserpine	548

List of Substances (Continued)

	<u>Page</u>
Saccharin	552
Safrole	556
Selenium Sulfide	560
Streptozotocin	563
Sulfallate	566
2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	569
Tetrachloroethylene (Perchloroethylene)	575
Thioacetamide	580
Thiourea	583
Toluene Diisocyanate	587
o-Toluidine and o-Toluidine Hydrochloride	593
Toxaphene	598
2,4,6-Trichlorophenol	603
Tris(1-aziridinyl)phosphine Sulfide	607
Tris(2,3-dibromopropyl)phosphate	610
Urethane	614