Information Resources in Toxicology

Third Edition

Edited by

Philip Wexler • Pertti J. Hakkinen

Gerald Kennedy, Jr. • Frederick W. Stoss

Academic Press

Information Resources in Toxicology

Third Edition

This Page Intentionally Left Blank

Information Resources in Toxicology

Third Edition

Editor-in-Chief

Philip Wexler
Toxicology and Environmental Health Information Program
National Library of Medicine
National Institutes of Health
Bethesda, Maryland

Associate Editors

P. J. (Bert) Hakkinen
The Procter and Gamble Company
Cincinnati, Ohio

Gerald L. Kennedy, Jr.
Haskell Laboratories
Dupont
Newark, Delaware

Frederick W. Stoss
Science and Engineering Library
State University of New York at Buffalo
Buffalo, New York

Academic Press

San Diego San Francisco New York Boston London Sydney Tokyo

This book is printed on acid-free paper. ♾

Academic Press
A Harcourt Science and Technology Company
525 B Street, Suite 1900, San Diego, California 92101-4495, USA
http://www.apnet.com

Academic Press
24-28 Oval Road, London NW1 7DX, UK
http://www.hbuk.co.uk/ap/

Library of Congress Catalog Card Number: 99-66137

International Standard Book Number: 0-12-744770-9

PRINTED IN THE UNITED STATES OF AMERICA
99 00 01 02 03 04 EB 9 8 7 6 5 4 3 2 1

For my parents, Yetty and Will,

my wife, Susan,

and my son, Jacob,

with love.

This Page Intentionally Left Blank

Concerning the oft forgotten wherefore of toxicology

And even in our times it is said, venomous animals poison the water after the setting of the sun, so that the good animals cannot drink of it, but in the morning after the sunrise, comes the unicorn and dips his horn into the stream driving away the poison from it . . . this I have seen for myself.

—John of Hesse

Concerning the difficulty of coherently structuring information

One day the devil and a friend were taking a stroll when they saw a man bend down and pick up something from the ground. He looked at it carefully and put it away in his pocket. The friend asked the devil, ''What did that man pick up?'' ''He picked up a piece of the Truth,'' answered the devil. ''That is unfortunate for you,'' said his friend. ''On the contrary,'' the devil replied, ''I am going to let him organize it.''

—paraphrased from a talk given by Krishnamurti

This Page Intentionally Left Blank

Contents

CHAPTER

25

Countries 583

Japan

TETSUO SATOH

The Netherlands

G. J. MULDER

Norway

RICHARD WIGER AND ERIK DYBING

Russia

B. A. KURLYANDSKI AND K. K. SIDOROV

Spain

M. REPETTO

Sweden

ELISABETH MALMBERG AND GUNILLA HEURGREN

Taiwan

JEN-KUN LIN

United Kingdom

CLAIRE STEED AND CARON HARTLEY

Uruguay

M. BURGER

Contributors

Numbers in parentheses indicate the pages on which the authors' contributions begin.

Laila A. M. Abd El-Megid (608) Forensic Medicine and Clinical Toxicology Department, Alexandria Poison Center, Alexandria University, 2111 Alexandria, Egypt

S. N. Agarwal (647) Industrial Toxicology Research Centre, Lucknow-226 0011, India

Maury M. Bandurraga (413, 425) The Procter & Gamble Company, Winton Hill Technical Center, Cincinnati, Ohio 45224

Robert O. Beauchamp, Jr. (553) Raleigh, North Carolina 27641

Elizabeth A. Behrendt (439) World Resources Institute, Washington, DC 20006

John R. Bend (583) Department of Pharmacology and Toxicology, University of Western Ontario, London, Ontario N6A5C1, Canada

Mabel Burger (757) Department of Toxicology, Hospital de Clínicas, Montevideo, Uruguay

Christina E. Cowan-Ellsberry (559) The Procter & Gamble Company, Ivorydale Technical Center, Cincinnati, Ohio 45217

Kathy Deck (355) National Center for Environmental Health, Centers for Disease Control and Prevention, Atlanta, Georgia 30341

Jacques Descotes (627) Lyon Poison Center, Hopital Edouard Hezziot, 69437 Lyon, France

Herbert Desel (631) Poison Information Center North, University of Göttingen, D-37075 Göttingen, Germany

Adriana Dracos (669) Documentation Service, Istituto Superiore di Sanita, 00161 Rome, Italy

Patricia Dsida (433) ChemADVISOR, Inc., Pittsburgh, Pennsylvania 15238

Erik Dybing (710) Department of Environmental Medicine, National Institute of Public Health, N0403 Oslo, Norway

Janet M. Everitt (1) Pharmacy and Upjohn Company, Kalamazoo, Michigan 49009

P. J. (Bert) Hakkinen (241, 287, 439, 525, 545) The Procter & Gamble Company, Miami Valley Laboratories, Cincinnati, Ohio 45253

Caron Hartley (749) Health Aspects of the Environment and Food, Information Unit, Department of Health, London SE1 6LW, England

Gunilla Heurgren (734) National Chemicals Inspectorate, S-17127 Solna, Sweden

Michael J. Irwin (559) The Procter & Gamble Company, Sharon Woods Technical Center, Cincinnati, Ohio 45241

Regine Kahl (631) Institute of Toxicology, University of Düsseldorf, D-40225 Düsseldorf, Germany

Gerald L. Kennedy, Jr. (27) DuPont Haskell Laboratory for Toxicology and Industrial Medicine, Newark, Delaware 19714

Hannu Komulainen (613) Laboratory of Toxicology, National Public Health Institute, FIN-70701 Kuopio, Finland

B. A. Kurlyandski (717) Russian Register of Potentially Hazardous Chemical and Biological Substances, 101479 Moscow, Russia

Christine C. Lally (559) The Procter & Gamble Company, European Technical Center, Temselaan 100, Strombeek-Bever, Belgium

Shen Li (599) Chinese Academy of Preventive Medicine, Scientific Information Center, Beijing, 100050 China

Jen-Kun Lin (744) Institute of Biochemistry, College of Medicine, National Taiwan University, Taipei, Taiwan, Republic of China

Edmund M. K. Lui (583) Department of Pharmacology and Toxicology, University of Western Ontario, London, Ontario N6A5C1, Canada

Linda A. Malley (27) DuPont Haskell Laboratory for Toxicology and Industrial Medicine, Newark, Delaware 19714

Elisabeth Malmberg (734) National Chemicals Inspectorate, S-17127 Solna, Sweden

Ida Marcello (669) Inventario Nazionale delle Sostanze Chimiche, Istituto Superiore di Sanita, 00161 Rome, Italy

Daniel Marsick (433) U.S. Department of Energy, Germantown, Maryland 20874

Linda Miller Poore (333, 349) OPPT Library, Office of Pollution Prevention and Toxics, U.S. EPA, Washington, DC 20460

Gerard J. Mulder (705) Division of Toxicology, Leiden/Amsterdam Center for Drug Research, Leiden University, Leiden, The Netherlands

Paolo Preziosi (669) Department of Pharmacology, Catholic University, Rome 00168, Italy

Manuel Repetto (728) National Institute of Toxicology, 41080 Sevilla, Spain

El-Sayed M. Salem (608) Public Health and Environmental Toxicology Department, Institute of Graduate Studies and Research, Alexandria, Egypt

Tetsuo Satoh (700) Biomedical Research Institute, Shiroi, Inba, Chiba 270-1402, Japan

Nancy S. Selzer (27) DuPont Haskell Laboratory for Toxicology and Industrial Medicine, Newark, Delaware 19714

P. K. Seth (647) Industrial Toxicology Research Centre, M. G. Marg, Lucknow-226 0011, India

Sushma Sharma (647) Industrial Toxicology Research Centre, M. G. Marg, Lucknow-226 0011, India

K. K. Sidorov (717) Russian Register of Potentially Hazardous Chemical and Biological Substances, 117419 Moscow, Vadkovsky Per. 18-20, Russia

Claire Steed (749) Glaxo Wellcome, Middlesex UB6 0HE, England

Frederick W. Stoss (241, 269, 287, 339, 355, 383, 439, 513) Science and Engineering Library, Capen Hall, State University of New York at Buffalo, Buffalo, New York 14260

Catherine A. M. Suzuki (583) Toxicology Research Department, Health Protection Branch, Health Canada, Ottawa, Ontario, Canada K1A0l2

Katherine D. Watson (1) Wellcome Institute for the History of Medicine, Wolfson College, Oxford OX2 64D, England

Philip Wexler (1, 27, 225, 287, 383, 439, 513) National Library of Medicine, National Institutes of Health, Bethesda, Maryland 20894

Richard Wiger (710) Department of Environmental Medicine, National Institute of Public Health, N0403 Oslo, Norway

Tamara L. B. Wilson (349) Centerville, Virginia 20120

Dan Yan Zhu (599) Scientific Information Center, Chinese Academy of Preventive Medicine, Beijing, 100050 China

Foreword

Since the early 1960s, toxicology has evolved from a stepchild of pharmacology to a full-fledged and robust scientific discipline. Not only has its scientific basis been strengthened, but there have been dramatic increases in the numbers of toxicologists, research centers, laws and regulations, and books and other publications and in funding. Toxicology has matured from a science once largely descriptive to one mechanistically grounded. Society, too, has been transformed and, buffeted by technological innovation and controversy, seeks ways to adjust. Toxicology's roles related to human health and the environment are having a greater impact on society than ever before.

Amid all this change, we who practice toxicology and the many who depend on our studies are constantly challenged with the need to find answers, data, information. The current perception that the Internet provides universal and complete access to information is nowhere as fallacious as in toxicology. So much more information is available—but where? How do we sift out the good from the bad, the relevant from the irrelevant?

A solution has come in the form of a completely revised and updated edition of *Information Resources in Toxicology*. While devoting considerable attention to itemizing and reviewing a core selection of the latest resources available through the Internet, this book serves as a broader, powerful tool for those seeking a wider representation of information. From books, newsletters, and journals to organizations and regulations, separate chapters prepared by experts in toxicology and information science address the full spectrum of available information systems.

The earlier editions of this work were valuable. This new edition is invaluable.

Shayne Cox Gad, Ph.D., DABT
Principal
Gad Consulting Services
Raleigh, North Carolina

This Page Intentionally Left Blank

Preface to the Third Edition

The goal of this revised third edition is to provide an up-to-date selective guide to sources of information in all aspects of toxicology and ancillary fields, such as environmental and occupational health and risk analysis. The core of this reference work is an extensive annotated bibliography of books categorized by subject. This is joined by listings of journals, organizations, audiovisuals, popular works, and many other areas. Perhaps the most obvious change in access to toxicology information in the 10 years since the second edition has been the growth of electronic sources of information and digital technologies to access it, sparked by the pervasiveness of personal computers in office and home and the still burgeoning Internet. It is, in fact, ironic that despite this phenomenal transition in scientific information-seeking behavior, we nonetheless have a need for and joy in old-fashioned information-rich paper products, such as books. That said, I continue to harbor the hope that this book will one day be joined, but not replaced, by an electronic version.

The scope of toxicology has widened and its areas of focus have shifted significantly in the last decade. Whereas the subject breakdown of books is similar to that in the second edition, there are an increasing number devoted to biochemical, cellular, molecular, and genetic aspects and more of an emphasis on both mechanisms of action and risk assessment. There will always be a chemical or topic of the hour, be it Agent Orange or endocrine disruptors, to which it may seem a disproportionate amount of attention is paid. We have tried to include resources covering such subjects if their significance is likely to endure.

It has become considerably more difficult to know how to categorize items. There used to be a common understanding of what the words ''book,'' ''journal,'' or ''newsletter'' meant, but with these formats and others, as understood traditionally, being replaced or complemented by electronic versions, we in the information fields find ourselves groping for the right word to describe a resource. A database used to be a collection of information accessed directly over standard phone lines. It still may be, although we now have the much more multifaceted and versatile World Wide Web and Internet. Databases can be PC-resident, networked, on CD-ROMs, packaged with software that ''does'' something with or to the data and allows new data to be imported (e.g., modeling, structure–activity), etc. Words such as ''book,'' ''journal,'' or ''newsletter,'' though not likely to vanish any time soon, will probably become much more nuanced and ambiguous, requiring clarification, perhaps, about whether one is talking about content in hard-copy print or digital form. We have thus, for want of good substitutes, used many of the same format types from earlier editions. There are many more cross-references, though, to Web sites.

Each chapter retained from the second edition, some renamed, has been considerably enlarged, and a number of new chapters have been added. The new chapters cover publishers, grants and other funding opportunities, assessment of physical hazards, patent literature, technical reports, an overview of international activities, and the IUPAC glossary. Also contributed were new chapters describing toxicological activities in Russia and Paraguay. The addition of three Associate Editors, each well versed in the intersection of toxicology and information, has energized and brought a fresh perspective to the text.

Many thanks to Tari Paschall, Destiny Irons, Kay Sasser, and Joanna Dinsmore of Academic Press. Their combined editorial and production skills have transformed a loose jumble of chapters into a coherent and logical whole.

Disclaimer

I wrote this book in my capacity as a private citizen, not as a government employee. The views expressed are strictly my own. No official support or endorsement by the U.S. National Library of Medicine or any other agency of the U.S. Federal Government was provided or should be inferred.

Philip Wexler

Preface to the Second Edition

Since the first edition of this book five years ago, the field of toxicology has continued to grow unabated. This younger sibling of the more established sciences is crossing more and more disciplinary boundaries while gradually refining its scientific basis. Much fundamental research is still necessary. The excitement of toxicology is based, in large measure, on the difficulty of making predictions about the response of biological systems to exogenous agents. Its challenge is to balance technological and product innovation with the guarantee for a reasonably safe and healthy environment.

This book considers toxicology primarily from the perspective of the harmful effects of chemicals on biological systems. ''Harmful,'' of course, is a highly problematic word. ''Harmful'' may be on a clinical, pathological, or biochemical level. It may change over time in relation to advances in analytical instrumentation. The Congress, regulatory agencies at all levels of government, the courts, and the public all have their own ideas about what such words as ''harmful,'' ''hazardous,'' ''poisonous,'' ''toxic,'' and ''adverse'' mean. I will leave debate over these fine distinctions to others and consider all the terms as roughly synonymous for the purposes of this book.

Nonchemical concerns of toxicology relate to the effects of certain physical agents (e.g., radiation) and complex biotoxins (e.g., snake venoms, aflatoxins) on biological systems. Chemical, physical, and biological agents may act not only upon living organisms but upon atmospheric, terrestrial, and aquatic environments. Certain subjects are just beginning to gain a foothold in the realm of the toxicological sciences. Biotechnology, an explosively fertile field in its own right, meets toxicology when studies of the adverse effects of genetically engineered microorganisms are considered. The animal rights movement has made its presence strongly felt, and therefore alternatives to animal testing must be seriously examined by responsible toxicologists. The sophistication of new computer systems is allowing studies in such areas as structure–activity relationships. Indeed, computers in general are aiding experiments in direct measurement and analysis, as well as data capture, manipulation, and retrieval.

Areas of toxicology that this book has not stressed are management of hazardous wastes, aspects of pollution control, and engineering/equipment considerations. Abuse of drugs, alcohol, and tobacco, while also within the broad scope of toxicology, have generally not been treated here.

This book of ''information resources'' is addressed to anyone who has a need to know where to look for toxicology information. A library cataloger may describe it as an annotated bibliography and directory. I prefer to think of it as a sourcebook, a kind of ''Whole Toxicology Catalog.'' The current edition is an expanded and updated version of the first. The scope has been widened as indicated above, and there has been a finer subdivision of categories within toxicology. This remains a selective list with no attempt made to cover exhaustively all available materials. A selective list always assumes a certain presumptuousness on the author's part in judging some books more deserving than others. I have further risked charges of audacity by highlighting the books that I deem especially noteworthy with an asterisk (*). I have no concrete criteria for these judgments other than my personal opinion in examining the texts. Nonasterisked books may be just as, or more, valuable for certain applications and no slight is intended toward any of the authors. All quoted passages within annotations are taken from the item cited or from promotional literature. Book prefaces and the ''Information for Authors'' section of periodicals were typical sources for such quotations. This edition includes many new books

and new editions of older works. Thus, there has been a considerable increase in scope, size, and currency.

The other major change is the international coverage of the current edition. The inclusion of countries outside the English-speaking world was necessary to make this a thorough compendium. Unfortunately, I was unable to obtain contributions from all of the countries I would have liked to include, and I regret these omissions. Contributed chapters on the history of toxicology and on regulatory information were supplied. Also included are a variety of supplemental lists and directories, such as the directory of mutagenicity testing laboratories in the United States.

The organization of the book, an issue I struggled with in the first edition, continued to plague me here. The widely disparate nature of the form of material (book, series, monographic series, handbook, book in parts, etc.) and the interdisciplinary nature of the field itself have made it difficult to impose a wholly coherent and justifiable order on the work. It has not been easy to reconcile the following two seemingly contradictory facts: (a) organization of a combined directory/bibliography is critical in providing efficient access to the information contained therein; and (b) there is no perfect way to organize such a book. In the end, I hope the organization selected, along with the indexes and cross-references, will prove at least reasonable and convenient to use. The very best way to access information in a book of this nature is to create an online searchable computer version which should definitely be considered if future editions are contemplated. The other frustration an online version would eliminate is the difficulty of keeping up with new and changing information. As the manuscript for this book leaves my hands and makes it way to publication, over months, new toxicology resources will come to light.

I am indebted to many individuals for their assistance with this book. Certainly a sourcebook of this magnitude would not have been possible without all the fine contributions by my U.S. and international colleagues. Dr. Jose Alberto Castro, of Argentina, was particularly helpful in directing me to other international contributors and sharing with me his keen insight into toxicological information in developing countries. I would like to extend special thanks to Drs. Henry Kissman and George Cosmides for their many helpful suggestions and to Mr. Bruno Vasta for his encouragement of this project. I am equally grateful to Mrs. Aurora K. Reich for her continued interest and guidance. The valuable advice and good spirits of Elsevier's Yale Altman cannot be underestimated as important factors in the successful completion of this book. Christine Hastings, the book's Desk Editor, miraculously transformed the dishabille of my manuscript into an elegantly tailored book. Finally, I am thankful to my friends, parents, Yetty and Will, and my wife, Susan, for more than I can express.

Disclaimer

I wrote this book in my capacity as a private citizen, not a government employee. The views expressed are strictly my own. No official support or endorsement by the U.S. National Library of Medicine or any other agency of the U.S. Federal Government was provided or should be inferred.

Philip Wexler

Preface to the First Edition

Although literature in toxicology is proliferating at a phenomenal rate, and access to this literature by use of computer data bases and other tools is fairly adequate, there has as yet been no succinct guide directing devotees of toxicology to the major sources of information in the field. This guide is an attempt to fill this void. It is a selective and annotated list of information resources. I have tried to select material that is or has the potential of being widely and frequently used and is exceptional in its content and presentation. In addition, I have included material that may not necessarily be of reference use but that is representative of a subject or format. Both relatively broad areas of toxicology and more specific fields of interest have been covered.

Toxicology deals with chemical, physical, and biological (i.e., plant and animal toxins) hazards to man. Chemicals have unavoidably been emphasized. The large number of potentially dangerous commercial chemicals and the large populations exposed to them has resulted in a focus of attention on chemical hazards in research, regulations, and press coverage. I have tried to balance this emphasis by including substantial resources on physical and biological hazards.

For the purposes of this guide, the following areas are within the scope of toxicology: industrial and household chemicals and substances, food, drugs, cosmetics, gases, radiation and radioactive substances, sound, heat light, laser, microwave, metals, minerals, trace elements, biotoxins (mushrooms, plants, insect stings, snake and marine life venoms), environmental pollutants, pesticides, industrial hygiene and occupational medicine, analytical techniques, chemical and forensic toxicology, epidemiology, contamination of water and air, carcinogenesis, mutagenesis, teratogenesis and reproductive toxicology, behavioral toxicology, toxicity testing, legislation, regulations, and societal issues, veterinary toxicology, and target systems toxicology. The concentration is that of health effects. Therefore, topics such as management and storage of wastes and waste disposal; engineering, equipment, and monitoring aspects; mechanical aspects of pollution, and ecology and environmental impact where man is not considered a key component of the biosphere are peripheral to the scope of this guide. In addition, the following topics have not been emphasized: alcohol and tobacco, drug abuse, allergy and hypersensitivity, and mechanical and traffic hazards.

The materials chosen are in English and the organizations are primarily within the United States. One chapter provides a glimpse into international activities.

The chapter divisions devised for this guide are somewhat arbitrary, although not indiscriminate. Some of the materials in both the periodicals and books sections, for instance, could have been merged into a chapter on handbooks (e.g., RTECS, TOSCA Inventory, etc.). Then, the associated problem of how to categorize items that were partially handbooks of data and partially expository prose, would have arisen. Directories, on the other hand, for which there is a separate chapter, could have been dispersed among the serials and books. After much thought, I have settled on the organization that follows.

The guide has been organized in a manner that should be most convenient for scanning as well as for accessing a particular item or class of items. The overall organization, along with the indexes, should provide sufficient access. I have avoided creating too many categories and chapters as this tends to confound matters and create an extremely disjointed product in a field where there is great overlap in subdisciplines.

There was a great temptation to make this guide much larger than it is, since there is no shortage of material. This, however, would have become unwieldy

and defeated the purpose of providing a core list of the most necessary and useful information.

All quoted passages within the annotations are taken from the item cited—for serials this information usually appears as scope notes or information for authors; for books, the quoted sections have usually been extracted from the preface.

This guide was compiled with the assistance of many individuals and organizations. Holdings lists of libraries, individual specialists' recommendations, reading lists for classes in toxicology, compilations of materials used in the creation of data bases, and library card catalogs were all consulted. The outstanding facilities of the National Library of Medicine, the Library of Congress, the National Institutes of Health Library, as well as those of other Washington area libraries, were utilized to examine virtually all of the items.

Special thanks are owed to the following individuals who provided valuable guidance and support throughout this project: Arthur Wykes, Mel Spann, Aurora K. Reich, Pat O'Brien, and Sally Moulton.

Since a guide such as this quickly becomes outdated it is essential that revised editions be published periodically. Comments and suggestions from readers regarding the content and organization of the guide as it exists, items omitted, those that seem unnecessary, or alternate ways of presenting the material would be greatly appreciated, as they will result in future editions of even greater value to the toxicologist.

The views expressed in this book are the personal opinions of the author and should not be taken to represent the views of any organization with which he is or has been associated.

Philip Wexler

ANNEX

1

Some Toxicological Abbreviations Used in This Book

ADI	Acceptable daily intake
ALARA(P)	As low as reasonably achievable (practicable) In the United Kingdom, regulations relating to worker exposure. In the United States, the goal of risk management (USNRC regulations).
ATP	Adenosine triphosphate
BAL	British anti-Lewisite
BATNEEC	Best available technology not entailing excessive cost
BPEO	Best practicable environmental option (United Kingdom)
bw	Body weight
DN$_n$	See **ND**$_n$
EC	Enzyme classification number or effective concentration
EC$_n$	Median effective concentration to n% of a population
EDI	Estimated daily intake
ED$_n$	Median effective dose to n% of a population
EEC	Estimated exposure concentration
EED	Estimated exposure dose
EEL	Environmental exposure level
EMDI	Estimated maximum daily intake
EQO	Environmental quality objective
EQS	Environmental quality standard
ERL	Extraneous residue limit
ETS	Environmental tobacco smoke
GAP	Good agricultural practice
GLP	Good laboratory practice
GMP	Good manufacturing practice
HQ	Hazard quotient
HSG	Health and Safety Guide (IPCS)
IC	Inhibitory concentration
IDLHC	Immediately dangerous to life or health concentration
im	Intramuscular
inhl	By inhalation
ip	Intraperitoneal
IPD	Individual protective devices
I-TEF	International toxicity equivalency factor
iv	Intravenous
K_{oc}	Organic carbon partition coefficient
K_{ow}	Octanol–water partition coefficient
LC$_n$	Median concentration lethal to n% of a test population
LD$_n$	Median dose lethal to n% of a test population
LEL	Lowest effect level, same as **LOEL**
LOEL	Lowest-observed-effect-level
LOAEL	Lowest-observed-adverse-effect-level
LT$_n$	Median time for death of n% of a test population
LV	Limit value
MAC	Maximum allowable concentration
MCL	Maximum contaminant level (United States: Safe Drinking Water Act)
MCLG	Maximum contaminant level goal (United States: Safe Drinking Water Act)
MEL	Maximum exposure limit
MF	Modifying factor
MOE	Margin of exposure
MRL	Maximum residue limit
mRNA	Messenger ribonucleic acid

MSDS Material safety data sheet
MTC Maximum tolerable concentration
MTD Maximum tolerable dose; maximum tolerated dose
MTEL Maximum tolerable exposure level
NADP(H) Nicotinamide adenine dinucleotide phosphate (reduced)
ND_n Median dose narcotic to *n*% of a population
NEL No effect level, same as **NOEL**
NOAEL No-observed-adverse-effect-level
NOEL No-observed-effect-level
OEL Occupational exposure limit
OES Occupational exposure standard
pc *Per cutim* (Latin) = through the skin
PEL Permissible exposure limit
PMR Proportionate mortality rate, ratio
po *Per os* (Latin) = by mouth
P_{OW} Octanol–water partition coefficient
PPD Personal protective device
PPE Personal protective equipment
PTWI Provisional tolerable weekly intake
QSAR Quantitative structure–activity relationship
RD Rate difference
RfC Reference concentration
RfD Reference dose
RME Reasonable maximum exposure (USEPA)
RNA Ribonucleic acid
RR Rate ratio
SAR Structure–activity relationship
sc Subcutaneous
SCE Sister chromatid exchange
SMR Standard mortality ratio
SNARL Suggested-no-adverse-response-level
STEL Short-term exposure limit
$t_{1/2}$ Half-life
TCDD 2,3,7,8-Tetrachlorodibenzo-*p*-dioxin
TDI Tolerable daily intake
TEF Toxicity equivalency factor
TEQ Toxicity equivalent
TL_n See **LT_n**
TLV Threshold limit value
TMDI Theoretical maximum daily intake
TSEL Tentative safe exposure level
TWA Time-weighted average
TWAC Time-weighted average concentration
TWAE Time-weighted average exposure
UF Uncertainty factor

ANNEX

2

Abbreviations of Some National and International Organizations and Miscellaneous Terms

ACGIH	American Conference of Governmental Industrial Hygienists
ACTS	HSE Advisory Committee on Toxic Substances (United Kingdom)
ASHRAE	American Society of Heating, Refrigerating, and Air-Conditioning Engineers (United States)
BCR	Bureau Communautaire de Référence (Bruxelles)
BIBRA	British Industrial Biological Research Association
CCFA	Codex Committee on Food Additives
CCOHS	Canadian Centre for Occupational Health and Safety
CCPR	Codex Committee on Pesticide Residues
CDC	Cancer Detection Centre
CEC	Commission of the European Communities
CERCLA	Comprehensive Environmental Response, Compensation, and Liability (United States)
CFR	Code of Federal Regulations
CHIP	Classification, Hazard Information and Packaging (United Kingdom)
COC	Committee on Carcinogenicity (United Kingdom)
COM	Committee on Mutagenicity (United Kingdom)
COPR	Control of Pesticides Regulations (United Kingdom)
COSHH	Control of Substances Hazardous to Health (United Kingdom)
COT	Committee on Toxicity (United Kingdom)
CPL	Classification, Packaging and Labeling
CRISP	Computer Retrieval of Information on Scientific Projects
CSM	Committee on Safety of Medicines (United Kingdom)
DART	Developmental and Reproductive Toxicology
DEA	Drug Enforcement Agency
DOD	Department of Defense
EC	European Community, European Commission
ECETOC	European Chemical Industry Ecology and Toxicology Centre
EEC	European Economic Community
EIA	Environmental Impact Assessment
EINECS	European Inventory of Existing Chemical Substances
EIS	Environmental Impact Statement
EPA	Environmental Protection Agency (United States); same as USEPA
FAC	MAFF Foods Advisory Committee (United Kingdom)
FAO	Food and Agricultural Organization
FDA	Food and Drug Administration (United States)
FEMA	Federal Emergency Management Agency; also, Flavour and Extract Manufacturers Association
FONSI	Finding of No Significant Impact (United States)

FSC Food Safety Council, Washington, DC
GEMS Global Environmental Monitoring System
HSC Health and Safety Commission (United Kingdom)
HSE Health and Safety Executive (United Kingdom)
IAEA International Atomic Energy Agency
IARC International Agency for Research on Cancer
ICRP International Commission on Radiological Protection
ICSU International Council of Scientific Unions
IFCC International Federation of Clinical Chemists
ILO International Labour Office
IPCS International Programme on Chemical Safety
IRIS Integrated Risk Information System (United Kingdom)
IRPTC International Register of Potentially Toxic Chemicals
ISO International Organization for Standardization
IUPAC International Union of Pure and Applied Chemistry
IUTOX International Union for Toxicology
JECFA Joint FAO/WHO Expert Committee on Food Additives
JMPR Joint FAO/WHO Meeting on Pesticide Residues
MAFF Ministry of Agriculture, Fisheries and Food (United Kingdom)
MARC Monitoring and Risk Assessment Centre (United Kingdom)
NBS National Bureau of Standards (United States); now NIST
NEHA National Environmental Health Association
NIH National Institutes of Health (United States)
NIOSH National Institute of Occupational Safety & Health (United States)
NIST National Institute of Standards and Technology (United States); formerly NBS
NRC National Research Council (United States)
NTIS National Technical Information Service
OECD Organization for Economic Cooperation and Development
OMS Organisation Mondiale de la Santé; same as WHO
OSHA Occupational Safety and Health Administration (United States and/or United Kingdom)
PSPS Pesticides Safety Precautions Scheme (United Kingdom)
RSC The Royal Society of Chemistry (United Kingdom)
RCRA Resource Concentration and Recovery Act (United States)
SCOPE Scientific Committee on Problems of the Environment (ICSU)
SIS Specialized Information Services
TEHIP Toxicology and Environmental Health Information Program
TIR Toxicology Information Roundtable
TIRC Toxicology Information Resource Center
TRI Toxic Chemical Release Inventory
UNEP United Nations Environment Programme
USEPA United States Environmental Protection Agency; same as EPA
USNRC U.S. National Research Council
WHO World Health Organization; same as OMS

CHAPTER

1

History

KATHERINE D. WATSON, PHILIP WEXLER, AND JANET M. EVERITT

All substances are poisons; there is none which is not a poison. The right dose differentiates a poison and a remedy.
(Paracelsus)

HIGHLIGHTS IN THE HISTORY OF TOXICOLOGY

KATHERINE D. WATSON

The science dealing with the harmful effects of chemical agents on biological systems is called toxicology, from the Greek word *toxikon*, a bow (to shoot poisoned arrows) or a poison in which to dip arrowheads [1]. A poison, for which it has long been surprisingly difficult to give an exact definition [2,3], may generally be taken to be a substance that is capable of destroying life or causing illness when introduced into, or absorbed by, a living system in small quantities. Toxicology is often considered to be a modern science as, since 1900, it has undergone continuous expansion and development by assimilating knowledge and techniques from most branches of the physical and biological sciences [4]. Its origins, however, lie in the earliest history of poisons and poisoning. Historically, attempts to both kill and cure with chemically active preparations (poisons and drugs) have led to the evolution of toxicology, so that today it is a discipline of diverse application and widespread importance.

It is likely that the history of toxicology is as old as the history of the human race: early man must have learned 'to discriminate between things which were good to eat and those that were not' [5]. In exploring his environment and searching for food, he would have observed the healing or harmful effects of plants and minerals, and that the bites of certain insects and reptiles caused illness or death. It would have been a natural progression to use injurious substances for hunting, against enemies in warfare, and for homicide [6]. Arrow poisons were developed by ancient peoples in all parts of the world (with the possible exception of Australia and New Zealand), and many are still in use [7]. Among the best known are the 'calabash curares' (derived mainly from varieties of *Strychnos* in South America), reptile poisons (venoms) from toads and salamanders in Central and South America, and ouabain, from African varieties of *Acocanthera* and *Strophanthus* [8]. The science of pharmacology (which deals with the preparation, uses, and effects of drugs) has benefitted from knowledge of these poisons, and some of the active agents derived from them are now used therapeutically in Western medicine.

The earliest use of arrow poisons probably occurred during the Mesolithic age, when arrows first began to appear. The archaeological evidence does not permit firm conclusions to be drawn, but it is possible that Masai hunters who lived in Kenya 18,000 years ago may have used poison. Other sites in Africa indicate later use (3000–1700 BC), and in ancient Egypt and Nubia poisoned arrows appear to have been used during the period 3100–300 BC [7].

In China, arrow poisons have been known to the Han and other peoples for at least 2500 years. They were used for both hunting and warfare, and documentary evidence indicates that the principal source of poison was *Aconitum*, the tubers of which yield aconitine [9]. The same poison was also used in ancient

India, where it was called visha and derived from a plant known as Bish. In Sanskrit literature, we find the term *visha-kanya*, or poison girl (maidens who had slowly developed a tolerance for aconitine, so that certain death would result from their embrace). The legend of using young girls as instruments of death originated in India and later spread into medieval European literature via Greek and Arabic writings [10]. The hymns of the *Rg Veda* and *Atharva Veda* (1200–900 BC) show that poisoned arrows were used in war, and that the tubers of *Aconitum* were the major poison source. Later Buddhist and Sanskrit writings indicate the continued use of poisoned arrows (for hunting, warfare, and clandestine purposes) and reveal that a second source of poison was obtained from decomposing snakes; the latter is confirmed by Diodorus Siculus in his account of Alexander the Great's campaign (325 BC) in western India [11].

Among the peoples of the ancient Middle and Near East, the Egyptians, Assyrians, Sumerians, and Hebrews all had some knowledge of poisons, from which they developed a primitive pharmacology. Much of their experience was bound up with mysticism and the supernatural, and many details remain unclear. However, where it has been possible to identify individual items of the ancient pharmacopoeia, modern practice indicates that some remedies could have been extremely effective [12]. The Bible, where most references are to venoms (as in the Midrash and Talmud), does not contain a list of poisons or allude to their deliberate use [13]. In all likelihood, the Hebrew people acquired much of their information about poisons in Egypt, where they not only endured a captivity near the end of the second millenium, but are also known to have established a vibrant community after the destruction of Jerusalem in the sixth century BC.

Egyptian knowledge of poisons appears to have been highly advanced [14]. Originally divided into two kingdoms, Upper and Lower Egypt, the land was united under the first pharaoh (or king), Menes, in about 3000 BC. He is said to have cultivated and studied poisonous and medicinal plants, but there is no detailed description of his activities [5,13]. Following his reign, much information about animal, vegetable, and mineral poisons was accumulated in Egypt, and the discovery in 1872 of a complete medical text showed the extent of Egyptian learning. Named in honor of its discoverer, the German Egyptologist Georg Ebers (1837–1898), the Papyrus Ebers, written about 1550 BC, is a compilation of medical prescriptions derived from a number of much earlier sources. There are in total 829 prescriptions, of which 72% are quantified and a few are duplicated; spells and incantations are included throughout. The text lists many possibly active drugs, including [12]:

> Sulphate, oxide, and other salts of lead used as astringents and demulcents; pomegranate and acanthus pith as vermifuges; sulphate and acetate of copper; magnesia, lime, soda, iron, and nitre; oxide of antimony, sulphide of mercury; peppermint, fennel, absinth, thyme, cassia, coriander, carraway, juniper, cedar wood oil, turpentine, and many other essential oils; gentian and other bitters; mandrake, hyoscyamus, opium with other hypnotics and anodynes; linseed, castor oil, squills, colchicum, mustard, onion, nasturtium, tamarisk, frankincense, myrrh, and yeast.

Of the vegetable and mineral substances cited, some were, clearly, poisonous. Another papyrus provides an early record of the preparation of a poison, as it records the following warning:

> Pronounce not the name of I.A.O. under the penalty of the peach.

C. J. S. Thompson suggests that the Egyptians may have been able to distill a weak solution of hydrocyanic acid from peach kernels; I.A.O. is, possibly, a representation of the ancient Hebrew name for God [15].

The literature of ancient Greece contains many references to poisons and their use [16], none more famous than Plato's account of the death of Socrates. Condemned to death for impiety and corruption of youth, the Athenian philosopher swallowed a fatal dose of hemlock in 399 BC. This was the state method of execution, the poison being derived from the tubers of *Conium maculatum* (the 'spotted hemlock' or 'poison hemlock'); for quicker effect, it may have been mixed with opium [17]. Other poisonous plants known to the Greeks were mentioned in the ninth (probably spurious) book of the *De Historia Plantarum* of Theophrastus (371–287 BC), and included aconite, hellebore, mandrake and henbane [18]. The writings attributed to Hippocrates (460– c.375–350 BC), the 'father of medicine,' mentioned (among other things) about 400 drugs of mainly plant origin and suggested methods for the management of poisoned patients that relied primarily on limiting the absorption of toxic agents [13]. During the reign of Attalus III, the last king of Pergamon in Asia Minor (reigned 138–133 BC), poisonous plants were cultivated and experiments made on condemned prisoners by Attalus and, probably, others in his court. Rulers lived in fear of poison, and Mithridates VI Eupator, king of Pontus (reigned 120–63 BC), spent years searching for a universal antidote to all poisons; he has been called the first experimental toxicologist. [13,19]. After investigating individual venoms, poisons, and antidotes, he combined all of the effective substances

into one antidote, which he took daily to obtain, reportedly successfully, immunity to poison. His formula, called Mithridatium, underwent considerable revision but survived in various forms until the nineteenth century. A variant derived from poisonous reptiles became known as theriac, and was equally long-lived in European pharmacopoeias [20].

Theriac—a term derived from the word *theria* (dangerous or poisonous beasts)—became famous as a result of its association with the earliest extant work on poisonous animals, The *Theriaca* of Nicander of Colophon (second century BC). Also author of a shorter poem, the *Alexipharmaca,* Nicander is the best cohesive source for classical toxicology [21]. His poems describe venomous animals (snakes, scorpions, spiders, insects, and myriapods) and their bites and prescribe specific remedies; poisonous plants are also treated [22]. Working in the intellectual atmosphere created by Attalus III, Nicander was a poet of nature who was, quite possibly, ignorant of his subject: he has been traditionally considered to have taken his information directly from a lost work of Apollodorus of Alexandria, the *Peri therion* (*On Poisonous Animals*), of the third century BC [22]. Despite varying opinion on the originality of Nicander's work, it seems that he was widely influential [23]. Successive Greek and Roman authors (including Scribonius Largus, Celsus, Pliny, Galen, Philumenus, and Oribasius) took much of their information on toxicology from him; he was read and cited for many centuries [24].

Following the work of Nicander, in which lay the beginnings of a scheme for identifying toxic agents by means of the symptoms they produce in human victims, a system of toxicology based on this principle developed between the second century BC and the first century AD [25]. The Roman naturalist and historian Pliny the Elder (23/24–79 AD), a great compiler of information, described the biological effects of poisonous plants and animals in his *Historia Naturalis*. In the works attributed to his contemporary, Pedanius Dioscorides (first century AD), there is a classification of poisons based on their origin (animal, vegetable, mineral) that remains convenient to this day [26]. Known as the father of materia medica, Dioscorides is generally thought to have been a physician in the service of the Roman legions. He studied the medicinal properties of plants and minerals, and provided descriptions of about 600 plants and 1000 simple drugs, with the diseases they might cure, in his *Materia Medica,* the leading text in pharmacology for 16 centuries. Later Greek and Byzantine physicians transmitted the established information, the last being Paul of Aegina (fl. c. 645 AD): Book 5 of his *Epitome* deals with toxicology, specifically bites and wounds of venomous animals [13].

Mineral poisons were also well known in the ancient world. In particular, the ores and compounds of arsenic, antimony, copper, mercury, and lead were familiar to many cultures. Pseudo-Dioscorides detailed the poisonous effects of arsenic (meaning sometimes the sulphide, sometimes the white oxide), litharge (red lead or lead oxide), cinnabar (mercuric sulphide), and white lead (lead acetate) [6]. Hippocrates, Nicander, Dioscorides, Galen, and Paul of Aegina wrote clinical accounts of lead poisoning, of which there were occasional epidemics [27,28], and miners were known to be at risk from the fumes created by smelting processes [29]. After the third century AD and the synthesis by Galen [30], few if any additions were made to the information presented by Pseudo-Dioscorides [26], and a passage from Galen suggests that it would have been imprudent to do so because of the risk of encouraging crime [6].

The chronicles of ancient Greece contain few references to cases of criminal poisoning, but the fact that Hippocrates required his students to swear that they would 'give no deadly medicine to any one if asked, nor suggest any such counsel' [31] implies that it was a problem. Suicide by poison was fairly common; the state would give permission and provide a lethal dose of hemlock [6,32]. In the Roman Republic, however, criminal poisoning reached epidemic proportions. In his *History of Rome,* Livy (59 BC–17 AD) recorded the details of an event that was supposed to have occurred in 331 BC: a series of deaths initially attributed to pestilence were found to be the result of poisoning. A slave informed the authorities that leading citizens who had all died of the same mysterious malady had in fact been poisoned by a group of matrons. A search of the women's houses yielded concoctions which they declared to be medicines; when required to drink the potions to prove their claim, they all perished. Further investigation disclosed 170 accomplices, who were tried and found guilty. According to Livy, there had never before been a trial for poisoning in Rome [33].

At the time of the civil wars in Rome, poisoning had become so common that the dictator Sulla issued the *Lex Cornelia* in 82 BC. This was the first legislative attempt to prevent poisoning, and it carried harsh penalties: banishment and confiscation of property if an offender was of noble birth, exposure to wild animals if of low status. Later interpretations made the law applicable to careless preparers of drugs [6]. Despite this edict, however, homicidal poisoning continued to plague Rome, where according to Tacitus, Juvenal, and Suetonius, a class of professional poisoners arose and practiced their skills with impunity [34]. During the

first century AD, the worst offenders were members of the ruling family, particularly Nero and his mother Agrippina, who used poison as a political tool. Both employed a Gallic woman named Locusta, who had been convicted of poisoning but pardoned and taken into imperial service. She used a variety of poisons, probably aconite, henbane, belladonna, arsenic, and poisonous fungi, and is reputed to have performed experiments on slaves supplied for the purpose [5,6].

The death of Galen circa 216 AD marked the beginning of a long period of transition in Western (i.e., Greek) medicine, during which what is usually called monastic medicine gradually emerged. From about 500 to 1130, medical practice and writing resided in the hands of monks, where it was merely complementary to their divine mission [31]. The study of toxicology as a system of knowledge came to a halt in the Christian world and was not taken up again until after the rise of the school of Salerno in twelfth century Italy [35]. It was no coincidence that Salerno was close to Arab Sicily because, following the rise of Islam in the seventh century, scholarship shifted to Muslim centers, where Arab and Persian physicians dominated medical learning. They discovered Greek medicine through translations made from Byzantine manuscripts and contributed their own original observations to the subject. Similarly, medical texts written in India were made available in translation.

Several Indian medical texts containing information about poisons, together with the works of Greek authors, became key sources of information for Arab toxicologists. The most important Indian works were those of Charaka (second century AD), Susruta (about 500 AD), and Shanaq (slightly later). The most complete Arabic works on toxicology still extant are the *Book on Poisons* of ibn Jabir (ninth century), the *Paradise of Wisdom* of al-Tabari (born ca. 810), and the *Book on Poisons* of ibn Wahshiya (fl. late ninth century). Portions of the *Liber continens* of al-Razi (860–932) and the *Canon Medicinae* of ibn Sina (980–1037) consider poisons. There were in addition numerous other medical texts on poisons and poisoning, but many are now lost [36]. The *Canon* of ibn Sina, or *Avicenna,* and the *Treatise on Poisons and Their Antidotes* of Moses Maimonides (1135–1204) were particularly well known in medieval European universities and medical schools, where works written in Greek and Arabic were made available in Latin translation after the eleventh century.

The few new contributions made to knowledge of poisons during the Middle Ages came primarily from the physicians and alchemists of the Islamic world. They were the first to note the toxic properties of corrosive sublimate (mercuric chloride), and ibn Sina described the foul odor exhaled by victims of mercury poisoning. The replacement of arsenic trisulphide by white arsenic (arsenic trioxide) in poisonous preparations had a profound influence on the history of toxicology, as it became one of the most versatile and widely-used poisons ever known [6,13,35]. The medical works of Maimonides, a Jewish philosopher and physician in the service of the Sultan of Egypt, are still seen as modern in their approach to illness; his book on poisons contained original experiments, treatments, and views. The first part of the book discussed the bites of snakes and other animals, while the second considered poisoning with vegetable and mineral substances. For the former, he advised drawing the poison from the wound (sucking, cupping glasses, plasters) and antidotes (including theriac and Mithridatium); for the latter, vomiting and purging by means of various agents. Some of his suggestions—suitable diet, keeping the patient awake, sedatives applied to the affected spot or taken internally—hold true today. So, too, the composition of some of his medicinal recipes and their use according to the age of the patient [37].

One century later, the professor of medicine at the University of Padua, Petrus of Abano (1250–1316), wrote a book on poisons that was based upon his reading of Greek and Arabic works. His *De Venenis* classified poisons as vegetable, mineral, and animal, and listed all known poisonous agents with their symptoms and treatment. It also suggested methods for avoiding the ingestion of poison and for neutralizing it if taken [38]. This may explain the wide popularity of the book, which went through 14 editions after its first printing in 1472: the later Middle Ages and Renaissance were, in Italy, periods in which poison was frequently used to accomplish murder and political assassination. Schools of poisoning arose in Rome, Naples, and Florence and flourished until the beginning of the eighteenth century. In Venice, poison was recognized officially as a means of furthering policy: the records of the infamous Council of Ten list, among other information, intended victims and the fees paid to poisoners for their services. By the seventeenth century, the activities of Italian poisoners had been redirected towards social, marital, and financial objectives. In Naples, Giulia Toffana (ca. 1635–1719) sold arsenical solutions under the name of *Acquetta di Napoli* and is supposed to have poisoned over 600 people; in Rome, Hieronyma Spara conducted a similarly lucrative business (ca. 1659), her clients being primarily young married women [5,6,34]. Both were executed for their crimes.

Italian refinements to the 'art' of poisoning are said to have been introduced to France by Catherine de Medici in the sixteenth century. Favored poisons included arsenic mixed with the decomposition prod-

ucts of an animal to which it had been administered (corrosive sublimate was sometimes substituted), cantharides, and mixtures of arsenic, aconite, belladonna, and opium. Poisoning became a public menace, and in 1662 Louis XIV issued a decree forbidding apothecaries to sell poisons to anyone unknown to them and requiring purchasers to sign a register. Professional poisoners thus had more incentive to ply their trade, but a series of scandals soon brought about their downfall. In 1676, the Marquise de Brinvilliers was executed for the murders of her father, brothers, and husband; she had been aided by a poisoner named Sainte-Croix, who died as a result of one of his own experiments. In 1679, the Chambre Ardente was appointed to investigate suspected poisoning cases, and within three years it had brought charges against 442 people. Many of the worst offenders were influential enough to escape trial; others were less fortunate. Of those executed, the most notorious was Catherine Deshayes, known as La Voisin: she was convicted of many murders, including those of 2000 infants. When it was revealed that she had sold poisons to the king's mistress, Madame Montespan, the court was summarily dismissed [6,39].

The 'Affaire des Poisons' represented the culmination of the period of professional poisoners in France, but the fact that the crimes were brought to light owed more to the use of torture to extract confessions than to the ability of doctors or chemists to detect and identify poisons. It was not until the nineteenth century that experimental toxicology became sufficiently developed to make such practices far more risky for the poisoner, but the foundations of this progress were laid much earlier, during the sixteenth century. The key figure at the time when traditional lore began to give way to objective investigation in science and medicine was Paracelsus (1493–1541), a controversial but influential physician, alchemist, and scientist. Despite the fact that his science was mixed with mysticism and astrology, his contributions to medicine were revolutionary. Paracelsus rejected the medical theories perpetuated by the Greco-Arabic classics, insisted on the value of experimentation (including the use of animal tests), and developed the idea that minerals and chemicals could have medicinal applications (iatrochemistry). His use of mercury preparations in the treatment of syphilis led to accusations of poisoning, to which Paracelsus replied by writing the *Third Defense*. It contains the following important statement:

> What is there that is not poison? All things are poison and nothing (is) without poison. Solely the dose determines that a thing is not a poison.

Consequently, toxicologists give credit to Paracelsus for stating one of the basic concepts in toxicology, that of dose-dependency [40]. Paracelsus was the first to express the view that drugs and chemicals have effects on specific organs of the body (target organ toxicity), a concept which was further developed in the work of Felice Fontana (1730–1805) [13]. In his experimental studies of the venom of the European viper and its effects on animals, Fontana discovered that the symptoms of poisoning caused by a bite were attributable to the direct action of venom on the blood [41]. His findings contributed to the ongoing debate about whether drugs and poisons acted through the nerves or by a process of absorption and transport in the blood. This question arose during the seventeenth century, when iatrochemists attempted to explain physiological and pathological phenomena in chemical terms. The debate stimulated chemical and physiological research throughout the seventeenth and eighteenth centuries, while the advances made in chemistry near the end of the eighteenth century inspired increasingly sophisticated analyses of animal and plant substances. These factors, together with a mounting acceptance of animal experimentation, led to the development of experimental toxicology as a distinct scientific discipline during the nineteenth century [42].

The contribution made by physiology to toxicology is exemplified by the work of François Magendie (1783–1855), the first great experimental physiologist of the nineteenth century. He laid the foundation for the systematic study of the mechanisms by which poisons act in the body with his investigation of the Javanese arrow poison *Upas tieuté*, which was later shown to contain strychnine [43]. His pupil and successor at the Collège de France, Claude Bernard (1813–1878), studied the nature of the action of curare on neuromuscular transmissions, effectively using a poison as an instrument for resolving important physiological problems [44]. In addition, Bernard suggested that carbon monoxide poisoning occurs as a result of tissue asphyxiation caused by an irreversible combination with hemoglobin, which prevents the effective transport of oxygen to body tissues [6]. Another of Magendie's students, James Blake (1815–1893), found that there is often a relationship between the chemical structure of a drug and its biological activity, thus implying the concept of target organ toxicity [45]. There was subsequently a great deal of British research in the area of structure-activity relationships, perhaps the most sophisticated being that of Alexander Crum Brown (1838–1922) and Thomas Fraser (1841–1920) on organic alkaloids [46,47]. The successes of the experimental method in physiology, combined with notable advances in analytical chemistry, stimulated the development of pharmacology [31]. The complementary nature of toxicological and pharmacological research dur-

ing the nineteenth century was embodied in the work of the Germans Rudolf Kobert (1854–1918), who studied the digitalis glycosides and the ergot alkaloids, and Louis Lewin (1850–1929), who became an expert on narcotics, alcohols, poisonous gases, and arrow poisons [48].

The chemical approach to the study of poisons was pioneered by the work of a man who has long been considered the founder of modern toxicology, Mathieu Joseph Bonaventura Orfila (1787–1853) [49]. A Spaniard who made his career in Paris, Orfila established toxicology on a firm quantitative basis by introducing new, primarily chemical, experimental methods for proving lethal intoxications; diagnoses of that kind had previously been made solely on the basis of observed features. A trained chemist and physician, he performed experiments on thousands of dogs to gather the necessary data, and in 1814–15 he published a monumental work in two volumes: *Traité des poisons tirés des règnes minéral, végétal et animal, ou toxicologie générale, considérée sous les rapports de la physiologie, de la pathologie et de la médecine légale* (Paris: Crochard). The book examined the physiological and pathological effects of poisons, the symptoms of poisoning, antidotes, the chemical properties of poisons, and analytical methods for detecting them [50]. This was the first systematic attempt to correlate chemical and biological information concerning known poisons and was unique in combining the use of postmortem examination with analytical chemistry [13,51].

As the leading medicolegal expert of his time, Orfila made considerable contributions to legal (forensic) medicine. He made the important discovery that poisons are absorbed from the gastrointestinal tract and then accumulate in tissues specific to each poison, a finding that did much to further the progress of forensic toxicology. Previously, a chemist or a physician who found nothing in the stomach would not have troubled to examine the other organs of the body [34]. In Britain, the development of forensic toxicology was stimulated by the work of one of Orfila's pupils, (Sir) Robert Christison (1797–1882), a native of Edinburgh who became professor of medical jurisprudence and of materia medica at the university there. His *A Treatise on Poisons in relation to medical jurisprudence, physiology and the practice of physic* (Edinburgh: A. Black, 1829) was the first textbook of its kind to be written in English. He regarded toxicology as the principal branch of medical jurisprudence, its object being to unite evidence from four sources (pathology, chemistry, physiology, and visible symptoms) in order to detect crime [52].

The works of Orfila and Christison, which were widely read and translated, laid the foundation for the development of forensic toxicology during the nineteenth century. At a time when arsenic was easily available and widely used in criminal poisonings, Orfila was the first (1839) to extract it from human organs other than gastrointestinal tissue; in 1840, his analysis of organ samples resulted in the conviction of Marie Lafarge for the murder of her husband. The method used was a variation of that devised by James Marsh (1794–1846) in 1836, which was based upon Scheele's discovery (1775) that when zinc and acid act on arsenic salts, a gaseous compound (arsine) is evolved, that, when burned, deposits metallic arsenic. This test, which gave only qualitative results, marked the beginning of important stages in the development of chemical toxicology [53]. A modification introduced by Berzelius in 1837 allowed quantitative evaluation by ensuring that the mirrors of arsenic formed by reduction were deposited in a glass tube. The device that he used became known as the Marsh-Berzelius apparatus. A further refinement was made in 1841 by Hugo Reinsch, who deposited arsenic on copper foil from solutions of hydrochloric acid; the test was useful for its easy manipulation and quick results [54]. Three years later, Fresenius and von Babo devised a method for the systematic search for all mineral poisons, using wet ashing with chlorine (a technique described by Duflos in 1838) [6,35]. The first quantitative determination of metals in organs began about 1850, when they were weighed as a sulphate or oxide; electrolytic deposition was introduced in 1862.

New and precise methods of chemical analysis permitted the isolation of the major alkaloids from crude drug preparations [55]. By 1833, aconitine, atropine, codeine, hyoscyamine, morphine, nicotine, and strychnine had been isolated from plants by methods which were later (1850) modified by the Belgian chemist J. S. Stas (1813–1891) to achieve their isolation from human tissue samples. His process was adapted by F. J. Otto in 1856, who was able to obtain a purer alkaloidal residue and to remove more organic impurities. The modification became known as the Stas-Otto method. In 1874, Selmi discovered the first cadaveric alkaloid, a morphine-like ptomaine. Color tests for alkaloids were developed between 1861 and 1882; by 1890 quantitative methods for analyzing them had come into use. Physiological tests for alkaloids, particularly strychnine, were first used in 1856 and continued to be recommended well into the twentieth century [56]. Tests for alcohol were devised by Lieben (iodoform crystal test, 1870) and others (chromic acid reduction method, 1852–1883), and later perfected to allow the quantitative analysis of alcohol in body fluids and tissues. Qualitative tests for carbon monoxide in the blood originated in the work of Hoppe Seyler (spectroscopic), Salkowski (alkali), and Stopczanski (dilution and tan-

nic acid precipitation) between 1865 and 1889. In 1880, Fodor's palladium chloride reduction method allowed the quantitation of carbon monoxide in blood [6,35,53].

Textbooks of forensic medicine and toxicology proliferated throughout the nineteenth century. In Britain, the work of Christison was complemented by that of Alfred Swaine Taylor (1806–1880), an eminent medicolegal expert who wrote extensively on medical jurisprudence and toxicology. His books, which were based on his own experiences and incorporated legal precedents and judicial rulings, became standard texts which passed through numerous editions; the most recent (the thirteenth edition of *A Manual of Medical Jurisprudence*) appeared in 1984 [57]. A. W. Blyth's *Poisons: Their Effects and Detection* (1884) represented a valuable addition to the literature on analytical toxicology. In the United States, the first book pertaining to the symptoms and treatment of poisoning appeared in 1848: *A Practical Treatise on Poisons*, by O. H. Costill. In 1867, Theodore Wormley (1826–1897) published the first American text devoted exclusively to the experimental detection of poisons in organic mixtures, *The Micro-chemistry of Poisons*, which included the results of his original research. Within a few years, the professor of medical jurisprudence at the University of Pennsylvania, John Reese, produced a similar book (*Manual of Toxicology*, 1874), which he followed up a decade later with *A Text Book of Medical Jurisprudence and Toxicology* (1884) [13,18,35]. During the later decades of the nineteenth century and those of the early twentieth century, a great amount of toxicological data was presented in the thorough textbooks of German scientists, particularly Kobert (*Compendium der praktischen Toxikologie*, 1887) and Lewin (*Gifte und Vergiftungen*, 1929) [58]. The latter is today especially remembered as the author of a toxicologist's view of world history: *Die Gifte in der Weltgeschichte* (1920).

The early part of the twentieth century is generally considered to mark the beginning of the development of the modern science of toxicology. However, the most rapid growth of the discipline occurred after the Second World War, as the production of organic molecules for use as drugs, pesticides, and industrial chemicals began to increase at an exponential rate [59]. Today, toxicology is concerned with the many chemicals (there are now about 100,000 substances to which people could be exposed) that may be responsible for household, environmental, or industrial poisoning. While forensic and analytical toxicology continue to occupy an important position within the wider discipline, more and more attention has in recent years been paid to the biochemistry of toxin action, in an attempt to develop specific chemical antidotes. Modern toxicology utilizes skills and knowledge derived from pathology, pharmacology, physiology, biochemistry, chemistry, and statistics in order to study the quantitative effects of chemicals on living tissue [60,61].

Research on anesthetic gases during the nineteenth century facilitated the development and use of poisonous war gases in the twentieth [45]. Consequently, attempts to counteract the effects of chemical warfare agents and other toxic compounds—particularly arsenicals, introduced by Paul Ehrlich (1854–1915) for the treatment of syphilis—stimulated toxicological research after the First World War. This resulted in the synthesis of the first specific chemical antidote, British anti-Lewisite (BAL), which was developed in 1945 by R. A. Peters, L. A. Stocken, and R. H. S. Thompson in Oxford. In a related development, the mechanistic studies which led to a better understanding of how chemicals exert toxic effects proved to be the basis for the synthesis of effective insecticides. During the 1940s, the Swiss chemist Paul Müller discovered a compound, now known as DDT, that poisons insects when they come into direct contact with it. Some of the organophosphorus compounds developed for use as insecticides by Willy Lange and Gerhard Schrader during the 1930s and 1940s were so toxic that they are now classed as chemical warfare agents [58,62].

With the use of increasingly powerful drugs and chemicals in the workplace and in therapeutics, it became clear that toxicology had an important role to play in public health: workers and consumers required protection from the adverse effects of chemical exposure, from food additives, and from other potentially toxic products. In Britain, the systematic application of scientific techniques to the detection and control of food and drug adulteration arose largely as a result of the work of the Society of Public Analysts, founded in 1874 [63]. In the United States, concerns about adulteration were subject to congressional consideration for some three decades before the first American Food and Drug Act was passed in 1906 [64]. This law was created under the impetus of H. W. Wiley (1844–1930), the head of the Bureau of Chemistry of the U.S. Department of Agriculture, and later influenced food safety legislation worldwide [13]. There have since been a series of laws established, in the United States and elsewhere, that are designed to minimize public and, more recently, environmental encounters with harmful chemicals. Toxicologists are therefore required to provide accurate safety assessments when new chemicals of any kind are developed; the dose-response relationship for any adverse effect is particularly important [51].

The principal method used for assessing the safety of drugs, pesticides, food additives, and other chemicals prior to use is animal testing (bioassay), which

can usually reveal the worst possible effects of a new substance. The ''toxicology database'' is compiled by means of a set of ''testing protocol guidelines,'' which have been developed over the years [51]. However, the thalidomide catastrophe of 1961 showed what the possible shortcomings of the system may be: studies do not always establish the full toxicity of the test agent, and most risk-extrapolation models that use the results of animal tests cannot allow for the fact that the test and target species are biologically different. This is one of the reasons why there is now an increasing social disquiet in regard to animal testing requirements and animal welfare. These concerns have led to the development of alternative methods in toxicology, particularly *in vitro* assays [65], which are useful for prioritizing chemicals and for studying mechanisms of action. Such methods do not presently satisfy the standards set by regulatory authorities, but they do allow reductions in animal numbers [66]. [Note: *In vitro* protocols are beginning to make inroads into regulatory agency acceptance. A good place to find out more about alternatives to animal testing is Johns Hopkins' University's ALTWEB site (http://www.sph.jhu.edu/~altweb/).]

Modern toxicology may be divided into six principal areas of application: regulatory, occupational, environmental, clinical, forensic, and analytical [67]. In the United States, the eminent regulatory toxicologist Arnold J. Lehman (1900–1979) was instrumental in strengthening the commitment of the Food and Drug Administration (FDA) to toxicology. In 1955, he and his staff at the FDA published *Appraisal of the Safety of Chemicals in Foods, Drugs and Cosmetics,* the first attempt by the agency to provide guidelines for toxicological studies. Lehman's statement that ''anyone can become a toxicologist in two easy lessons, each of which takes ten years,'' has achieved the status of an adage among practicing scientists. Since then, significant contributions to the understanding of the mechanisms of action of various substances and to the establishing of safe exposure conditions (for humans and, where necessary, domestic and wild animals and plants) have been made by his successors at the FDA and other government agencies and by colleagues around the world [13].

Occupational and environmental toxicologists study and monitor the causes, conditions, effects, and safety limits of exposure to workplace and environmental contaminants [61]. In many instances, there are clear links between industrial and environmental toxins: lead, for example, has long been a focus of debate, together with other heavy metals [68]. During the nineteenth century, the use of arsenical insecticides led directly to the deaths of millions of bees and caused ill-health in humans and animals. This marked the beginning of public awareness of the fact that some substances can be beneficial in one way but harmful in another [69]. Similar problems occurred as a result of the introduction of DDT during the Second World War and after [70]. In 1962, the author of *Silent Spring,* Rachel Carson, touched off a heated debate about the links between industrialization and pollution when she claimed that 'we have put poisonous and biologically potent chemicals indiscriminately into the hands of persons largely or wholly ignorant of their potentials for harm' [71]. Although highly controversial, the book stimulated an organized approach to the study of chemical effects on ecosystems [72].

When cases of intoxication occur, the need for clinical toxicology becomes apparent: physicians are expected to make a correct diagnosis and implement appropriate treatment, which may involve delaying the absorption of the poison and/or enhancing its elimination [67]. Today, accidental and intentional self-poisoning contributes significantly to morbidity and mortality in many countries, most caused by household chemicals, drugs, pesticides, solvents, and carbon monoxide [73]. The establishing of poison control centers, the first of which opened in Chicago in 1953, has facilitated the compilation of information on the ingredients of pharmaceuticals and other industrial products and their toxicity, and has led to the creation of sophisticated information distribution systems. The ultimate aim is to quickly and accurately supply information to aid the diagnosis, treatment, and prevention of poisoning. Similar centers have been set up in many other countries [74].

Since poisons continue to be significant causes of death and disease, forensic and analytical toxicology remain important sciences. Both employ the same methods and techniques but apply them to different ends. Forensic toxicology is concerned with intentional and accidental poisonings in relation to the law, while analytical toxicology deals with the detection, identification, and measurement of poisons and their metabolites in biological specimens (often for the purposes of screening patients, employees, athletes, etc., for drugs of abuse). Before the advent of spectroscopic and chromatographic methods in the early 1950s, chemical techniques for separating and identifying the increasing number of organic drugs were time-consuming and lacking in sensitivity. A steady process of technological development has made it possible to conduct rapid tests for a variety of compounds: gas and high-performance liquid chromatography, together with immunoassay techniques, now allow quantitation of most organic drugs. The detection of toxic metals in cases of chronic poisoning is achieved by mass spectrometric, electrochemical, radiochemical, and spectro-

photometric methods; in acute cases, some chemical tests (e.g., Reinsch) remain relevant [6,35,75,76].

During the past 15 years or so, much of toxicology has been increasingly devoted to a quantitative assessment of the probable health risks posed by chemicals to which humans might be exposed. Society is no longer willing to defer appropriate control until serious injuries have appeared [77], and toxicological information is thus heavily relied upon by regulatory agencies responsible for prioritizing environmental health problems and policy [78]. Risk assessment and environmental regulations have, in effect, become the driving force behind how much of toxicology is now practiced in the United States. In the European Union, directives detail the requirements for toxicity and ecotoxicity testing necessary to comply with laws relating to the classification, packaging, and labeling of dangerous substances. Toxicity testing requirements are in fact remarkably similar across international boundaries (e.g., U.S., E.U. Japan, and Canada) [79].

Risk assessment is built upon a growing foundation of scientific knowledge that is mainly related to the recent advances made in our understanding of toxicology at the molecular level. This has followed directly upon the explosive growth of the science of molecular biology since methods for the sequencing of nucleic acids were developed in the mid-1970s. Together with biochemical (enzyme-oriented) approaches to the study of the metabolism of drugs and environmental toxicants, molecular toxicology has contributed to a better understanding of the nature, site, and mechanism of action of toxicants. Once the mechanism of toxicity of a compound is understood, it may be possible to design a replacement chemical that retains desirable properties but is less or nontoxic. The role played by genes in metabolic activation and detoxification constitutes another leading area of research in modern toxicology [80].

The development of toxicology as a recognized scientific discipline has thus proceeded at a rapid pace since the end of the Second World War, and its growth is likely to accelerate in the future. One of the most important consequences has been the establishing of training programs and the founding of scientific journals and societies. Graduate education in North America and Western Europe reflects the multidisciplinary nature of toxicology, as it is administered by a variety of university departments, including medicine (human and veterinary), pharmacy, pharmacology, chemistry, etc. The modern toxicologist is thus a specialist in one or more branches of the field, as it becomes increasingly difficult for one individual to be qualified in all aspects of the science [60,61]. This specialization is mirrored in the hundreds of national and international organizations and journals that are dedicated to toxicology and related subjects. Toxicologists remain united, however, in their ultimate objective, which is the reduction of morbidity and mortality that occurs in humans and other living systems as a result of exposure to toxic substances. As the numbers and variety of potentially toxic chemicals continue to expand, so too does the science of toxicology.

References

1. *The Oxford English Dictionary*, 2nd ed. (1989). Clarendon, Oxford, UK.
2. Stevenson, T. (1885). Poisons. In *Encyclopaedia Britannica*, 9th ed. **19,** 275–279.
3. Stevenson, L. G. (1959). *The Meaning of Poison*. Univ. of Kansas Press, Lawrence.
4. Gallo, M. A., and Doull, J. (1991). History and scope of toxicology. In *Casarett and Doull's Toxicology: The Basic Science of Poisons* (M. O. Amdur, J. Doull, and C. D. Klaassen, Eds.), 4th ed., pp. 3–11. Pergamon, Oxford, UK.
5. Smith, S. (1952). Poisons and poisoners through the ages. *Medico-Legal J.* **20,** 153–167.
6. Decker, W. J. (1987). Introduction and history. In *Toxicology* (T. J. Haley and W. O. Berndt, Eds.), pp. 1–19. Hemisphere, Washington, DC.
7. Bisset, N. G. (1989). Arrow and dart posions. *J. Ethnopharmacology* **25,** 1–41.
8. Paterson, W. F. (1996). A survey of arrow poisons. *Medi. Theme* **15,** 56–59.
9. Bisset, N. G. (1979). Arrow poisons in China. Part I. *J. Ethnopharmacology* **1,** 325–384.
10. Copley, A. L. and Boswell, H. (1944). Aconite the love poison. *Bull. Hist. Med.* **15,** 420–426.
11. Bisset, N. G. and Mazars, G. (1984). Arrow poisons in South Asia. Part I. Arrow poisons in ancient India. *J. Ethnopharmacology* **12,** 1–24.
12. Mann, R. D. (1984). *Modern Drug Use. An Enquiry on Historical Principles*. MTP Press, Lancaster, UK.
13. Borzelleca, J. F. (1994). History of toxicology. In *Principles and Methods of Toxicology* (A. W. Hayes, Ed.), 3rd ed., pp. 1–17. Raven Press, New York.
14. Nunn, J. F. (1996). *Ancient Egyptian Medicine*. British Museum Press, London.
15. Thompson, C. J. S. (1931). *Poisons and Poisoners. With Historical Accounts of Some Famous Mysteries in Ancient and Modern Times*. Harold Shaylor, London.
16. Touwaide, A. (1992). Studies in the history of medicine concerning toxicology after 1970. *Newsletter of the Soc. for Ancient Med.* **20,** 8–33.
17. Daugherty, C. G. (1995). The death of Socrates and the toxicology of hemlock. *J. Med. Biog.* **3,** 178–182.
18. Wax, P. M. (1994). Historical principles and perspectives. In *Goldfrank's Toxicologic Emergencies* (L. R. Goldfrank et al., Eds.), 5th ed., pp. 1–20. Appleton & Lange, East Norwalk.
19. Griffin, J. P. (1995). Mithridates VI of Pontus, the first experimental toxicologist. *Adverse Drug React. Tox. Rev.* **14,** 1–6.
20. Watson, G. (1966). *Theriac and Mithridatium: A Study in Therapeutics*. Wellcome Historical Medical Library, London.
21. Scarborough, J. (1977). Nicander's toxicology. I: Snakes. *Pharm. Hist.* **19,** 3–23.

22. Scarborough, J. (1979). Nicander's toxicology. II: Spiders, scorpions, insects and myriapods. *Pharm. Hist.* **21,** 3–34.
23. Touwaide, A. (1997). *Nicandro: Theriaca y Alexipharmaca,* Edición fac-simile del manoscrito griego Paris, BN, Suppl. Graecum 247. Moleiro Editor, Barcelona.
24. Knoefel, P. C., and Covi, M. C. (1991). *A Hellenistic Treatise on Poisonous Animals (the 'Theriaca' of Nicander of Colophon): A Contribution to the History of Toxicology.* Edwin Mellen Press, Lewiston, New York.
25. Touwaide, A. (1991). Les poisons dans le monde antique et byzantin: introduction à une analyse systémique. *Rev. d'Hist. Pharma.* **38,** 265–281.
26. Touwaide, A. (1984). L'authenticité et l'origine des deux traités de toxicologie attribués à Dioscoride. *Janus* **38,** 1–53.
27. Nriagu, J. O. (1983). *Lead and Lead Poisoning in Antiquity.* Wiley, New York.
28. Scarborough, J. (1984). The myth of lead poisoning among the Romans: an essay review. *J. Hist. Med.* **39,** 469–475.
29. Waldron, H. A. (1973). Lead poisoning in the ancient world. *Med. Hist.* **17,** 391–399.
30. Touwaide, A. (1994). Galien et la toxicologie. In *Aufstieg und Niedergang der Römischer Welt, II. 37.2* (W. Haase, Ed.), pp. 1887–1986. De Gruyter Verlag, Berlin.
31. Ackerknecht, E. H. (1982). *A Short History of Medicine,* Revised ed. Johns Hopkins Univ. Press, Baltimore.
32. van Hooff, A. II. (1990). *From Autothanasia to Suicide: Self-killing in Classical Antiquity.* Routledge, London.
33. Livy (1948). History of Rome, VIII, 18. In *Livy (IV),* Loeb Classical Library (B. O. Foster, Ed.). William Heinemann, London.
34. Blyth, A. W., and Blyth, M. W. (1920). Introductory. In *Poisons: Their Effects and Detection,* 5th ed., pp. 1–16. Charles Griffin, London.
35. Niyogi, S. K. (1981). Historical overview of forensic toxicology. In *Introduction to Forensic Toxicology* (R. H. Cravey and R. C. Baselt, Eds.), pp. 7–24. Biomedical Publications, Davis, CA.
36. Levey, M. (1966). Medieval Arabic toxicology. The Book on Poisons of ibn Wahshiya and its relation to early Indian and Greek texts. *Trans. Am. Phil. Soc.* **56**(7), 5–130.
37. Moses Maimonides (1966). *Treatise on Poisons and Their Antidotes* (S. Muntner, Ed.) Lippincott, Philadelphia.
38. Brown, H. M. (1924). De Venenis of Petrus Abbonus. A translation of the Latin edition of 1498. *Ann. Med. Hist.* **6,** 25–53.
39. Anon. (1900). Poisons and poisoners: old and new. *Practitioner* **65,** 171–177, 297–301, 658–663.
40. Deichmann, W. B., Henschler, D., Holmstedt, B., and Keil, G. (1986). What is there that is not poison? A study of the Third Defense by Paracelsus. *Arch. Toxicol.* **58,** 207–213.
41. Hawgood, B. J. (1995). Abbé Felice Fontana (1730–1805): founder of modern toxinology. *Toxicon* **33,** 591–601.
42. Earles, M. P. (1962). Early scientific studies of drugs and poisons. *Pharm. J.* **188,** 47–51.
43. Earles, M. P. (1961). Early theories of the mode of action of drugs and poisons. *Ann. Sci.* **17,** 97–110.
44. Thomas, K. B. (1964). *Curare: Its History and Usage.* Pitman, London.
45. Leake, C. D. (1975). *An Historical Account of Pharmacology to the Twentieth Century.* Charles C. Thomas, Springfield, IL.
46. Parascandola, J. (1971). Structure-activity relationships: the early mirage. *Pharm. Hist.* **13,** 3–10.
47. Bynum, W. F. (1970). Chemical structure and pharmacological action: A chapter in the history of 19th century molecular pharmacology. *Bull. Hist. Med.* **44,** 518–538.
48. Macht, D. I. (1931). Louis Lewin: pharmacologist, toxicologist, medical historian. *Ann. Med. Hist.* **3,** 179–194.
49. Beeson, B. B. (1930). Orfila—pioneer toxicologist. *Ann. Med. Hist.* **2,** 68–70.
50. Dall'Olio, G., and Galzigna, L. (1993). Matheo Orfila, toxicologist and forensic physician. *Eur. J. Lab. Med.* **1,** 109–110.
51. Doull, J., and Bruce, M. C. (1986). Origin and scope of toxicology. In *Casarett and Doull's Toxicology: The Basic Science of Poisons* (C. D. Klaassen, M. O. Amdur, and J. Doull, Eds.), 3rd ed., pp. 3–10. Macmillan, New York.
52. Adam, H. M. (1990). Book of the quarter—A Treatise on Poisons, by Robert Christison. *Proc. R. Coll. Phys. Edin.* **20,** 215–226.
53. Gettler, A. O. (1956). The historical development of toxicology. *J. Forensic Sci.* **1,** 3–25.
54. Campbell, W. A. (1965, May). Some landmarks in the history of arsenic testing. *Chem. Britain,* 198–202.
55. Lesch, J. E. (1981). Conceptual change in an empirical science: the discovery of the first alkaloids. *Hist. Stud. Phys. Sci.* **11,** 305–328.
56. Willcox, W. (1938). Toxicology with reference to its criminal aspects. *West London Med. J.* **43,** 133–153.
57. Coley, N. G. (1991). Alfred Swaine Taylor, MD, FRS (1806–1880): forensic toxicologist. *Med. Hist.* **35,** 409–447.
58. Holmstedt, B., and Liljestrand, G. (1963). *Readings in Pharmacology.* Pergamon, Oxford, UK.
59. Gallo, M. A. (1988). Highlights in the history of toxicology. In *Information Resources in Toxicology* (P. Wexler, Ed.), 2nd ed., pp. 3–12. Elsevier, New York.
60. Oehme, F. W. (1970). The development of toxicology as a veterinary discipline in the United States. *Clinical Toxicol.* **3,** 211–220.
61. Loomis, T. A., and Hayes, A. W. (1996). *Loomis's Essentials of Toxicology,* 4th ed. Academic Press, San Diego.
62. Marrs, T. C. Maynard, R. L., and Sidell, F. R. (1996). *Chemical Warfare Agents: Toxicology and Treatment.* Wiley, New York.
63. Stieb, E. W. (1966). *Drug Adulteration: Detection and Control in Nineteenth-Century Britain.* Univ. of Wisconsin Press, Madison.
64. Young, J. H. (1989). *Pure Food: Securing the Federal Food and Drugs Act of 1906.* Princeton Univ. Press, Princeton, NJ.
65. Parascandola, J. (1991). Historical perspectives on in vitro toxicology. In *In Vitro Toxicology: Mechanisms and New Technology* (A. M. Goldberg, Ed.), pp. 87–96. Liebert, New York.
66. Anderson, D., and Russell, T. (1995). *The Status of Alternative Methods in Toxicology.* Royal Society of Chemistry, Cambridge, UK.
67. Trestrail, J. H. (1992). An Introduction to Toxicology. Unpublished manuscript.
68. Rosner, D., and Markowitz, G., Eds. (1987). *Dying for Work: Workers' Safety and Health in Twentieth-Century America.* Indiana Univ. Press, Bloomington.
69. Whorton, J. (1974). *Before Silent Spring: Pesticides and Public Health in Pre-DDT America.* Princeton Univ. Press, Princeton, NJ.
70. Dunlap, T. R. (1981). *DDT: Scientists, Citizens, and Public Policy.* Princeton Univ. Press, Princeton, NJ.
71. Carson, R. (1962). *Silent Spring.* Houghton Mifflin, Boston.
72. Marco, G. J. Hollingworth, R. M., and Durham, W. (Eds.) (1987). *Silent Spring Revisited.* American Chemical Society, Washington, DC.
73. Writer, J. V. (1993). Epidemiology and prevention. In *Handbook of Medical Toxicology* (P Viccellio, Ed.), pp. 3–11. Little, Brown, Boston.
74. Tichy, W. (1977). *Poisons: Antidotes and Anecdotes.* Sterling, New York.
75. Niyogi, S. K. (1980). Historic development of forensic toxicology in America up to 1978. *Am. J. Forensic Med. Pathol.* **1,** 249–264.
76. Flanagan, R. J., Widdop, B., Ramsey, J. D., and Loveland, M. (1988). Analytical toxicology. *Human Toxicol.* **7,** 489–502.

77. Lu, F. C. (1996). *Basic Toxicology: Fundamentals, Target Organs, and Risk Assessment*, 3rd ed. Taylor & Francis, Washington, DC.
78. Fan, A. M., and Chang, L. W., Eds. (1996). *Toxicology and Risk Assessment: Principles, Methods, and Applications*. Dekker, New York.
79. Woodward, K. N. (1996). Hazard identification, risk assessment, regulation and legislation. In *Toxicology: Principles and Applications* (R. J. M. Niesink, J. de Vries, and M. A. Hollinger, Eds.), pp. 414–443. CRC Press, Boca Raton, FL.
80. Josephy, P. D. (1997). *Molecular Toxicology*. Oxford Univ. Press, New York and Oxford, UK.

Key Figures and Documents

Papyrus Ebers (about 1550 BC).
B. Ebbell, Trans. (1937).
Levin & Munksgaard, Copenhagen.

Of the ancient Egyptian medical papyri, this is the longest and most complete. It consists, for the greater part, of recipes (many of which contain effective chemical substances) designed to treat various diseases and symptoms. The contents are much older than the date of writing and in later times were incorporated into the Greek materia medica, suggesting that this may be the first known pharmacopoeia.

Nicander of Colophon (second century BC).
The Poems and Poetical Fragments.
A. S. F. Gow, and A. F. Scholfield, Eds. and Trans. (1953).
Cambridge Univ. Press, Cambridge, UK.

Nicander was the author of two poems, *Theriaca* and *Alexipharmaca*, which provide the best cohesive sources for classical Greek toxicology. Both were based on the lost works of Apollodorus (third century BC), who wrote the first treatises devoted to the study of poisons. The *Theriaca* discusses the venoms and stings of snakes, spiders, scorpions, insects, lizards and fish, and suggests remedies (mainly herbal, with some derived from animals). The *Alexipharmaca* describes vegetable poisons such as aconite, hemlock, henbane, and arrow poison, plus some others (blister beetles, fungi, salamanders, white lead); effects and antidotes are suggested throughout.

Moses Maimonides (original in Arabic, 1198).
Treatise on Poisons and Their Antidotes.
F. Rosner, Ed. and Trans. (1984).
Maimonides Research Institute, Haifa.

The text is divided into an introduction (which praises the author's patron, the Visier Al Fadhil) and two main sections. The first section deals with the bites of snakes and mad dogs and the stings of scorpions, bees, wasps, and spiders, with suggested treatment and remedies. The second section describes vegetable and mineral poisons and their antidotes. This treatise was translated into a number of languages soon after its appearance and served as a textbook of toxicology during the Middle Ages.

Georgius Agricola (original in Latin, 1556).
De Re Metallica.
H. C. Hoover and L. H. Hoover, Trans. (1912).
Mining Magazine, London. A new edition was published in 1950 (Dover, New York).

At the time of its publication, this was the most exhaustive textbook ever written on mining and metallurgy, as well as on the workers in these fields. Entirely based on personal experience and observation, the book devotes a short section to the maladies of miners (Book 6, pp. 214–217): 'some affect the joints, others attack the lungs, some the eyes, and finally some are fatal to men.' The author recognized that arsenical poisoning can occur in shafts where the rock had been broken by fire and described the 'pernicious pests' (insects and 'demons') that inhabited mines.

Paracelsus (original in German, 1567).
On the miners' sickness and other miners' diseases (G. Rosen, Trans.).
In ***Four Treatises of Theophrastus von Hohenheim Called Paracelsus*** (1941).
(H. E. Sigerist, Ed.), pp. 43–126 John Hopkins Press, Baltimore, MD. A new edition was published in 1979 (Arno Press, New York).

Written in the 1530s but not published until long after the author's death, this monograph is entirely devoted to the occupational diseases of miners, particularly pulmonary ailments and mercury poisoning. The poisonous effects of various metals and the difference between acute and chronic toxicity are recognized. Influenced by his experience of mining and miners, Paracelsus developed generalized ideas about pathology and etiology which he used to explain the facts that he observed and the therapeutic remedies that he advocated.

Bernardino Ramazzini (original (2nd ed.) in Latin, 1713).
De Morbis Artificum Diatriba.
W. C. Wright, Trans. (1940).
Univ. of Chicago Press, Chicago.

Ramazzini is regarded as the father of occupational medicine. His treatise describes the diseases of, among others, miners, gilders, chemists, tinsmiths, painters, sulfur-workers, mirror-makers, apothecaries, and tobacco-workers, and suggests methods of prevention and some remedies. He classified diseases as being caused firstly by the injurious character of the materials

handled by workers, which emit noxious vapours; secondly, by unnatural postures of the body. Ramazzini was the first to recommend that physicians should enquire first of all as to a new patient's occupation.

Percival Pott (1775).
Cancer Scroti in Chirurgical Observations Relative to the Cataract, the Polypus of the Nose, the Cancer of the Scrotum, the Different Kinds of Ruptures, and the Mortification of the Toes and Feet.
Hawes, Clark, and Collins, London.

Pott linked the occupation of chimney sweeps with cancer of the scrotum. This observation that chimney sweeps in 18th century England suffered from a higher than expected incidence of scrotal cancer is a landmark in occupational disease, carcinogenesis, and epidemiology. ''. . . every body is acquainted with the disorders to which painters, plummers, glaziers, and the workers in white lead, are liable: but there is a disease as peculiar to a certain set of people which has not, at least to my knowledge, been publickly noticed; I mean the chimney-sweepers' cancer.''

Felice Fontana (original in French, 1781).
Treatise on the Venom of the Viper; on the American Poisons; and on the Cherry Laurel and some other Vegetable Poisons.
J. Skinner, Trans. (1787). J. Murray, London.

This is considered the first modern text of toxinology. Fontana identified fundamental questions and followed a rigorous experimental method in his research on the venom of the European viper, and he also studied curare and cherry laurel (hydrocyanic acid). He made important contributions to the fields of physiology, pharmacology, botany, chemistry, and anatomy.

François Magendie (and A. Raffeneau-Delile) (1809). Examen de l'action de quelques végétaux sur la moelle épinière.
***Nouveau Bulletin Scientifique de la Société Philomatique* 1,** 368–405.

In a series of experiments on various animals, Magendie studied the toxic action of upas tieuté, nux vomica, St. Ignatius's bean, and other drugs of vegetable origin, thus marking the beginning of modern experimental pharmacology. He was able to show that upas and nux vomica (later shown to contain strychnine, a fact he had suspected) act on the spinal marrow, and was therefore able to conclude that drugs and poisons act solely by direct contact with target organs. Physiologists were thereby stimulated to further study the absorption and transport of drugs and poisons in living organisms.

M. J. B. Orfila (original in French, 1814–1815).
A General System of Toxicology or, a Treatise on Poisons, Drawn from the Mineral, Vegetable, and Animal Kingdoms, Considered as to Their Relations with Physiology, Pathology and Medical Jurisprudence.
J. A. Waller, Trans. (1816–1817).
E. Cox, London. First American edition 1817. M. Carey & Son, Philadelphia.

This is the earliest comprehensive treatise on toxicology and the first in which a systematic attempt was made to correlate chemical and biological information for all known poisons. The book is arranged by class of poison, of which there are six: acrid, corrosive, astringent, stupifying, narcotico-acrid, and septic (Orfila later reduced these to four). The principal poisons of each class are characterized in terms of physical and chemical properties, physiological action, general symptoms, and methods of treatment. Numerous experimental and case studies are described. The book was intended for use by physicians called to give assistance to persons poisoned and by experts called by a court of law to decide whether poisoning had taken place and if so, by what substance.

Robert Christison (1829).
A Treatise on Poisons, in Relation to Medical Jurisprudence, Physiology, and the Practice of Physic.
Adam Black, Edinburgh.

This is the first original and systematic English-language textbook of toxicology of the nineteenth century. Drawing together information gathered from French, German, and British periodicals, Christison intended his book to be an aid to the medical jurist who was faced with a case of suspected poisoning. He focused primarily on poisons commonly encountered in Britain and detailed the facts relating to their symptoms, pathology, physiology, and chemistry. His work contained many novel elements, including the idea that in many cases the aim must be to establish clearly the impossibility of poisoning.

Claude Bernard (and J. Pelouze) (1850). Recherches sur le curare.
***Comptes Rendus Hebdomadaires de l'Académie des Sciences* 31,** 533–537.

Bernard and Pelouze studied the chemical and physical properties of curare and found that it kills without producing convulsions. They were able to explain the fact that the poison is relatively harmless when swallowed but fatal when injected by showing that the gastrointestinal mucus membrane does not permit its absorption into the bloodstream. They noted that the

mode of action of curare is analagous to that of viper venom (cf. Fontana).

Claude Bernard (1857).
Leçons sur les Effets des Substances Toxiques et Médicamenteuses.
Ballière, Paris.

Bernard used poisons as physiological instruments for the experimental study of the anatomical properties and functions of living organisms. This book considers the effects of, among others, nicotine, curare, potassium thiocyanate, carbon dioxide, carbon monoxide, and strychnine.

Louis Lewin. (1929).
Gifte und Vergiftungen.
Stilke, Berlin.

In a single volume of nearly 1100 pages, Lewin summarized his own wide-ranging research and that of others in the field of toxicology. His diverse interests allowed him to address the study of poisons and poisoning from an interdisciplinary point of view: he considered the historical, statistical, pharmacological, clinical, pathological, and sociological aspects of his subject. Toxicology is today a multi-disciplinary field that attempts to extend this approach to scientific research.

E. G. C. Clarke, Ed. (1969 and 1975).
Isolation and Identification of Drugs in Pharmaceuticals, Body Fluids and Post-mortem Material, 2 vols.
Pharmaceutical Press, London.

This book provides a reliable source of analytical data for drugs and other potentially poisonous substances, and it has therefore become a standard reference text for those concerned with the identification of poisons. Methods and techniques relevant to a wide variety of situations are included, so that the book is equally useful to forensic toxicologists, hospital biochemists, research workers, chemists, etc. Instructions for the use of the book are given in four languages and indicate the screening procedure to be followed when: the case is an emergency; there is evidence of the identity of the drug under investigation; there is no clue to the identity of the drug.

SELECTED REFERENCES IN THE HISTORY OF TOXICOLOGY

PHILIP WEXLER

Note: The following articles are in a variety of languages.

Abrahamson, S. (1996). Lauriston Taylor lecture. 70 years of radiation genetics: fruit flies, mice and humans. *Health Phys.* **71**(5), 624–633.

Alden, C. L. (1997). Commemoration of the silver anniversary of Toxicologic Pathology and the Society of Toxicologic Pathologists [editorial]. *Toxicol. Pathol.* **25**(4), 421.

Aldrich, F. D. (1998). Looking back. *J. Toxicol. Clin. Toxicol.* **36,** 397–398.

Amberger-Lahrmann, M. (1991). Poisons history of toxicology. *Med. Welt.* **42**(6), 455–458.

Annas, G. J., and Elias, S. (1999). Thalidomide and the Titanic: reconstructing the technology tragedies of the twentieth century. *Am. J. Public Health* **89**(1), 98–101.

Anonymous (1998). 30 years ago in clinical toxicology. *J. Toxicol. Clin. Toxicol.* **36**(5), 393–396.

Anonymous (1998). Clair Patterson's influence on environmental research. *Environ. Res.* **78**(2), 65–185.

Anonymous. Environmental dermatology. Festschrift for H. R. H. Crown Prince El-Hassan bin Talal. *Clin. Dermatol.* **16**(1), 1–184.

Arrese Estrada, J., and Pierard, G. E. (1990). History of medicine. Poisons and pre-Columbian and traditional American Indian remedies. *Rev. Med. Liege* **45**(7), 343–347.

Astler, A. (1997). The French matches or the singular history of poisonings by the whit phosphorus. *Rev. Hist. Phar.* (*Paris*) **45**(316), 385–394.

Axelson, O. (1997). Some historical notes and remarks on prevention in environmental and occupational health. *Int. J. Med. Environ. Health* **10**(4), 339–347.

Azcue, J. M., and Nriagu, J. O. (1994). Arsenic: Historical perspectives. In *Advances in Environmental Science and Technology, Vol. 26. Arsenic in the Environment. Part I: Cycling and Characterization.* (J. O. Nriagu, Ed.), pp.1–15. Wiley, New York.

Bajgar, J., and Fusek, J. (1997). The history of military toxicology. *Acta Med.* (*Hradec Kralove*) **40**(3), 79–82.

Beale, G. (1993). The discovery of mustard gas mutagenesis by Auerbach and Robson in 1941. *Genetics* **134**(2), 393–399.

Bedrossian, C. W. (1992). Asbestos-related diseases: a historical and mineralogic perspective. *Sem. Diagn. Pathol.* **9**(2), 91–96.

Bellinger, D. C., and Matthews, J. A. (1998). Social and economic dimensions of environmental policy: Lead poisoning as a case study. *Perspect. Biol. Med.* **41**(3), 307–326.

Bisetti, A. A. (1988). Bernardino Ramazzini and occupational lung medicine. *Ann. N.Y. Acad. Med.* **534,** 1029–1037.

Bisset, N. G., and Mazars, G. (1984). Arrow poisons in south Asia. Part 1. Arrow poisons in ancient India. *J. Ethnopharmacol.* **12**(1), 1–24.

Bisset, N. G. (1989). Arrow and dart poisons. *J. Ethnopharmacol.* **25**(1), 1–41.

Boren, S., and Erickson, T. B. (1998). Toxicological deaths of major league baseball players. *J. Toxicol. Clin. Toxicol.* **36**(7), 737–742.

Borron, S.W., *et al.* (1997). An early study of pulmonary asbestosis among manufacturing workers: original data and reconstruction of the 1932 cohort. *Am. J. Ind. Med.* **31**(3), 324–334.

Borzelleca, J. F. (1994). History of toxicology. In *Principles and Methods of Toxicology,* (A. W. Hayes, Ed.), 3rd ed., pp. 1–17. New York, Raven Press.

Brandt-Rauf, P. W., and Brandt-Rauf, S. I. (1987). History of occupational medicine: relevance of Imhotep and the Edwin Smith papyrus. *Br. J. Ind. Med.* **44**(1), 68–70.

Brown, R. H. (1984). The development of methods for the determination of hazardous substances in factory atmsopheres: an historical perspective. *Ann. Occup. Hygiene* **28**(2), 183–188.

Brownstein, S. (1997). George III: a revised view of the royal malady. *J. Hist. Neurosci.* **6**(1), 38–49.

Campbell, W. A. (1981). The history of the chemical detection of poisons. *Med. Hist.* **25**(2), 202–203.

Chun, L. T. (1998). Accidental poisoning in children with special reference to kerosene poisoning [classical article, 1951]. *Hawaii Med. J.* **57**(3), 433–436.

Clarkson, T. W. (1997). The toxicology of mercury. *Crit. Rev. Clin. Lab. Sci.* **34**(4), 369–403.

Comstock, E. G. (1998). Roots and circles in medical toxicology: A personal reminiscence. *J. Toxicol. Clin. Toxicol.* **36**(5), 401–407.

Costa, L. G. (1987). Toxicology of pesticides: a brief history. In *NATO Asi (Advance Science Institute) Series, Series H: Cell Biology, Vol. 13. Toxicology of Pesticides: Experimental, Clinical and Regulatory Perspectives; Meeting, Riva del Garda, Italy, October 6–15, 1986*. (L. G. Costa, C. L. Galli, and S. D. Murphy, Eds.), pp. 1–10. Springer-Verlag, New York.

Cherniack, M. G. (1992). Diseases of unusual occupations: an historical perspective. *Occup. Med.* **7**(3), 369–384.

Clarke, C. (1987). Physicians, reformers and occupational disease: The discovery of radium poisoning. *Women Health* **12**(2), 147–167.

Coley, N. G. (1991). Alfred Swaine Taylor, MD, (1806–1880): Forensic toxicologist. *Med. Hist.* **35**(4), 409–427.

Comstock, E. G. (1998). Roots and circles in medical toxicology: A personal reminiscence. *J. Toxicol. Clin. Toxicol.* **36,** 401–407.

Coppes-Zantinga, A. R., and Coppes, M. J. (1998). The early years of radiation protection: A tribute to Madame Curie. *CMAJ* **159**(11), 1389–1391.

Craven, S. A. (1997). Georgius Agricola: 1494–1555—Mining engineer and physician. His contribution to occupational medicine and the aetiology of bronchus carcinoma. *South African Med. J.* **87**(5), 611–612.

Davies, M. L., and Davies, T. A. (1994). Hemlock: murder before the Lord. *Med. Sci. Law* **34**(4), 331–333.

Davis, A. P., and Justice, M. J. (1998). An Oak Ridge legacy: The specific locus test and its role in mouse mutagenesis. *Genetics* **148**(1), 7–12.

Decker, W. J. (1987). Introduction and history. In *Handbook of Toxicology* (T. J. Haley and W. O. Berndt, Eds.), pp. 1–19. Hemisphere, New York.

Deichmann, W. B., Henschler, D., Holmsted, B., and Keil, G. (1986). What is there that is not poison? A study of the Third Defense by Paracelsus. *Arch. Toxicol.* **58**(4), 207–213.

Dickerson, R. N. (1997). Di(2-ethylhexyl)phthalate as a plasticizer for intravenous bags and tubing: A toxicological quandary. *Nutrition* **13**(1112), 1010–1012.

Dow, M. I. (1994). Worker exposure studies. *Quality Assurance* **3**(3), 275–278.

Drake, J. W. (1994). Looking backward on a century of mutation research. *Environ. Mol. Mutagen.* **23**(Suppl. 24), 11–14.

Durbin, P. W. (1995). Human radiation studies: Remembering the early years: Oral history of Dr. Patricia Wallace Durbin, Ph.D. [micofiche]. U.S. Department of Energy, Office of Human Radiation Experiments, Washington, DC.

Eckert, W. G. (1981). Historical aspects of poisoning and toxicology. *Am. J. Forensic Med. Pathol.* **2**(3), 261–284.

Ericson, J. E., and Coughlin, E. A. (1981). Archaeological toxicology. *Ann. N.Y. Acad. Sci.* **376,** 393–403.

Evans, P. J. (1998). All the mice died. A pioneering experiment in air purification in the Royal Navy. *J. R. Nav. Med. Serv.* **84**(1), 38–46.

Faden, R. R. *et al.* (1996). US medical researchers, the Nuremburg Doctors Trial, and the Nuremberg Code. A review of findings of the Advisory Committee on Human Radiation Experiments. *JAMA* **276**(2), 1667–1671.

Felton, J. S. (1997). The heritage of Bernardino Ramazzini. *Occup. Med.* (*Oxford*), **47**(3), 167–179.

Flegal, A. R. (1998). Clair Patterson's influence on environmental research. *Environ. Res.* **78**(2), 64–70.

Gallo, M. A. (1988). Highlights in the history of toxicology. In *Information Resources in Toxicology,* 2nd ed., pp. 3–8. Elsevier, New York.

Gallo, M. A. (1996). History and Scope of toxicology. In *Casarett and Doull's Toxicology,* 5th ed, pp. 3–11. McGraw-Hill, New York.

Gillen, H. W. (1995). Occupational neurotoxicity and movement disorders: A historical perspective. *J. Hist. Neurosci.* **4**(1), 63–66.

Glaze, W. H. (1993). An historical perspective on environmental mass spectrometry. 205th ACS (American Chemical Society) National Meeting, Denver, Colorado, USA, March 28–April 2, 1993. *Abstr. Pap. Am. Chem. Soc.* **205**(1–2), Anayl 62.

Goldmann, S. (1990). Occupational satire in Bernardino Ramazzini's 'De Morbis Artificum Diatriba.' *Sudhoffs Arch. Z. Wissenschaftsgesch,* **74**(1), 1–21.

Gonzalez Luque, F. J., and Montejo Gonzalez, A. L. (1997). Implication of lead poisoning in psychopathology of Vincent van Gogh. *Actas Luso. Esp. Neurol. Psiquiatr. Cieno Afines* **25**(5), 309–326.

Gorman, S., and Kaplan, D. L. (1999). The affliction of Job: poisoned! *J. Am. Acad. Dermatol.* **40**(1), 126–128.

Graham, J. D. (1995). Historical perspective on risk assessment in the federal government. *Toxicology* **102**(1–2), 29–52.

Greenberg, M., and Selikoff, I. J. (1993). Lung cancer in the Schneeberg mines: a reappraisal of the data reported by Harting and Hesse in 1879. *Ann. Occup. Hygiene* **37**(1), 5–14.

Griffin, J. P. (1993). Famous names in toxicology. Claude Bernard 1813–1878. *Adverse Drug React. Toxicol. Rev.* **12**(4), 213–214.

Griffin, J. P. (1995). Famous names in toxicology. Methridates VI of Pontus, the first experimental toxicologist. *Adverse Drug React. Toxicol. Rev.* **14**(1), 1–6.

Griffin, J. P. (1996). Famous names in toxicology. Sir George Baker and the ''Devonshire colic.'' *Adverse Drug React. Toxicol. Rev.* **15**(1), 1–3.

Guengerich, F. P. (1999). The Vanderbilt University Center in Molecular Toxicology: the first 30 years. *Drug Metab. Rev.* **31**(1), 1–11.

Gunther, H. J. (1991). Autopsy of count Jakob 3d of Baden. The earliest forensic medicine case of the Freiburg University in 1590. *Beitr. Gerichtl. Med.* **49,** 297–305.

Haeublein, H. G. (1982). Early studies of miners and smelters. *Am. J. Ind. Med.* **3**(3), 357–358.

Haines, J. D. (1998). Absinthe—return of the green fairy. *J. Okla. State Med. Assoc.* **91**(7), 406–407.

Hamilton, A. (1985). Forty years in the poisonous trades [Landmark article in occupational medicine, April 1948]. *Am. J. Ind. Med.* **7**(1), 3–18.

Hanninen, H. (1985). Twenty-five years of behavioral toxicology within occupational medicine: a personal account. *Am. J. Ind. Med.* **7**(1), 19–30.

Harding, L. K. (1997). Radiation protection—Lessons from the past. *Br. J. Radiol.* **70**(Suppl.), S10–S16.

Harrington, J. M. (1999). 1998 and beyond—Legge's legacy to modern occupational health. *Ann. Occup. Hyg.* **43**(1), 1–6.

Harrison, B. (1996). *Not Only the ''Dangerous Trades.'' Women's Work and Health in Britain, 1880–1914.* [Feminist perspectives on the past and present]. Taylor & Francis, London.

Hawgood, B. J. (1995). Abbe Felice Fontana (1740–1805): Founder of modern toxicology. *Toxicon* **33**(5), 591–601.

Hawgood, B. J. (1996). Sir Joseph Fayrer MD FRS (1824–1907) Indian Medical Service: snakebite and mortality in British India. *Toxicon* **34**(2), 171–182.

Hayes, H. W. (1986). *Society of Toxicology History 1961–1986*. Society of Toxicology, Reston, VA. [Available from the Society in Reston, VA. Phone: 703-438-3115. E-mail: sothq@toxicology.org.]

Huxtable, R. J. (1998). Safety of botanicals: historical perspective [editorial]. *Proc. West. Pharmacol. Soc.* **41,** 1–10.

Hyson, J. M., Jr. (1997). Mercury poisoning with tooth loss: an 1813 case report. *J. Hist. Dent.* **45**(1), 27–28.

Infante, P. F., and Pesak, J. (1994). A historical perspective of some occupationally related diseases of women. *J. Occup. Med.* **36**(8), 826–831.

Izmerov, N. F. (1997). 75th anniversary of the journal Occupational Medicine—Occupational Medicine and Industrial Ecology. *Med. Tr. Prom. Ekol.* **1,** 1–8.

Johnson, G. (1998). Lithium—Early development, toxicity, and renal function. *Neuropsychopharmacology* **19**(3), 200–205.

Kantha, S. S. (1997). Could nitroglycerine poisoning be the cause of Alfred Nobel's anginal pains and premature death? *Med. Hypotheses* **49**(4), 303–306.

Kirchmann, R. U. (1998). Historical overview of the project ''Sunshine'' in Belgium. *Radiats. Biol. Radioecol.* **38**(4), 624–630.

Knight, J. A. (1998). Free radicals: their history and current status in aging and disease. *Ann. Clin. Lab. Sci.* **28**(6), 331–346.

Kyle, R. A., and Shampo, M. A. (1997). Alice Hamilton—Pioneer in industrial medicine. *Mayo Clinic Proc.* **72**(8), 726.

Lascaratos, J. G., and Marketos, S. G. (1998). The carbon monoxide poisoning of two Byzantine emperors. *J. Toxicol. Clin. Toxicol.* **36**(12), 103–107.

Lederberg, J. (1997). Some early stirrings (1950 ff.) Of concern about environmental mutagens. *Environ. Mol. Mutagen* **30**(1), 3–10.

Lee, M. R. (1998). The yew tree (taxus baccata) in mythology and medicine. *Proc. R. Coll. Physicians Edinb.* **28**(4), 569–575.

Lessler, M. A. (1988). Lead and lead poisoning from antiquity to modern times. *Ohio J. Sci.* **88**(3), 78–84.

Lucas, S. (1998). Wolfgang Bucherl, early toxinologist. *Toxicon* **36**(12), 2047–2051.

MacFarland, H. (1998). History of toxicology In *Encyclopedia of Toxicology* (P. Wexler, Ed.), pp. 347–354. Academic Press, San Diego.

Maehle, A. H. (1986). Scientific and moral justification of toxicologic animal trials in the 17th century. Johann Jakob Wepfer and Johan Jakob Harder. *Gesnerus* **43**(34), 213–221.

Mashkovskii, M. D. (1988). 50th anniversary of the journal Farmakologiia I toksikologiia. *Farmakol. Toksikol.* **51**(6), 5–16.

McConnell, F. E. (1995). Historical review of the rodent bioassay and future directions. *Regul. Toxicol. Pharmacol.* **21**(1), 38–43.

McDonald, J. C. and McDonald, A. D. (1996). The epidemiology of mesothelioma in historical context. *Eur. Respir. J.* **9**(9), 1932–1942.

Mehlman, M. A. (1998). Henry Spira (1927–1998). An advocate for animal rights: a 20th century man of la mancha. *Toxicol. Ind. Health* **14**(6), 783–787.

Mertz, W. (1998). Chromium research from a distance: from 1959 to 1980. *J. Am. Coll. Nutr.* **17**(6), 544–547.

Miles, D. (1997). What are occupational diseases? Risk and risk management in industrial medicine in Germany, c. 1880–1920. *Clio Med.* **41,** 179–195.

Miller, C. S. (1994). White paper: Chemical sensitivity: History and phenomenology. *Toxicol. Ind. Health.* **10**(45), 253–276.

Miller, J. A. (1998). The metabolism of xenobiotics to reactive electrophiles in chemical carcinogenesis and mutagenesis: a collaboration with Elizabeth Cavert Miller and our associates. *Drug Metab. Rev.* **30**(4), 645–674.

Miller, M. R. (1998). Chronic obstructive pulmonary disease and '150 years of blowing'. *Hosp. Med.* **59**(9), 719–722.

Morton, W. S. (1998). Hawaii Poison Center: Forty years of saving lives and health costs. *Hawaii Med. J.* **57**(3), 440–442.

Moss, W. D. (1995). Human radiation studies: Remembering the early years: Oral history of biochemist William D. Moss [microfiche]. U.S. Department of Energy, Office of Human Radiation Experiments, Washington, DC.

Muller, J. (1998). Witch ointments and aphrodisiacs. A contribution to the cultural history of nightshade plants. *Gesnerus.* **55**(3–4), 205–220.

Muller, J. L. (1998). Love potions and the ointment of witches: Historical aspects of the nightshade alkaloids. *J. Toxicol. Clin. Toxicol.* **36**(6), 617–627.

Muller, R. K. (1983). Development of toxicological thought in the 19th century. *Z. Gesamt. Hyg.* **29**(6), 348–350.

Neal, R. A. (1996). A career in toxicology. *Annu. Rev. Pharmacol. Toxicol.* **36,** 34–46.

Needleman, H. L. (1998). Clair Patterson and Robert Kehoe: two views of lead toxicity. *Environ. Res.* **78**(2), 79–85.

Neel, J. V. (1998). Genetic studies at the Atomic Bomb Casualty Commission-Radiation Effects Research Foundation: 1946–1997. *Proc. Natl. Acad. Sci. USA* **95**(10), 5432–5436.

Nicholson, W. J. and Teirstein, A. S. (1994). Remembering Irving J. Selikoff. *Mt. Sinai J. Med.* **61**(6), 500–503.

Nriagu, J. O. (1983). Occupational exposure to lead in ancient times. *Sci. Total Environ.* **31**(2), 105–116.

Nriagu, J. O. (1998). Clair Patterson and Robert Kehoe's paradigm of ''show me the data'' on environmental lead poisoning. *Environ. Res.* **78**(2), 71–78.

Oser, B. L. (1987). Toxicology then and now. *Regul. Toxicol. Pharmacol.* **7**(4), 427–443.

Pabst, M., and Hofer, F. (1998). Deposits of different origin in the lungs of the 5,300-year-old Tyrolean Iceman. *Am. J. Phys. Antrhopol.* **107**(1), 1–12.

Packer, S. (1998). Jewish mystical movements and the European ergot epidemics. *Isr. J. Psychiatry Relat. Sci.* **35**(3), 227–239.

Parke, D. V. (1997). A history of drug metabolism in the United Kingdom. *Drug Metab. Rev.* **29**(3), 801–851.

Parke, D. V. (1996). Personal reflections on 50 years of study of benzene toxicology. *Environ. Health Perspect.* **104**(Suppl. 6), 1123–1128.

Petersen, D. F. (1995). Human radiation studies: Remembering the early years: Oral history of cell biologist Don Francis Petersen, Ph.D. [microfiche]. U.S. Department of Energy, Office of Human Radiation Experiments, Washington, DC.

Piegorsch, W. W. (1989). Quantification of toxic response and the development of the median effective dose (ED50)—a historical perspective. *Toxicol. Ind. Health.* **5**(1), 55–62.

Proctor, R. N. (1997). Wilhelm C. Hueper: Pioneer of environmental carcinogenesis. *Abh. Gesch. Med. Naturwiss.* **81,** 290–305.

Quick, J. C., *et al.* (1997). Creating healthier workplaces: The American Psychological Association/National Institute of Occupational Safety and Health cooperative agreement: Introduction and historical overview. *J. Occup. Health Psychol.* **2**(1), 3–6.

Ramazzini, B. (1990). De Moribis artificium diatriba (diseases of workers), 1713 [classical article]. *Allergy Proc.* **11**(1), 51–55, discussion 49–50.

Ratzan, R. M., and Ferngren, G. B. (1993). A Greek progymnasma on the physician-poisoner. *J. Hist. Med. Allied Sci.* **48**(2), 157–170.

Reynolds, R. C., and Chappel, C. I. (1998). Sucrose acetate isobutyrate (SAIB): Historical aspects of its use in beverages and a review of toxicity studies prior to 1988. *Food Chem. Toxicol.* **36**(2), 81–93.

Roe, F. J. (1998). A brief history of the use of laboratory animals for the prediction of carcinogenic risk for man with a note on needs for the future. *Exp. Toxicol. Pathol.* **50**(4–6), 271–276.

Roff, S. R. (1998). Puff the magic dragon: how our understanding of fallout, residual and induced radiation evolved over fifty years of nuclear weapons testing. *Med Confl. Surviv.* **14**(2), 106–119.

Rondeau Du Noyer, C. (1998). Le chemin historique de la sant'e au travail [The historical path of occupational health]. *Rev. Infirm.* **35,** 9–12.

Rutten, A. M., and Statius van Eps, L. W. (1998). Poisoning with toxic plants in Curacao in 1766. *Ned. Tijdschr. Geneeskd.* **142**(51), 2796–2798.

Sakula, A. (1983). Ramazzini's De Morbis Artificum and occupational lung disease. *Br. J. Dis. Chest* **77**(4), 349–361.

Sanotskii, I. V. (1967). Industrial toxicology during the 50 years of the Soviet regime. *Gig. Tr. Prof. Zabol.* **11**(11), 20–23.
Sanotskii, I. V. (1987). Main stages in the development of Soviet industrial toxicology. *Gig. Tr. Prof. Zabol.* **11,** 10–12.
Scheuer, P. J. (1966). Marine toxin research: An historical overview. *J. Nat. Toxins.* **5**(2), 181–189.
Schou, I. S. (1996). Cooperation of Nordic Pharmacological and Toxicological Societies: history and future perspectives. *Pharmacol. Toxicol.* **78**(6), 361–363.
Schull, W. J. (1998). The somatic effects of exposure to atomic radiation: the Japanese experience, 1947–1997. *Proc. Natl. Acad. Sci. USA* **95**(10), 5437–5341.
Schulze, R. H. (1993). The 20-year history of the evolution of air pollution control legislation in the USA. *Atmos. Environ. Part B Urban Atmos.* **27**(1), 15–22.
Schwartz, D. (1998). The risk in epidemiology and in public health: risk management. *Rev. Epidemiol. Sante Publique* **46**(6), 541–544.
Sellers, C. (1997). Discovering environmental cancer: Wilhelm Hueper, post-World War II epidemiology, and the vanishing clinician's eye. *Am. J. Public Health* **87**(11), 1824–1835.
Sherwood, R. J. (1994). Agricola revisited: Identification and control of hazards in the 16th century. *Am. Ind. Hygiene Assoc. J.* **55**(4), 305–307.
Skovenborg, E. (1995). Lead in wine through the ages. *J. Wine Res.* **6**(1), 49–64.
Slavec, Z. Z. (1998). Occupational medicine in Idria mercury mine in 18th century. *Vesalius* **4**(2), 51–59.
Smith, R. M. (1998). Signs of depth and danger. *Int. Anesthesiol. Clin.* **36**(4), 17–28.
Squire, R. A. (1997). A quarter century of Toxicologic Pathology: a personal perspective [editorial]. *Toxicol. Pathol.* **25**(4), 423–425.
Stitzel, R. E. (1999). Fifty years of Pharmacological Reviews: a historical perspective. *Pharmacol. Rev.* **51**(1), 3–6.
Tansey, T. (1993). The history of toxicology: the long and short of it [editorial]. *Hum. Exp. Toxicol.* **12**(6), 459–461.
Thoman, M. (1998). The American Academy of Toxicology a historic pediatric perspective. *J. Toxicol. Clin. Toxicol.* **36**(5), 399–400.
Thomas, A. A. (1986). The chemical frontier. *Aviation Space Environ. Med.* **57**(10, Pt.2), 49–53.
Thorpe, C. M., and Spence, A. A. (1997). Clinical evidence for delayed chloroform poisoning. *Br. J. Anaesth.* **79**(3), 402–409.
Toren, K., and Blanc, P. D. (1997). The history of pulp and paper bleaching: respiratory-health effects. *Lancet* **349**(9061), 1316–1318.
Touwaide, A. (1992). Studies in the history of medicine concerning toxicology after 1970. *Newslett. Soc. Anc. Med.* **20,** 8–33.
Truhaut, R. (1987). Orfila, the founder of toxicology. *Bull. Acad. Natl. Med.* **171**(4), 259–267.
Trump, B. F. (1997). A personal perspective on the past, present, and future of toxicologic pathology. *Toxicol. Pathol.* **25**(4), 426–428.
Uppenbrink, J. (1966). Arrhenius and global warming. *Science* **272**(5265), 1122.
Van Aken, H., Thomson, D., Smith, G., and Zorab, J. (1998). 150 years of anaesthesia—a long way to perioperative medicine: The modern role of the anaesthesiologist. *Eur. J. Anaesthesiol.* **15**(5), 520–523.
van den Heede, M. A. (1998). Het gebruik van chemische oorlogsagentia: Historiek en toxicologische aspecten. *Bull. Cercle. Benelux. Hist. Pharm.* **94,** 20–32.
van Genderen, H. (1990). Toxicology in development and its relationship to pharmacology. *Tijdschr. Diergeneeskd.* **115**(14), 689–694.
Verma, D. K., and des Tombe, K. (1999). Measurement of benzene in the workplace and its evolution process. Part I. Overview, history, and past methods. *Am. Ind. Hyg. Assoc. J.* **60**(1), 38–47.
Vidal, F. (1984). Theriaca-panacea of the 16th, 17th, and 18th centuries. *Chir. Dent. Fr.* **54**(248), 33–39.
Volker, A. (1992). Mining medicine in the 18th century. On the 250th anniversary of the birthday of Ignaz von Born (1742–1791). *Z. Gesamte Inn. Med.* **47**(12), 583–590.
Waldron, H. A. (1983). On the history of scrotal cancer. *Ann. R. Coll. Surg. Engl.* **65**(6), 420–422.
Waldron, H. A. (1997). Occupational health during the Second World War: hope deferred or hope abandoned. *Med. Hist.* **41**(2), 197–212.
Waller, R. E. (1994). 60 years of chemical carcinogens: Sir Ernest Kennaway in retirement. *J. R. Soc. Med.* **87**(2), 96–97.
Wassom, I. S. (1989). Origins of genetic toxicology and the Environment Mutagen Society. *Environ. Mol. Mutag.* **14**(Suppl. 16), 1–6.
Wax, P. M. (1997). Analeptic use in clinical toxicology: a historical appraisal. *J. Toxicol. Clin. Toxicol.* **35**(2), 203–209.
Wedeen, R. P. (1989). Were the hatters of New Jersey ''mad''? *Am. J. Ind. Med.* **16**(2), 225–233.
Weideman, M. (1993). Toxicity tests in animals: historical perspective and new opportunities [news]. *Environ. Health Perspect.* **101**(3), 222–225.
Weiss, B. (1996). Long ago and far away: a retrospective on the implications of Minimata. *Neurotoxicology* **17**(1), 257–263.
Wennig, R. (1984). History of toxicology in Luxembourg. *Bull. Soc. Sci. Med. Grand Duche Luxemb.* **121**(2), 39–52.
Wigle, D. T. (1998). Safe drinking water: A public health challenge. *Chronic Dis. Can.* **19**(3), 103–107.
Williamson, A. M. (1996). Historical overview of computerized behavioral testing of humans in neurotoxicology. *Neurotoxicol. Teratol.* **18**(4), 351–357.
Wilsdorf, G., and Graf, G. (1998). Historical review of development of veterinary toxicology in Berlin from 1790–1945. *Berl. Munch. Tierarztl. Wochenschr.* **111**(1), 21–26.
Winchester, J. F. (1995). History of paraquat intoxication. In *Drug and Chemical Toxicology, Vol. 10. Paraquat Poisoning: Mechanisms, Prevention, Treatment,* pp. 1–16. (C. Bismuth and A. H. Hall, Eds). Dekker, New York.
Wolf, A. D. (1995). Ginger Jake and the Blues: A tragic song of poisoning. *Vet. Hum. Toxicol.* **47**(3), 252–254.
Zapp, J. A., Jr., and Doull, J. (1993). Industrial toxicology: Retrospect and prospect. In *Patty's Industrial Hygiene and Toxicology, Vol. II, Part A: Toxicology* (G. D. Clayton and F. E. Clayton, Eds.), 4th ed., pp. 1–23. Wiley, New York.
Zbinden, G. (1992). The three eras of research in experimental toxicology. *Trends Pharmacol. Sci.* **13**(6), 221–223.
Zbinden, G. (1993). The concept of multispecies testing in industrial toxicology. *Regul. Toxicol. Pharmacol.* **17**(1), 85–94.

A HISTORICAL PERSPECTIVE OF TOXICOLOGY INFORMATION SYSTEMS[1]

JANET M. EVERITT

Abstract

Toxicology information systems have evolved swiftly from early, library-based bibliographic tools to advanced packages utilizing sophisticated computer

[1] This material is based on the historical information contained in the publication Toxicology information systems: A historical perspective (1985). *J. Chem. Info. Comp. Sci.* 25:212–217, which was also published in the second edition of this book. I would like to thank the authors, P. Wexler and H. M. Kissman, for allowing me use of their material as a starting point for my research.

and telecommunication technologies. These systems have evolved concurrently with the rapid expansion of the science of toxicology itself. Bibliographic files such as TOXLINE represent first attempts to handle the toxicology literature through online retrieval. Subsequent approaches applied the use of computers to provide literature-derived data, as in the HSDB or RTECS databanks, or to capture data directly from the laboratory. Societal concerns about hazardous substances, manifested in legislation and regulations, have been responsible for the generation of much toxicity information and the impetus to systematically collect and disseminate this data. Changes in information technologies—such as the trend toward high-density storage devices, developments in computer technology, and the use of the Internet's ''shared'' resources—affect how data is being assembled, interpreted and analyzed. The amount of information has risen dramatically over the years, and it is more accessible and current than ever before. Other influences on the nature and use of toxicology information systems are related to advances in biotechnology, improved analytical methodologies, alternatives to whole-animal testing, and global harmonization efforts.

Introduction

The field of toxicology has witnessed an unprecedented growth within the past 25 years. This explosion in subject matter, stemming largely from social concerns and matched by equally rapid technological innovation, has resulted in a serendipitous marriage between toxicology information and advanced systems to collect, organize, and distribute this information. This chapter will briefly define toxicology and historically trace the state of toxicology information systems from precomputer days through current computerized systems and on to future projected systems. Representative systems will be described within a framework of the impetus, often regulatory, for the generation of toxicological information.

Toxicology deals largely, though not exclusively, with the effects of chemicals on biological systems. Toxicological information takes many forms: raw laboratory data (quantitative, qualitative, and descriptive), field data (e.g., poisoning incidence, workplace hazard monitoring), statutes and regulatory information, bibliographic works, reports, etc. Toxicology information systems arrange portions of these data in a concerted plan or to serve a common purpose. One of the main difficulties for designers of toxicology information systems has been the interdisciplinary nature of the field. Toxicology borrows heavily from chemistry, biology, pharmacology, and other sciences. With toxicology being such a hybrid discipline, a major challenge has been how to identify and manage this dispersed information efficiently.

Early History

Throughout the first half of the twentieth century, toxicology was frequently considered a subset of pharmacology. A 1960 paper considering whether toxicology was an independent scientific discipline pointed out that ''our toxicology is an infant, barely emerged from the womb of pharmacology. We do not fully know how to utilize our strengths and talents''[1]. Similarly, at that time, whatever toxicology instruction existed was usually presented within the context of a pharmacology course. There was no full-scale toxicology Ph.D. program operating [2]. National attention was focused on existing and new pharmaceutical products, related poisoning incidents, and the need to ensure the safety of these and other consumer products.

The 1938 Food, Drug and Cosmetic Act required an assessment of drug safety before marketing. Between 1959 and 1962, the birth of deformed babies linked to the use of thalidomide in pregnancy, an anti-emetic used widely in Europe, caused widespread concern on the safety of consumer products. The 1962 amendments to the Food, Drug, and Cosmetic Act, passed in part as a response to the thalidomide disaster, strengthened pre-market testing requirements for pharmaceuticals.

While the debt of toxicology to pharmacology was undisputed, the expanded role that toxicology would play in broader environmental issues was starting to be recognized. A 1960 conference entitled ''Problems in Toxicology'' [3] brought together distinguished scientists who addressed not only food, drug, and cosmetic control but environmental chemicals, pesticides, industrial chemicals, radioactive materials, and more. The chairman of this conference, in his opening remarks, stated, ''Toxicity is suddenly upon us as a social problem'' [4]. However, it took two more years, with the 1962 publication of *Silent Spring* [5], for the public to be jolted into an awareness of the dangers associated with the uncontrolled production and use of thousands of chemicals. That chemicals could produce chronic effects, sometimes not apparent until years after exposure, was a stunning revelation to the American public. The environmental movement was conceived in the 1960s and burgeoned in the 1970s; toxicology became caught up in its tide.

What was the state of toxicology information systems in the early and mid 1960s? Information communication among scientists at professional meetings was, as it still is today, an important means of transmitting

new findings. Among the earliest journals in the field—still linked to pharmacology—were the German *Sammlung von Vergiftungsfaellen* (1930), the Russian *Farmakilogiia i Toxicology* (1938), and the Danish *Acta Pharmacologia et Toxicologica* (1945). In the United States, the journal *Toxicology and Applied Pharmacology* was to become the official organ of the Society of Toxicology, founded in 1961. Many journals with a toxicology focus would be born thereafter, and, as is common in this media, shift focus as the discipline evolves.

Published toxicology information was largely library based. Indexing and abstracting tools for the major disciplines were well-established. Such reliable standards as *Biological Abstracts, Chemical Abstracts, Excerpta Medica,* and *Index Medicus* offered means of tracking toxicology literature, (1) albeit in a limited way by today's standards. All of these bibliographic tools would eventually see their automated counterparts, for widespread availability of computer technology was on the horizon. The batch-processed MEDLARS (Medical Literature Analysis and Retrieval System) became operational at the National Library of Medicine in 1964, followed by MEDLINE, the online version of *Index Medicus,* in 1971. Still, there were no information systems dedicated to serving the toxicologist, to pull together and make readily accessible the far-flung data being generated by increased testing and appearing in an increasing array of publications.

One of the key documents providing an insight into the dissemination of toxicology information was the 1966 Report of the United States President's Science Advisory Committee entitled ''Handling of Toxicological Information'' [6], known here as the PSAC Report. The PSAC Panel expressed its concern about the dispersion of toxicological information over a large area of the published journal literature, published and unpublished reports, and unpublished information files of industrial companies and government agencies. The panel's major finding was that ''there exists an urgent need for a much more coordinated and more complete computer-based file of toxicological information than any currently available, and further, that access to this file be more generally available to all those legitimately needing such information'' [6, p. 212] The panel also provided a useful definition of toxicological information as ''all information descriptive of the effects of chemicals on living organisms or their component subsystems'' [6, p. 202]. The recommendations of the PSAC Panel led, in 1967, to the establishment of the Toxicology Information Program (eventually renamed the Toxicology and Environmental Health Information Program) at the National Library of Medicine (NLM) [7].

In 1995, the Institute of Medicine (IOM) formed the Committee on Toxicology and Environmental Health Information Resources for Health Professionals. The task of this committee was to investigate the information needs of health professionals and to recommend to the NLM the role it should play in organizing and directing access to environmental health and toxicology information. The committee's findings [8], like the 1966 PSAC Report, supported the importance of ready access to environmental and toxicological information and the continuing need for coordination to assist in this endeavor. The committee also declared that since the environment is increasingly recognized as having an impact on human and ecological health, there is a far larger and diverse potential audience for this type of information. And finally, the committee recognized the importance of the NLM in playing a key role in organizing and providing pointers to all available toxicology and environmental health information.

Advent of Computerized Databases

Bibliographic Systems

TOXLINE, the earliest online bibliographic system for toxicology, was developed by NLM's Toxicology Information Program in 1972 as a ''one-stop shopping center'' for bibliographic information in toxicology. The original intent to follow the MEDLINE lead and ''mechanize'' an existing abstracting and index (A&I) source for online bibliographic retrieval had to be adjusted because no one secondary source adequately covered the field of toxicology. It was decided, therefore, to combine ''toxicology subsets'' from various A&I services into one file that would look reasonably homogenous to the online user. Thus, TOXLINE initially incorporated relevant segments from *Index Medicus, Biological Abstracts, Chemical Abstracts,* and *International Pharmaceutical Abstracts* [9, 10]. Over the years, other segments have been added and some have been deleted from the file, so that now 19 subfiles are represented in the database.

TOXLINE also served to validate the utility of whole-text searching without a controlled vocabulary. This was accomplished by creating one large inverted file of all searchable terms. Over the years, TOXLINE has grown to over 2.7 million records and has been made available through several commercial vendor systems and free on the Internet through Medscape (http://www.medscape.com/home/topics/multispecialty/multispecialty.html) or Grateful Med (http://www.igm.nlm.nih.gov/). Because of the continual growth of toxicology information in the published arena, TOXLINE did not reach its goal of becoming the single ''one-stop shopping center'' for toxicology information, but one of a number of online

databases to be consulted for comprehensive retrieval of information [11, 12].

Because toxicology is concerned with the effects of chemicals on biological systems, the accurate identification of the chemical substance(s) involved in a toxicological event is a critical preliminary to utilizing toxicology information systems. For TOXLINE, this problem was met by NLM building an online companion file, CHEMLINE, that derived its content mainly from the Chemical Abstracts Service (CAS) Registry System [13]. CHEMLINE became the first of the ''online chemical dictionaries'' that link nomenclature, structural information, and CAS Registry Numbers to the location of information about specific chemical or groups of structurally related chemicals in other files. CHEMLINE made two fundamental contributions to chemical information retrieval: it demonstrated the importance of the CAS Registry Number in online information seeking, and it showed that the fragments derived from parsing standardized chemical nomenclature could provide useful online substructure retrieval capabilities. The file was discontinued in 1997, and the non-royalty ChemIDplus file now serves as the main nomenclature inventory file for the NLM systems.

As the drive for computerization of its entire production system continued at CAS, larger portions of the CAS Registry System were made available to online information distribution organizations, such as DIALOG (Knight-Ridder) and ORBIT (QUESTEL), which mounted CHEMNAME and CHEMDEX, respectively. This process culminated, in a sense, when CAS made the entire CAS Registry File accessible for online searching [14].

Efforts to provide controlled vocabulary for biological entities have been well established with the MeSH (Medical Subject Heading) system, IUPAC and IUBMB enzyme nomenclature, and the International Council of Scientific Unions CODATA standards for biological terminology and nomenclature. The efforts of the UMLS project of the NLM to establish a complete biomedical nomenclature and those of the International Union of Pharmacology (IUPHAR) to establish a systemized nomenclature for receptors and ion channels both should be recognized for progress in the standardization of non-chemical terminology [15].

While the TOXLINE paradigm of a bibliographic service devoted to toxicology (albeit in an extremely broad sense) was not used by other information providers, many of the online files generated by the secondary services that covered the biomedical literature naturally included references to the literature in toxicology. Numerous studies comparing online retrieval from TOXLINE with that from other online bibliographic services have been reported in the journal literature [11, 16–18].

Over the years, other systems for handling the bibliographic information of specialized areas of toxicology have also been developed. Generally, these files cover the journal literature, though some also include government-generated information and evaluated data extracted and reformatted by scientific panels. Examples of these ''targeted'' files include those from the Environmental Mutagen Information Center (EMIC) and the Environmental Teratology Information Center (ETIC) [19].

Cancer-related literature, including carcinogenesis, is accessible through CANCERLIT and the *Chemical Carcinogenesis Research Information System* (CCRIS) file, both funded by the National Cancer Institute (NCI). Pesticide information is available in the Crop Protection/PestDoc (Derwent) and AGRICOLA (National Agricultural Library) files. The literature of occupational exposure to chemicals and other toxic hazards is covered by NIOSHTIC (U.S. National Institute for Occupational Safety and Health) and the CIS file from the International Labour Office. Recently, NIOSH announced a severe cutback in the coverage of NIOSHTIC to only NIOSH generated/authored documents because of funding limitations and the acknowledgement of coverage of this literature by other online systems.

Data- or Fact-Retrieval Systems

Bibliographic retrieval systems—online or in printed form—are fact locators in that they direct the user to published literature that contains the sought-after facts. In contrast, data- or fact-retrieval systems, like handbooks, provide the user with the actual facts themselves. While *data* and *fact* are here used synonymously, the name *fact-retrieval systems* is perhaps more appropriate for this discussion because *data* often connotes numeric values, while so much in toxicology represents observations that must be described in words.

Early examples of literature-derived factual data banks in toxicology, still available online, are the U.S. government-sponsored systems HSDB (Hazardous Substances Data Bank), RTECS (Registry of Toxic Effects of Chemical Substances), and OHMTADS (Oil and Hazardous Materials Technical Assistance Data System).

The HSDB, built and operated by the NLM, was started as the Toxicology Data Bank (TDB) in 1978 to provide users online, interactive access to evaluated toxicological data. Some of the decisions made in designing this database touch on general issues that have to be considered in building data-retrieval systems.

To obtain ''evaluated'' data for HSDB, data statements were extracted from monographs and handbooks rather than from the primary journal literature. This was based on the assumption that the intellectual filtering process taking place while moving information from primary journals to tertiary sources will select proven or reasonable observations over those that are more speculative or are contradicted by later observations. Nonetheless, HSDB is now being augmented with data from the primary literature and technical reports because, for some chemicals, the monographic sources do not contain sufficiently up-to-date or extensive information.

HSDB contents are further screened by a committee of toxicologists, the Scientific Review Panel (originally named the Peer Review Committee), before they are released online [20]. This serves as a means of quality assurance, a critical feature of any data system intending to provide accurate and reliable information. The original committee was an offshoot of the National Institutes of Health (NIH) Toxicology Study Section, which has as its main function the evaluation of grant applications in the area of toxicology. This committee successfully transferred the consensus development methods used in grant review to the evaluation of toxicological data extracts from the literature.

The HSDB, with over 150 data elements and over 4000 chemical records, is organized as a handbook of compounds with their chemical, physical, toxicological, and environmental attributes. HSDB contains such information about compounds that are potentially hazardous and to which there is significant human exposure.

RTECS is a compilation that provides brief descriptions of substances for which acute or other toxic effects have been reported in the literature. As with other toxicology information systems intended to support U.S. health and safety initiatives, the RTECS system has been mandated by the U.S. Congress and is created under the sponsorship of NIOSH. The original edition, known as the Toxic Substances List, was published on June 28, 1971, and included toxicological data for approximately 5000 chemicals. RTECS now contains over 140,000 chemicals, providing nomenclature, CAS registry numbers, and mutagenic, teratogenic, and carcinogenic effects data, as well as references to government regulations and standards. The database is available online, on CD-ROM, or via computer tape. The RTECS Editorial Review Board reviews a limited number of citations to resolve ambiguities, but in general the information is not peer reviewed and data are selected for inclusion based on rigid criteria [21]. RTECS is available through several commercial vendor systems and not as part of the TOXNET Web database offerings.

OHMTADS is a data bank developed by the EPA to provide data about compounds that might be involved in chemical spills. It carries some 126 data elements and describes 1400 compounds. OHMTADS content is not peer reviewed. OHMTADS is an example of a system that broke ground in terms of informatics but not used enough to warrant continued updating. The database was privatized in the early 1980s and has not been updated for the last 12 years.

Another ''handbook'' system is the Integrated Risk Information System (IRIS) database, which contains information on hazard identification and dose-response assessment for over 500 chemicals reviewed by the EPA. The data contained within the file is reviewed and represents EPA consensus information.

Computerized systems to collect and process biological data developed during research and testing are becoming more prevalent. One such system, developed by the National Center for Toxicological Research, allowed collection, processing, and analysis of large-scale, rodent-based tests [22]. Beckman Instruments, Inc., developed this approach further into a free-standing data collection and processing system called TOXSYS, consisting of both specialized hardware and specialized software [23]. Two widely used systems today include the Xybion Medical Systems' PATH/TOX, a totally integrated system handling all pre-clinical data-management tasks in a protocol-controlled environment, and the DATATOX family of software modules from Instem-Apoloco, which uses one protocol to cover a wide range of pre-clinical safety assessment studies, including reproductive toxicology [24].

Most such data-collecting and -processing systems are intended for support of research and testing in a given organization, and the resulting data banks are not usually accessible to outsiders. However, one system, the Laboratory Animal Data Bank (LADB), developed and tested by NLM, was created to compile laboratory results for control animals in hematology, clinical chemistry, and pathology from many laboratories and provide them to users online for analysis and reference. The project was terminated in 1981 due to funding cuts [25, 26].

Impetus for Toxicology Information Systems

Having traced the evolution of toxicology information systems up to the present, it might be appropriate to pause and examine some of the reasons for their development, before exploring future directions. As alluded to earlier, there is a significant societal component to toxicology. Although the public has, in one sense, benefited greatly from the growing number of chemicals in commerce, it has also become justifiably

fearful about hazards that these chemicals pose to humans and the environment. These concerns have, in turn, expressed themselves in legislation at various levels.

These laws, and the regulations sprouting from them, have been an important influence on the creation of toxicology information systems. Affected societal groups had to install new information-gathering and -reporting procedures, and they, in turn, have led to the development of new information systems and services. The rapid growth of computerized systems for information handling over the same time period naturally had a profound impact on the nature of these systems and services. Several federal laws that influenced the formation of toxicology information systems are mentioned below.

The 1906 Food and Drugs Act was recast in 1938 as the Federal Food, Drug and Cosmetic Act. Its 1962 amendments, which were mentioned earlier, strengthened reporting requirements, resulting in increased generation of data related to efficacy, safety, and clinical experience, the maintenance of records, and the creation of corporate systems to handle these data.

The Occupational Safety and Health Act of 1970, among its provisions for protecting workers and adopting workplace standards, called for the publication of ''a list of all known toxic substances by generic family or other useful groupings and the contractions at which such toxicity is known to occur'' [Section 20(a) (6)]. In compliance with this directive, the Toxic Substances List was published in 1971. This was the forerunner of RTECS, discussed earlier. Other databases, such as IRIS, Genetox, DART, and others, have all been made possible under the EPA mandates for public dissemination of toxicity information on chemicals in general use.

The landmark 1976 Toxic Substances Control Act (TSCA) attempts to control the introduction, production, distribution, or use in commerce of any chemical that presents an unreasonable risk of injury to health or the environment. In response to the information-gathering requirements of this law, the Interagency Toxic Substances Data Committee was organized and recommended the adoption of the Chemical Substances Information Network (CSIN) project described below. Another direct outgrowth of TSCA was the creation of the TSCA Chemical Substances Inventory, which currently lists chemicals in commerce. Information from TSCA is available online through several vendor systems, and locator identification is contained on online nomenclature/directory files. Requirements for the extensive testing of chemical substances developed after 1976, as well as for the reporting and retention of information by manufacturers, have resulted in the creation of numerous corporate information systems [29] and both internal and public EPA files.

Chemicals in use when TSCA went into effect in 1976 were exempt from the basic toxicity screening tests required for all chemicals developed after that date. Only a fraction of these exempt chemicals have ever been screened for potential harm to humans and the environment. An agreement signed in 1998 by the U.S. government, the Environmental Defense Fund (EDF), and the Chemical Manufacturers Association (CMA) requires that 2800 of these high-use, high-production-volume chemicals be run against the EPA test battery. International cooperation for the testing initiative has been obtained through the International Council of Chemical Associations (ICCA). It is hoped that the Organization for Economic Cooperation & Development (OECD) will also provide impetus to see the testing done within stated timelines and through international cooperation. Though there are many questions related to costs, control, and data assessment related to this initiative, it will potentially generate information to fill a wide gap in our knowledge of the effects of chemicals present in the environment [28].

The Comprehensive Environmental Response, Compensation and Liability Act of 1980 (CERCLA, also known as the Superfund Act), authorized liability, compensation, cleanup, and emergency response for hazardous substances released into the environment and the cleanup of inactive hazardous waste disposal sites. It mandates the establishment of the Agency for Toxic Substances and Disease Registry, whose administrator will ''establish and maintain an inventory of literature, research, and studies on the health effects of toxic substances'' [Section 104(I) (2)]. Title III of the Superfund Amendments and Reauthorization Act (SARA) was directly responsible for the creation of the Toxic Chemicals Release Inventory (TRI).

The Hazard Communication (or Right-to-Know) rules first issued by the U.S. Department of Labor in 1983, and many similar laws enacted by many states and municipalities, require that workers be informed by their employers about chemicals to which they are being exposed in the workplace. Among other requirements, the rules mandate written hazard communication programs, labels as hazard warnings, and extensive development of material safety data sheets (MSDS). The formats and thoroughness of MSDS vary considerably between sources, but in a little over a decade the overall quality of these documents has improved markedly. Compliance to this law has made available a considerable amount of toxicological data previously residing only in internal company files available to workers, customers, and the general public [29].

The laws listed above and others—such as the Clean Air Act (1963) and Amendments (1997), the Consumer Product Safety Act (1972), the Federal Insecticide, Fungicide and Rodenticide Act (1972), the Resource Conservation and Recovery Act (1976), and the Safe Drinking Water Act (1977) [30]—and their resulting regulations are responsible for many of the currently available governmental and private information systems ventures. Indeed, it has been suggested about toxicology that the pressure from the regulatory arena is driving the development and evolution of the discipline [31].

Development of Advanced Systems

The sheer volume of toxicological literature and data, generated because of research, testing, legislation, or otherwise, is the immediate motivating factor for new information systems design. More than 120 journals currently devote most of their space to toxicological concerns. Many specialized toxicology organizations now exist, and the Society of Toxicology has compiled a list of 60 academic and postdoctoral programs in toxicology [32]. With new avenues for the distribution of data and information, it becomes increasingly important to order it in a logical manner.

Many other aspects of toxicology information systems, especially those related to computer and communications technology, have changed drastically over the last 30 years. The steady reduction in the cost of computer storage; the growth of the value-added communications networks such as MCI or Sprintnet, and, most recently, the ability to use the Internet as a primary mechanism for sharing information have had major impacts on all scientific information systems, including those of toxicology.

These technical developments created a market for the large, multi-file, online systems vendors of information such as OVID, DIALOG, QUESTEL, and STN. These vendors, using bibliographic files created by other organizations—such as the major indexing and abstracting services—provide the information user with an impressive array of published scientific and technical information resources.

One online data retrieval system that places emphasis on files relevant to toxicology is the Chemical Information System (CIS), which was originally created and supported by the NIH and EPA [33]. For a while, EPA was the main supporter of CIS, but the system is now owned by the private Oxford Molecular Group. The system is an aggregate of data files including RTECS and OHMTADS. The Structure and Nomenclature Search System (SANSS) file supports the identification of relevant compounds and classes of compounds with pointers to the availability of information on these compounds in the other CIS component files. The Commission of the European Communities developed The Environmental Chemicals Data and Information Network (ECDIN), a somewhat similar system, which is accessible through EURONET, DIANE, and other hosts [34].

Another approach to extracting toxicological information from large multi-file, online systems without being expert in the intricacies of the varied retrieval languages employed by these systems was developed by the CSIN project [35, 36]. CSIN (now defunct) consisted of software and an ''interface'' computer through which the user accessed one or more online systems. Information collected from one system or file could be transformed in CSIN for use in the query statement posed to another system or file.

Future of Toxicology Information Systems

Although prophecy is not considered a scientific discipline, predictions about future activities can reasonably be made by extrapolating present trends. Thus, is reasonable to assume that toxicology information systems will be affected by changes in three areas: (1) information technologies, (2) changes in the science of toxicology, and (3) international harmonization.

It is also important to note here the direction of the NLM's Toxicology and Environmental Health Information Program (TEHIP). TEHIP manages TOXNET (Toxicology Data Network) and supports training and educational aspects related to toxicology activities at NLM. One objective of the program is to establish ''road maps'' to online information toxicology resources. In late 1997, TEHIP mounted several of its online databases for public access on the SIS (Specialized Information Services) server at the National Library of Medicine (http://www.TOXNET.nlm.nih.gov/). It has added interactive Web-based toxicology tutorials, a listing of toxicology-related Internet resources, and full-text research reports, and it has made available TOXLINE and ChemIDplus into the TOXNET system. With the myriad of potentially useful sources of information growing each day, projects such as these are vital to enabling us to identify and access available data. It is hoped that support for this plan is forthcoming, as well as continued support of the acquisition, development, and maintenance of the invaluable range of TEHIP-managed databases.

Changes in Information Technologies

Over the past 30 years, technological advances, principally in computer sciences and telecommunications, have fundamentally changed the way information is

gathered, stored, and disseminated. Some important trends in this area include global communication arrays now offered by the Internet; the availability of information stored on increasingly inexpensive computer storage devices, such as optical disc and DVD technology; and the ability to provide enhanced full-text/graphical information access.

The phenomenal growth of the Internet as a mechanism for communication has been swift and pervasive. Though in use by scientists since the late 1960s, the standard network protocols and easily nagivated web of interconnected computers have made the Internet one of the primary information conduits for the world. The Internet can be used to disseminate methods, discoveries, and knowledge at unprecedented speed and unhindered by limitations of geography and cost. Electronic mail, bulletin board systems, usenet groups, IRC, and listservers connect people to people. Browsers, search engines, subject directories, and hypertext support searching this World Wide Web, and common protocols allow for displaying and downloading/printing retrieved information, both graphical and text. At no other time in history has the opportunity to explore the world's knowledge base been so much within our grasp. But as with all information resources, the necessity to evaluate Internet resources based on content, authority, timeliness, structure, and accessibility is an intregal part of ascertaining value for decision making.

Scientific organizations, academia, government bodies, publishers, and private companies are using the Internet to provide access to information stored on computer. As in the print resources, toxicology information is just as amorphously distributed across numerous discipline collections on the Internet, but the ability to now identify previously buried or inaccessible data, especially data collected by government and international regulatory bodies, is increasing. Several government projects related to the development of resource locator, expert system, and search engines are currently underway that have promise of greatly improving access to toxicology information.

The National Environmental Data Index (NEDI) [37], an interagency effort of the federal government, provides full-text searching of the environmental information compiled by several agencies of the federal government. The second phase of the NEDI project is to expand to link across local, state, international, and private (nonprofit and commercial) environmental resources. The NLM and the Clearinghouse for Networked Information Discovery and Retrieval (CNIDR) have developed a Web-based application—*Sorcerer*—that accepts queries, translates, selects sources, performs searches, and returns results, all invisibly to the user. A companion software, *Apprentice,* currently in development, will allow for registration of biomedical information sources into a centralized database [8, pp. 127–128; 39].

Changes in Toxicology and Related Sciences

Toxicology and its information systems are bound to be affected by the advances taking place in biology, especially in the areas of biotechnology and genetic engineering. Because toxicology deals primarily with ''adverse effects,'' it will be concerned with these aspects of the new sciences. Applications of these new technologies will involve the deliberate and, occasionally, the inadvertent release into the environment of organisms with new genotypes. The health and environmental implications of such events are being considered by government bodies worldwide, and regulations applying to the handling, manufacture, and distribution of genetically altered organisms are already in place in most developed countries.

In the U.S., the FDA's regulatory approach identified issues related to characteristics of foods that raise safety questions and therefore elicit a higher level of review over traditional foodstuffs. Such characteristics include the introduction of a completely ''new'' substance in the food supply, the presence of an allergen in an unusual milieu, increased levels of toxins that are normally found in foods, and alterations of important nutrients [40]. On May 29, 1992, the FDA announced its policy on the oversight of new varieties of food plants. Guidelines for the safe handling of genetically engineered materials have been issued by the Center for Biotechnology at the FDA and made mandatory for research and production facilities [41].

Articles on biotechnology and related concerns are being processed into the bibliographic retrieval systems by the relevant A&I systems. Separate services covering these areas have been established (e.g., Derwent Biotechnology Abstracts, Current Biotechnology Abstracts), and the expansion of the scope of traditional systems has expanded to cover this new literature and its unique focus. Historically, information support functions for toxicology focused mainly on chemical substances; now systems describing the impact of biotechnology need to encompass biological organisms, as well.

Classification systems are being modified or created, as are the techniques used for dealing with data and information relevant to biological entities. Examples of these new databanks include the European Molecular Biology EMBL system, the U.S. National Center for Biotechnology Information GENBANK databank, and the Japanese DDBJ databank, with their concomitant

search systems, such as ENTREZ or the BLAST homology search system.

Biotechnology and advances in electronics and analytical chemistry are also producing ever more subtle analytical techniques to detect trace amounts of contaminants and evidence that biological systems have been exposed to xenobiotics. Identification of populations at risk has become more finely tuned. Refinements in analytical methodologies such as high-input screens, predictive assays such as quantitative structure-activity relationship methods (QSAR), and bioanalytical culturing techniques are continuously altering the course of toxicological evaluations as well as related regulations and information systems.

Another aspect of toxicology undergoing scrutiny and change is testing and research using whole animals. Widespread and increasing public pressure against the use of animals in research, as well as economic considerations, are bringing about the reappraisal and possible replacement of many presently used systems, such as the Draize test in rabbits for eye irritation and the LD50 (lethal dose 50 percent) toxicity test and carcinogenesis testing [42, 43]. Since 1980, rapid developments have occurred in the field of in vitro toxicology testing. Several organizations, such as the Johns Hopkins Center for Alternatives to Animal Testing, the Foundation for the Replacement of Animals in Medical Experimentation, the European Research Group for Alternatives in Toxicity Testing, and the Japanese Society for Alternatives to Animal Experiments, have spearheaded efforts to promote and validate alternatives for refinement, reduction, and replacement of whole-animal tests. The significant body of information from these centers, information contained in peer-reviewed journals such as *Alternatives to Laboratory Animals* and *In-Vitro Toxicology*, and increasing cost/benefit imperatives have led to worldwide changes in regulatory requirements for new chemical testing. The Animal Welfare Act and Amendments established the U.S. National Agricultural Library Animal Welfare Information Center as a primary resource for information related to alternatives and other provisions of these acts [44, 45].

Harmonization Accords

The formation of economic unions by many countries worldwide has been instrumental in establishing harmonized requirements for marketing and production in the member states. The areas of environmental risk, drug/consumer products testing, and pharmacovigilance are of particular note here. The basis for the requirements for safety and hazard disclosure have been the work of committees that are composed of some of the best scientists and toxicologists in the world. Their conclusions and recommendations form a valuable knowledge base of current opinion on contemporary testing procedures, hazard identification, and risk assesment. The information generated under these accords are also being made available quicker and more widely than ever before. The peer-review process that takes place when information is widely distributed forms a self-validating system.

The international concerns over contamination of the environment have resulted in several international initiatives to address these concerns and to set limits on discharge of known toxic pollutants. The toxicology and hazard information coming out of regulatory agencies, consumer protection organizations, environmental action groups, and academia and the concern generated by the wide distribution of this information have been the reason for these initiatives. Recently, the European Community put into place rules governing basic discharge of emissions by member states. The Kyoto Accord (1997) has also attempted to deal with this issue on a voluntary worldwide level. The first European Union guidelines for requiring excotoxicity testing as part of the registration of new animal and human pharmaceuticals were established in 1995 [46].

Another recent initiative worthy of note has been the establishment of The International Conference on Harmonisation of Technical Requirements for Registration of Pharmaceuticals for Human Use (ICH) [46]. The project brings together the regulatory authorities of Europe, Japan, and the U.S. and experts from the pharmaceutical industry in the regions to discuss scientific and technical aspects of product registration. This and other harmonization efforts are changing the way information on a global level is generated, organized, and disseminated.

Finally, it is useful to remember that the information processed, stored, and retrived is only as good as the research and testing that first developed the supporting data. Even in this age of global communication systems and access to billions of bytes of computerized data, good decision making and progress can only be achieved on the foundation of reproducible, authoritative, and high-quality research findings.

References

1. Smyth, H. F., Jr. (1960). Recognition of toxicology as a scientific discipline. *Fed. Proc. Fed. Am. Soc. Exp. Biol.* **19,** 43–49.
2. Hodge, H. C. (1960). Training of toxicologists. *Fed. Proc. Fed. Am. Soc. Exp. Biol.* **19,** 50–52.
3. Coon, J. M., and Maynard, E. A. (Eds.) (1960). Problems in toxicology. *Fed. Proc. Fed. Am. Soc. Exp. Biol.* **19,** 1–52.
4. [deleted in proofs]
5. Carson, R. (1962). *Silent Spring.* Houghton Mifflin, Boston.

6. President's Science Advisory Committee (1996). *Handling of Toxicology Information.* Reprinted in *Symposium on the Handling of Toxicological Information* (C. J. Cosmides, Ed.), pp. 201–223 NTIS, Springfield, VA, 1978 (PB-283 164).
7. Miles, W. D. (1982). *A History of the National Library of Medicine. The Nation's Treasury of Medical Knowledge.* U. S. Government Printing Office, Washington, DC (NIH Publ. No. 82-1904).
8. Liverman, C. T., Ingalls, C. E., Fulco, C. E., and Kipen, H. M. (Eds.) (1997). *Toxicology and Environmental Health Information Resource: The Role of the National Library of Medicine.* National Academy Press, Washington, DC.
9. Schultheisz, R. J. (1981). TOXLINE: Evolution of an online interactive bibliographic database. *J. Am. Soc. Inf. Sci.* **32,** 421–429.
10. Bauden, D. (1979). Chemical toxicology searching. *Database* **2,** 11–18.
11. Bac, R. (1980). A comparative study by the PDR of toxicology information retrieval from online literature databases. *Online* **4,** 29–33.
12. King, J. (1983). Searching international data bases: A comparative evaluation of their performance in toxicology. *Br. Libr.,* Library and Information Research Report 3.
13. Schultheisz, R. J. Walker, D. F., and Kannan, K. L. (1978). Design and implementation of an on-line chemical dictionary (CHEMLINE). *J. Am. Soc. Inf. Sci.,* **29,** 173–179.
14. Farmer, N. A., and O'Hara, M. P. (1980). CAS online. A new source of substance information from chemical abstracts service. *Database,* **3,** 10–24.
15. Cosmides, G. J. (1995). Electronic surveillance of the pharmacology-toxicology literature: The need for controlled vocabularies and registry systems. *Regul. Toxicol. Pharmacol.* **21,** 208–210.
16. Knodel, L. C., and Bierschenk, N. F. (1983). Selective use of online literature searching by a drug information service. *Am. J. Hosp. Pharm.* **40,** 257–259.
17. Schirner, H., and Lorent, J. P. (1978). An attempt to compare EMCS (Excerpta Medica Computer System) with TOXLINE. *Online Rev.* **2,** 155–162.
18. Bawden, D., and Brock, A. M. (1982). Chemical toxicology searching: A collaborative evaluation comparing information resources and search techniques. *J. Inf. Sci.* **5,** 3–18.
19. Wassom, J. S. (1980). Mutagenesis, carcinogenesis and teratogenesis information systems. In *Safe Handling of Chemical Carcinogens, Mutagens, Teratogens and Highly Toxic Substances,* (D. B. Walters, Ed.), Vol. 1, pp. 299–311. Ann Arbor Science, Ann Arbor, MI.
20. Decker, W. J., and Kissman, H. M. (1977). The National Library of Medicine's Toxicology Data Bank—An information source potentially useful to the clinical toxicology. *Vet. Hum. Toxicol.* **19,** 90–92.
21. RTECS (1997). U.S. National Institutes of Occupational Safety and Health, Washington, DC. Web site (http://www.cdc.gov/niosh/rtecs.html).
22. Lawrence, L. R. Konvicka, A. J., and Herrick, S. S. (1977). Information systems as utilized by the National Center for Toxicological Research. *Drug Info. J.* **11,** 104–108.
23. McGuire, E. J., Shin, M. H., DiFonzo, C. J., Daly, A., and de la Iglesia, F. A. (1981). Toxicology laboratory interactive computer-based data acquisition and information systems. *Drug Info. J.* **15,** 181–188.
24. Instem-Apoloco Web site (http://www.instem-apoloco.co.uk) (1998). Xybion Corporation Web site (http://www.xybion.com) (1998).
25. Kissman, H. M. (1978). Operation of a data bank In biomedical science and correlation problems. *CODATA Bull.* **29,** 34–40.
26. Altman, P. L., and Fisher, K. D. (1981). ''Guidelines for Development of Biological Data Banks.'' Federation of American Societies for Experimental Biology, Bethesda, MD.
27. Vogt, H. C., and Kerfoot, E. J. (1980). Information reporting procedures under the Toxic Substances Control Act (TSCA), subsection 8(e). *J. Chem. Info. Comput. Sci.* **20,** 253–255.
28. Johnson, J. (1998). Pact triggers tests. *Chem. Eng. News* **76**(44), 19–20.
29. Kraska, R. C. (1995). Hazard communication and exposure limits: Labeling and other workplace and transportation requirements for industrial chemical under OSHA, DOT, and Similar authorities around the world. In *Regulatory Toxicology.* (C. P. Chengelis, J. F. Holson, and S. C. Gad, Eds.) pp. 185–209. Raven Press, New York.
30. Merrill, R. A. (1996). Regulatory toxicology. In *Casarett and Doull's Toxicology. The Basic Science of Poisons* C. D. Klassen, M. O. Amdur, and J. Doull, Eds. 5th ed., pp. 1011–1023. Macmillan, New York.
31. Doull, J. (1984). The past, present and future of toxicology. *Pharmacol. Rev.* **36**(2) (Suppl.), 155–185.
32. Society of Toxicology (1995). *Resource Guide to Careers in Toxicology,* 3rd ed. Society of Toxicology, Reston, VA.
33. Heller, S. R., and Milne, G. W. A. (1980). Linking scientific databases: The NIH-EPA chemical information systems. *Online* **4,** 45–57.
34. Hushon, J. M., Powell, J., and Town, W. G. (1983). Summary of the history and status of the system development for the Environmental Chemicals Data and Information Network (ECDIN). *J. Chem. Inf. Comput. Sci.,* **23,** 38–43.
35. Bracken, H. C. (1981). Using distributed data base management technologies to handle chemical and toxicological information. In *Proceedings of the Symposium on Information Transfer in Toxicology,* Bethesda, MD, September 16–17, 1981, PB82-220922, pp. 117–124. NTIS, Springfield, VA.
36. Tidwell, D. C., Brown, G. E., and Siegel, S. (1981). Chemical substances Information Network (CSIN): An overview. Technical Report of Interagency Toxic Substances Data Committee, PB85-135-812. NTIS, Springfield, VA.

36a. Liverman, C. T., Fulco, C. E. and Kipen, H. M. (1998). Internet access to the National Library of Medicine's Toxicology and Environmental Health Databases. National Academy Press, Washington, DC (TOXNET web access at http://www.toxnet.nlm.nih.gov) (Grateful Med web access at http://www.igm.nlm.nih.gov/).

37. NEDI (National Environmental Data Index) (1997). Catalog Web site (http://www.nedi.gov/NEDI-Catalog/).
38. National Library of Medicine (NLM) (1995). National Library of Medicine programs and services, 1994, NIH Publication No. 95–256. NLM, Bethesda, MD.
39. Statement of policy: Foods derived from new plant varieties. (May 29, 1992). *Fed. Reg.* **57,** 22984–23005.
40. Foods of the future. (1993). *JAMA* **269**(7), 910–912.
41. Dagani, R. (1983). Alternative methods could cut animal use in toxicity tests. *Chem. Eng. News.* **61**(44), 7–13.
42. Dagani, R. (1984). In-vitro methods may offer alternatives to animal testing. *Chem. Eng. News.* **62**(46), 25–28.
43. Frazier, J. M., and Goldberg, A. M. (1990). Alternatives to and reduction of animal use in the biomedical research, education, and testing. *Cancer Bull.* **4,** 238–242.
44. National Agricultural Library, Agricultural Research Service, U.S. Department of Agriculture (April 17–18, 1997). ''AWIC Workshop.''
45. Henschel, K. P., Wenzel, A., Diedrich, M., and Fliedner, A. (1997). Environmental hazard assessment of pharmaceuticals. *Regul. Toxicol. Pharm.* **25,** 220–225.
46. ICH (International Conference On Harmonization) (1997). Web site (http://www.ifpma.org/ichl.html).

This Page Intentionally Left Blank

CHAPTER

2

Books and Special Documents

GERALD L. KENNEDY, Jr., PHILIP WEXLER, NANCY S. SELZER, AND LINDA A. MALLEY

First Witch:
Round about the cauldron go,
In the poisoned entrails throw.
Toad that under cold stone
Days and nights has thirty-one.
Sweltered venom sleeping got,
Boil thou first i'th' charmed pot.

All:
Double, double, toil and trouble,
Fire burn, and cauldron bubble.

Second Witch:
Fillet of a fenny snake,
In the cauldron boil and bake.
Eye of newt and toe of frog,
Wool of bat and tongue of dog,
Adder's fork and blind-worm's sting,
Lizard's leg and owlet's wing,
For a charm of powerful trouble,
Like a hell-broth boil and bubble.

All:
Double, double, toil and trouble,
Fire burn, and cauldron bubble.

(William Shakespeare, *Macbeth*)

This chapter provides a selective list of books and other special documents, such as monographic series, conference proceedings, and technical reports, although Chapter 8 looks at technical reports in more detail. Also listed are some journal titles and selected journal review articles. Any reader of the second edition of this book will immediately notice the substantial increase in the number of toxicology books included. It is no surprise that despite the steamrolling incursion of computers into our daily lives, authors and publishers continue to collaborate in the production (albeit computer assisted) of old-fashioned books, and readers continue to buy them. This is not to deny that vast changes have taken place in the publishing industry, nor that increasingly more publishers will find it difficult to compete in the market without a digital presence. However, the bottom line is that books on paper are here to stay.

We are offering mostly recent books, published since 1990, with somewhat fewer books from the 1980s and fewer yet from before 1980. Older toxicological literature is not necessarily invalidated by newer literature, and there have been cases in which older seminal works, now considered classics, have not been updated. The books were therefore chosen on an item by item basis with no strict cutoff date as a criteria for selection. If a book has appeared in multiple editions, we have cited only the most recent edition.

The books are arranged by subject following, with slight modifications, the scheme of the previous edi-

tion. As always, there are cases in which it is frustratingly difficult to determine how to categorize a particular book. Would a book with the title *Reproductive and Genetic Aspects of Cancer Causing Chemicals in the Workplace* be categorized under Cancer, Development and Reproductive Toxicology, Genetic Toxicology, or Occupational Health? If no one of these subjects predominates it can really be a toss-up. Of course, this is a problem librarians have faced since time immemorial. However, for this reason we have cross-references.

New to the current edition is a section titled Chemical Compendia. Here we have placed books which, in support of or despite their titles, are large, typically alphabetical, lists of chemicals describing hazardous properties and other attributes of each. In the case of chemical lists with a subject focus, we have placed such books in the appropriate subject categories. Thus, compendia that stress the teratogenic potential of the chemicals they list would be placed in the Developmental/Reproductive Toxicology section and not in the Chemical Compendia section. Try as we might to parcel out each book to some defined subject category, there remained the inevitable few that just did not fit—thus, the Miscellaneous section.

Monographic series are listed in this chapter instead of with the journals. In most cases the title of the series has been included and sometimes individual monographs within the series which merit significant attention have also been listed separately. Libraries have different policies on how they catalog and shelve the volumes of a series—together or individually. It should be noted that many publishers have trouble identifying their own series and tend to feel more comfortable locating individual titles. One series for which we have individually listed a perhaps disproportionate number of volumes are publications by the ECETOC, which we find to be extremely useful and underutilized by toxicologists.

A separate chapter is devoted to highlighting some of the relatively few publishers responsible for the vast majority of the toxicology literature, including books and journals. Readers are advised to consult that chapter for information on ordering materials by the listed publishers. Web sites have been included there where available. Publishers have taken to providing informative Web sites, with some, such as the National Academy Press, going so far as to post their books online. They have found that, perhaps counterintuitively, this has served to increase sales of their hard copy books. Johns Hopkins University Press makes available 40 online journals in full text, albeit with a modest subscription fee. Many books you will note now have CD-ROM versions accompanying or updating their paper copy texts, and some have online versions as well. Be advised, though, that the merger and takeover mania that has been sweeping the publishing industry may sometimes make it difficult to track down the party responsible for a book at any given point in time. More books may be found in the Chapters 5 (*General Interest and Popular Works*) and 11 (*Toxology Data and Information Management*).

Books are also available from many bookstores and distributors. On the Web, Amazon (*http://www.amazon.com*) and Barnes and Noble (*http://www.barnesandnoble.com*) are vast online bookstores. Libraries with major holdings in toxicology include the Library of Congress (online catalogs at *http://lcweb.loc.gov/homepage/online.html*), the National Library of Medicine (online public access at *http://www.nlm.nih.gov/locatorplus*) catalog, called *Locator-Plus* and the EPA Library Network's Online Library System (*http://www.epa.gov/epapages/natlibra/ols.htm*) as well as libraries at universities with programs in toxicology and environmental/public health or at governmental public health and environment agencies.

Other good sources for locating books include publications by Bowker (*http://www.bowker.com*), such as *Books in Print Online* which contains records for more than 1 million titles in print, forthcoming, or out-of-print. It is produced by Bowker Reed Reference Electronic Publishing and available from Knight-Ridder Inc.'s DIALOG system (*http://dialog.krinfo.com*).

GENERAL TEXTS

Anderson, D., and Conning, D. M. (Eds.) (1993) ***Experimental Toxicology: The Basic Issues,*** 2nd ed. Royal Society of Chemistry, Cambridge, UK

Contains 25 chapters dealing with current issues in experimental toxicology. Basics such as animal husbandry, statistical analysis, and experimental design are included as well as more advanced topics such as biochemical principles, conceptual problems in immunotoxicology, and molecular toxicology. Each chapter has information that is needed by the practicing toxicologist.

Ballantyne, B., Marrs, T., and Syversen, T. (Eds.) (1999) ***General and Applied Toxicology,*** 2nd ed. Macmillan, London

In three volumes. Completely revised and significantly expanded, with 35 new chapters. Provides an in-depth review of the basic science of toxicology, its specializations, and the application of toxicological knowledge. Subject and chemical indexes in each volume.

Clayton, G. D., and Clayton, F. E. (Eds.) (1995)
Patty's Industrial Hygiene and Toxicology, 4th ed.
Wiley, New York

With over 9000 pages in four volumes and 10 parts in the print edition, *Patty's* is a reliable and complete reference on the principles and practice of industrial hygiene. It is a starting point for research on the toxicological properties of chemicals, research trends, regulations, premissible exposure level data, and more. Volume 2 focuses on toxicology. Wiley also makes available a CD-ROM version.

Derelanko, M. J., and Hollinger, M. A. (Eds.) (1996)
CRC Handbook of Toxicology
CRC Press, Boca Raton, FL

A resource of reference information useful to practicing toxicologists in the chemical and pharmaceutical industries, contract laboratories, regulatory agencies, and academia. Includes diverse information such as normal hematology and clinical chemistry values, reproductive indices, physiological parameters, animal housing requirements, toxicology classifications, and regulatory requirements.

Duffus, J. H., and Worth, H. G. J. (Eds.) (1996)
Fundamental Toxicology for Chemists
Royal Society of Chemistry, Cambridge, UK

Contains a proposed curriculum for teaching toxicology to chemists and gives a firm grounding in the basics. Offers a unique assessment of the subject specifically for chemists. Covers all general principles as well as newly developing areas such as reproduction, behavior, and ecological toxicology. It has been approved the IUPAC (International Union of Pure and Applied Chemists) committees on toxicology and the teaching of chemistry.

Hayes, A. W. (Ed.) (1994)
Principles and Methods of Toxicology, 3rd ed.
Raven Press, New York

Designed as a textbook for courses dealing with an evaluation of toxicologic data providing a thorough, systematic introduction to the field. It describes the most current testing procedures, offers guidance on data interpretation, and highlights current areas of interest. The 31 chapters are well written and are collected under the major headings of toxicologic principles, testing methods, and specific organ systems. This is a standard text which needs to be included in any collection of toxicology books.

Hodgson, E., and Levi, P. E. (1997)
Textbook of Modern Toxicology
Appleton & Lange, Stamford, CT

Reflects current core curriculum covered in a basic toxicology course for graduate students. The text emphasizes the fundamental basis of toxic action at the cellular and molecular level along with laying the foundation for specialized areas of study.

Hodgson, E., Mailman, R. B., and Chambers, J. E. (1998)
Dictionary of Toxicology, 2nd ed.
Macmillan Reference, London

A highly condensed, informative guide to the fundamental basis and applications of toxicology. Provides an understanding of the most important terms and chemical compounds for both novice and expert scientist working in the field.

Kamrin, M. A. (1988)
Toxicology: A Primer on Toxicology Principles and Applications
Lewis, Chelsea, MI

Discusses the general principles of toxicology and how these are applied in assessing the acute, subacute, and chronic effects of chemicals. Both the qualitative and quantitative measures of toxicity are addressed, as are the protocols for the various tests. The following four case studies are presented: cyclamate and saccharin, asbestos, formaldehyde, and benzene.

Kent, C. (1998)
Basics of Toxicology
John Wiley, New York

An easy-to-understand guide offering a broad overview of toxicology, its history, terminology, basic concepts, and methods, with an introduction to epidemiological and toxicological studies.

Klaasen, C. D. (Ed.) (1996)
Casarett & Doull's Toxicology: The Basic Science of Poisons, 5th ed.
McGraw-Hill, New York.

With contributions from over 60 leading experts, this textbook contains virtually all the information one could want on any aspect of poisons and their effects on the human body. Invaluable for students and practitioners alike, it remains the best recognized and most widely used text in a field becoming increasingly crowded with competing works.

Lewis, R. A. (1998)
Lewis' Dictionary of Toxicology
Lewis, Boca Raton, FL

Contains a broad array of commonly used terms in toxicology and related fields. Entries categorize major definitions and usage. Extensive cross-references for

synonyms and related entries. Based on terms found in over 600 journals.

Loomis, T. A., and Hayes, A. W. (1996)
Essentials of Toxicology, 4th ed.
Academic Press, San Diego

A quick overview of toxicology from biological and chemical factors that influence toxicity to routes of exposure, toxicologic testing methods, and effects of exposures on biologic systems. This is a basic text, easily readable, and it covers the major principles of the science.

Lu, F. C. (1996)
Basic Toxicology; Fundamentals, Target Organs, and Risk Assessment, 3rd ed.
Taylor & Francis, Washington

An introductory book intended for students taking toxicology courses or for scientists in allied disciplines. It is divided into four parts: general principles of toxicology, testing procedures, target organs, and toxic substances and safety/risk assessment.

Malachowski, M. J. (1995)
Health Effects of Toxic Substances
Government Institutes, Rockville, MD

Examines the most common hazardous agents present in workplaces and details the routes of exposure and their effects on human organ and system function. The transport of chemicals within the body and factors which determine toxicity and responses, risk assessment, and the anatomy associated with exposure are discussed.

Marquardt, H., Schafer, S., McClellan, R. O., and Welsch, F. (Eds.) (1999)
Toxicology
Academic Press, San Diego

A new text for researchers and graduate students in toxicology and public health. It covers fundamentals, organ toxicology, the toxicology of compounds, biomonitoring and occupational medicine, environmental toxicology, and risk assessment.

Massaro, E. J. (Ed.) (1997)
Handbook of Human Toxicology
CRC Press, Boca Raton, FL

Reflects the current state of human toxicology on metals, nutrition, inhalation, immunologic, and reproductive and developmental effects. Intended for use by a wide range of specialties and includes state-of-the-art methodology, current interest topics, hard to find data, and complete references in each section. A 1999 online version, titled *Human Toxicology Handbook,* is also available through CRC Press' CRCnetBASE.

Niesink, R. J. M., de Vries, J., and Hollinger, M. A. (1996)
Toxicology: Principles and Applications
CRC Press, Boca Raton, FL

Introductory text considering fundamental principles of toxicology, molecular aspects of toxicology, and organ toxicology through applications of toxicology, such as ecotoxicology and occupational toxicology. Includes toxicological safety standards and legislation concerning harmful substances.

Ostler, N. K., Byrne, T. E., and Malachowski, M. J. (1996)
Health Effects of Hazardous Materials
Prentice Hall, Upper Saddle River, NJ

Intended as an introduction to the subject of toxicology for hazardous materials technicians. Topics covered include origin and classification of toxic agents, distribution through the body, metabolism, effects on reproduction in general, affects on target organ systems, effects of environmental pollutants, health effects of radiation, and common industrial hazards.

Ottoboni, M. A. (1991)
The Dose Makes the Poison: A Plain Language Guide to Toxicology, 2nd ed.
Van Nostrand–Reinhold, New York

Presents an objective discussion of what makes chemicals harmful or harmless. The author succeeds in tying together numerous technical concepts and presenting the principles and examples in layman's terms. The chapter titles give an indication of the simple, direct, yet in-depth manner in which she has accomplished this: What Are Chemicals? How They Cause Harm, A Brief History of Toxicology, Factors Influencing Toxicity, Types of Toxicity, Special Biologies, Methods for Study, Human Experience, and Risk.

Schiefer, H. B., Irvine, D. G., and Buzik, S. C. (1997)
Understanding Toxicology: Chemicals, Their Benefits and Risks
CRC Press, Boca Raton, FL

Introduces to the layperson the science of toxicology as it relates to daily living. The book provides a general overview and presents the facts and underlying principles needed by nonspecialists for making decisions about potentially hazardous substances in everyday settings. For those interested in chemical safety, toxic risks, pollution, hazardous wastes, and potential health hazards in the home, this in a very useful book.

Sipes, I. G., Gandolfi, A. J., and McQueen, C. A. (Eds.) (1997)
Comprehensive Toxicology
Pergamon, New York

Designed to encompass investigation from a molecular level to the intact organism. It provides a balanced presentation that integrates specific biological effects of pertinent toxicants across the various disciplines of toxicology. Approximately 7000 pages, in 13 volumes, this book is a mammoth and noteworthy undertaking.

Stine, K. E., and Brown, T. M. (1996)
Principles of Toxicology
CRC Press, Boca Raton, FL

Covers this field from the viewpoint of three different functional levels: molecular and cellular, physiological, and environmental and ecological. Easy to read format is appealing to the novice desiring an overview of the topic.

Timbrell, J. A. (1995)
Introduction to Toxicology, 2nd ed.
Taylor & Francis, London

An introductory text for the beginner. The specific chapters, presented in simple terms, cover introduction, distribution of chemicals, types of exposure and response, drugs, industrial chemicals, food additives, pesticides, environmental agents, natural products, household products, and toxicity testing and risk assessment.

Timbrell, J. (1997)
Study Toxicology through Questions
Taylor & Francis, London

Intended for use as a study guide and revision aid for students and teachers of toxicology. It offers a compilation of questions with answers; the majority are short-answer questions involving the application of principles or data interpretation to work through. It is also useful as an adjunct to the standard teaching texts.

Walker, C. H., Hopkin, S. P., Sibley, R. M., and Peakall, D. B. (1996)
Principles of Toxicology
Taylor & Francis, London

Intended primarily for students, the simplified text covers the basics of the field in an easy-to-read and understand manner.

Wexler, P. (1998)
Encyclopedia of Toxicology
Academic Press, San Diego

The first and only (to date) encyclopedia of toxicology and related disciplines. The book presents an alphabetical arrangement of potentially hazardous chemicals and toxicological principles and concepts. Designed for the toxicologist and nontoxicologist alike, this encyclopedia is extensively indexed and cross-referenced, and it is an ideal first source for learning the basics of many specific areas of concern to toxicology.

See Also:
Maines: *Current Protocols in Toxicology* (Testing Methods and Toxicity Assessment)
Sullivan: *Clinical Environmental Health and Toxic Exposures* (Clinical Toxicology)

Journals

Archives of Toxicology

Chemical Research in Toxicology

Critical Reviews in Toxicology

Human and Experimental Toxicology

International Journal of Toxicology

Journal of Applied Toxicology

Journal of Toxicological Sciences

Toxicological Sciences

Toxicology

Toxicology and Applied Pharmacology

Toxicology Letters

Veterinary and Human Toxicology

ANALYTICAL TOXICOLOGY

Analyses of Hazardous Substances in Biological Materials (1985–)
Wiley, New York

Contains standardized analytical methods for use in biological monitoring. All methods are suitable for routine use and meet standards of reliability and reproducibility. This is a monographic series, with Vol. 5 published in 1997.

Baselt, R. C. (1987)
Analytical Procedures for Therapeutic Drug Monitoring and Emergency Toxicology, 2nd ed.
PSG, Littleton, MA

Presents the methods employed in the analysis of biological specimens for drugs and chemicals. Included in the book are the specific analyses (often multiple methods are presented) for 101 specific chemicals or

chemical grouping. The majority of the agents presented here are commonly prescribed drugs.

Brandenberger, H., and Maes, R. A. A. (Eds.) (1997)
Analytical Toxicology for Clinical, Forensic, and Pharmaceutical Chemists
de Gruyter, Hawthorne, NY

This is Vol. 5 of the series, *Clinical Biochemistry*. Critically evaluates analytical possibilities to assist the reader/user in the choice of methods. Presents information to reach investigation goals and proper interpretation. In addition to the extensive analytical and toxicologic information, the book guides the analytical toxicologist in terms of technical obligations.

Chamberlain, J. (1995)
The Analysis of Drugs in Biological Fluids, 2nd ed.
CRC Press, Boca Raton, FL

Focuses on a variety of techniques available for the analysis of drugs in biological fluids. Other than specific chapters describing the various methods available (chromatography, radioimmunoassay, etc.), the book covers the why's of doing this work and has a useful chapter on the pitfalls with practical solutions to these problems.

Cruros, M. (1997).
Environmental Sampling and Analysis: Laboratory Manual
Lewis, Boca Raton, FL

Directed to environmental health professionals as a guide to practical laboratory techniques. The text presents detailed laboratory safety procedures, explanations of quality assurance and quality control procedures, solution preparation and standardization guidelines, and step-by-step analytical methods for training laboratory technicians.

Eller, P. M., and Cassinelli, M. (Eds.) (1994)
NIOSH Manual of Analytical Methods, 4th ed.
National Institute for Occupational Safety and Health, Cincinnati, OH

A collection of air and biological analytical methods evaluated by NIOSH containing methodology for over 250 toxic substances. These methods have been developed specifically to have adequate sensitivity to detect the lowest concentrations as regulated by OSHA and recommended by NIOSH and sufficient range to measure concentrations exceeding safe levels of exposure.

Flanagan, R. J. (1995)
Basic Analytical Toxicology
World Health Organization, Geneva

Describes simple analytical techniques using a minimum of special apparatus. It provides practical information on the analysis of many substances frequently involved in acute poisonings. Common pitfalls and problems are emphasized and basic health and safety precautions for laboratory workers are discussed.

Hochachka, P. W., and Mommsen, T. P. (1994)
Analytical Techniques: Biochemistry and Molecular Biology of Fishes
Elsevier, Amsterdam

Describes the chemical tools needed to study the effects of chemicals on fish and the effects of fish on chemicals. The book presents detailed procedures for many of the more commonly used chemical analyses.

Jameson, C. W. (Ed.) (1984)
Chemistry for Toxicity Testing
Butterworth, Boston

Describes general chemistry considerations for an *in vivo* toxicity study. It covers dosage mixing, analysis of chemicals, and evaluation of data for a toxicity study. This book is a very useful addition to any toxicology collection despite its age.

Kettup, A. (Ed.) (1995)
Analyses of Hazardous Substances in Air
Wiley–VCH, Berlin

Continuing series providing the analytical methodologies available for detection and quantitation of specific airborne chemicals.

Muller, R. K. (Ed.) (1991)
Toxicological Analysis
Verlag Gesundheit, Berlin

Comprehensive text on identification and methods of analysis of poisons and drugs. It includes detailed descriptions of analysis methods and supporting references.

Oehme, F. W., and Everson, R. J. (1981)
Analytical Toxicology Manual
American College of Veterinary Toxicologists, Manhattan, KS

A manual of analytical methods for the determination of toxicants/nutrients/drugs or their metabolites in body tissues, fluids, feedstuffs, air, water, soil, and building materials.

Pfleger, K., *et al.* (1992)
Mass Spectral and GC Data of Drugs, Poisons, Pesticides, Pollutants and Their Metabolites, 2nd revised and enlarged ed.
VCH, Weinheim

A massive three-volume reference effort for all those using gas chromatography and gas chromatography–mass spectrometry for substance detection and identification in clinical and forensic toxicology. The new edition triples the number of entries to 4370 spectra covering 1500 drugs and medicaments, 800 pesticides and pollutants, and 2000 metabolites.

Shibamoto, T. (Ed.) (1998)
Chromatographic Analysis of Environmental and Food Toxicants
Dekker, New York

Covers a variety of topics such as conventional chromatographic techniques, accommodating cleanup and preparing substances for further instrumental analysis. This is a practical resource showing how to choose the most effective techniques for analytically assessing the toxicity of chemicals in both food and the environment.

Stahr, H. M., (1991)
Analytical Methods in Toxicology
Wiley, New York

Contains proven methods for analytical toxicology. Main classes of chemicals presented in this text include inorganics, myxotoxins, pesticides, rodenticides, antibiotics, drugs, vitamins, food additives, and miscellaneous commercially important chemicals. The appendices present details of the more common methodologies recommended in the chemical-specific section.

Sunshine, I., and Jatlow, P. I. (Eds.) (1975–1982)
Methodology for Analytical Toxicology, Vols. 1 and 2
CRC Press, West Palm Beach, FL

Key book on analytical toxicology. This text describes tests that the treating physician should use in his or her laboratory to diagnose and treat poisonings. The basic principles of the many published methods are discussed. Three types of methods are suggested: a simple direct and qualitative test, a quantitative procedure for the average laboratory, and an elegant precise method for the research lab. The book is divided into an introduction, methods for specific substances, and screening procedures.

Wong, S. H. Y. (Ed.) (1985)
Therapeutic Drug Monitoring and Toxicology by Liquid Chromatography
Dekker, New York

Presents active research into the clinical application of liquid chromatography to drug analysis and reviews the clinical pharmacology of major classes of drugs. This book is directed to clinician, toxicologists, and analytical chemists. Chapters include principles of therapeutic drug monitoring, sampling techniques, instrumentation topics, six classes of drug and their analyses, medicolegal guidelines, LC analyses of miscellaneous drugs, and laboratory management considerations.

Wong, S. H. Y., and Sunshine, I. (Eds.) (1997)
Handbook of Analytical Therapeutic Drug Monitoring and Toxicology
CRC Press, Boca Raton, FL

Contains recent information on the laboratory practices used to monitor drug and metabolite levels in various media. The currently used analytical techniques are discussed in individual chapters as are the methods and means needed for integrity of specimens and quality assurance.

See Also:

Armstrong: *Principles of Exposure Measurement in Epidemiology* (Epidemiology)

Asamovics: *Analysis of Addictive and Misused Drugs* (Chemicals—Drugs)

Berman: *The Laboratory Practice of Clinical Toxicology* (Clinical Toxicology)

Curry: *Poison Detection in Human Organs* (Clinical Toxicology)

ECETOC: *Monograph No. 42: Critical Evaluation of Methods for the Determination of n-Nitrosamines* (Chemicals—Cosmetics and Other Consumer Products)

Erickson: *Analytical Chemistry of PCBs* (Chemicals—Selected Chemicals)

Fong: *Pesticide Residues in Foods* (Chemicals—Pesticides)

Keith: *Principles of Environmental Sampling* (Environmental Toxicology—General)

Landsberger: *Elemental Analysis of Airborne Particles* (Chemicals—Dusts and Fibers)

Maes: *Topics in Forensic and Analytical Toxicology* (Forensic Toxicology)

Ness: *Surface and Dermal Monitoring for Toxic Exposures* (Occupational Health)

Ryan: *Toxicology Desk Reference* (Chemical Compendia)

U.S. Environmental Protection Agency: *Occupational Dermal Exposure Assessment* (Target Sites—Skin)

Journal

Journal of Analytical Toxicology

Journal Articles

Baars, J. A. (1996, June). Analytical toxicology: From environmental monitoring to residue analysis. ***Arhiv za Higijenu Rada i Toksikologiju*** (*Zagreb*) **47**(2), 199–209. [In English]

Black, K. G. and Fenske, R. A. (1996). Dislodgeability of chlorpyrifos and fluorescent tracer residues on turf: Comparison of wipe and foliar wash sampling techniques. ***Arch. Environ. Contam. Toxicol.*** **31**(4), 563–570.

Bost, R. O. (1993). Hair analysis—Perspectives and limits of a proposed forensic method of proof: A review. ***Forensic Sci. Int.*** **63,** 31–42.

el-Masri, H. A., *et al.* (1997). Integrated approaches for the analysis of toxicologic interactions of chemical mixtures. ***Crit. Rev. Toxicol.*** **27**(2), 175–197.

Ferrara, D. S., Tedeschi, L., Frison, G., and Brusini, G. (1998, August 21). Quality control in toxicological analysis. ***J. Chromatogr. B. Biomed. Sci. Appl.*** **713,** 227–243.

Flanagan, R. J. (1995). The poisoned patient: The role of the laboratory. ***Br. J. Biomed. Sci.*** **52,** 202–213.

Flanagan, R. J. (1998). Guidelines for the interpretation of analytical toxicology results and unit of measurement conversion factors. ***Ann. Clin. Biochem.*** **35**(Pt. 2), 261–267.

Hoja, H., *et al.* (1997; March/April). Applications of liquid chromatography–mass spectrometry in analytical toxicology: A review. ***J. Anal. Toxicol.*** **21**(2), 116–126.

Kissel, J. C., *et al.* (1996). Field measurement of dermal soil loading attributable to various activities: Implications for exposure assessment. ***Risk Anal.*** **16,** 115–125.

Tracqui, A., *et al.* (1995). Systematic toxicological analysis using HPLC/DAD. ***J. Forensic Sci.*** **40**(2), 254–262.

Van Emon, J. M., Gerlach, C. L., and Bowman, K. (1998). Bioseparation and bioanalytical techniques in environmental monitoring. ***J. Chromatogr. B.*** Biomedical Applications **715**(1), 211–228.

de Zeeuw, R. A. (1998). Recent developments in analytical toxicology: For better or worse. ***Toxicol. Lett.*** 102–103, 103–108.

ANIMALS IN RESEARCH

Baker, H. J., II, Lindsey, J. R., and Weisbroth, S. H. (Eds.) (1979)
The Laboratory Rat, 2 vols.
Academic Press, New York

Details biology and diseases of *Rattus norvegicus* as a species and is a useful book for scientists using the rat as a test species. There are chapters on taxonomy, genetics, anatomy, physiology, and hematology and clinical biochemistry, as well as nutrition, reproduction, and husbandry. Emphasis is given to spontaneous diseases. Volume 2 reports on research applications of the rat, including research methodology, gnotobiology, and wild rats in research.

Bennett, B. T., Abee, C. R., and Hendrickson, R. (Eds.) (1995)
Nonhuman Primates in Biomedical Research. Biology and Management
Academic Press, San Diego

Presents a definitive reference source for working with and care for nonhuman primates in biomedical research. It provides basic information on the biology and management of commonly used primate species. It includes laws, regulations, and policies; morphology, taxonomy, social behavior; as well as genetics, reproductive biology, housing, nutrition, medical management, and biosafety.

Committee on Dogs, Institute of Laboratory Animal Resources (1994)
Dogs: Laboratory Animal Management
National Academy Press, Washington, DC

Presents regulatory requirements for laboratory animal care, design and maintenance of facilities, animal care, transportation, aging dogs, pain management, and care of breeding animals.

Evans, D. H. (Ed.) (1993)
The Physiology of Fishes
CRC Press, Boca Raton, FL

Aimed at marine biologists and comparative physiologists who wish to learn more about the physiological strategies unique to fish. The 16 chapters cover the differences and similarities among various fish species and compare and contrast them to those in other organisms.

Foster, H. L., Small, J. D., III, and Fox, J. G. (Eds.) (1981)
The Mouse in Biomedical Research, 4 vols.
Academic Press, New York

Provides information on taxonomy, nomenclature, breeding systems, and a historical perspective on the

development and origins of the laboratory and wild mouse. Volume 2 compiles information on infectious diseases of the mouse. These include bacterial, mycotic, viral, protozoal, rickettseal, and parasitic diseases. Volume 3 provides coverage of normative biology and management and care of the laboratory mouse. Volume 4 includes selected applications of the mouse in research.

Fowler, M. E. (1986)
Zoo & Wild Animal Medicine, 2nd ed.
Saunders, Philadelphia

This edition expands the variety of animal groups presented and includes chapters on behavior, disease of free-living wild animals, preventative medicine, and poisoning.

Fox, J. G., Cohen, B. J., and Loew, F. M. (1984)
Laboratory Animal Medicine
Academic Press, New York

Presents information on diseases and biology of the major species of laboratory animals used in biomedical research. The history of laboratory animal medicine, legislation affecting laboratory animals, experimental methods and techniques, design and management of animal facilities, zoonoses, biohazards, animal models, and genetic monitoring are also covered.

Hamm, T. E. (1986)
Complications of Viral and Mycoplasmal Infections in Rodents to Toxicology Research and Testing
McGraw-Hill, New York

Presents papers given at a conference which was held because the infectious diseases of rodents continue to affect research in most laboratories. Examples of how these factors can influence research and testing programs are given as well as current information on prevention or minimization of these as confounders. The book presents data regarding the prevalence of the problem, reviews the manifestations of these diseases in rodent colonies, reviews methods for detection and diagnosis, and discusses practical ways to minimize the impact on scientific research.

Jones, T. C., Mohr, U., and Hunt, R. D. (Eds.) (1993)
Nonhuman Primates I and II
Springer-Verlag, Berlin

Two-volume text dealing with the procurement, handling, and maintenance of this group of animals as related to their use in biomedical research. A series of chapters details the specifics of what is needed to handle these species in the proper manner so as to obtain the best scientific information without violating the rights of these valuable animals. A necessary set for those using or considering the use of the primate in the laboratory.

Loeb, W. F., and Quimby, F. W. (Eds.) (1999)
Clinical Chemistry of Laboratory Animals, 2nd ed.
Taylor and Francis, Philadelphia

An updated comprehensive reference of the clinical chemistry of laboratory animals. Information is presented on a species-by-species basis regarding routine collection and preservation of specimens.

Manning, P. J., Ringler, D. H., and Newcomer, C. E. (Eds.) (1994)
The Biology of the Laboratory Rabbit, 3rd ed.
Academic Press, San Diego

Provides a comprehensive and authoritative source of scientifically based information on the rabbit. The text emphasizes the normal biology as well as diseases of the European domestic rabbit. Other chapters cover anesthesia and analgesia, models in infectious disease research, models in ophthalmology and vision research, polyclonal antibody production, and toxicity and safety testing and there is an appendix on drug dosages and clinical reference data.

Mobbing, G. P. (Ed.) (1985)
Animal Stress
American Physiological Society, Bethesda, MD

The problems and methods of studying stress and suggestions for possible research directions are the theme of this book. The four sections include determination of what constitutes well-being in animals, the evolutionary and ontogenetic determinants of animal suffering, and the use of the biological responses to stress and possible ways to monitor stress in animals.

National Academy of Sciences (1996)
Occupational Health and Safety in the Care and Use of Research Animals
National Academy Press, Washington, DC

Identifies principles for building an effective safety program and discusses the accountability of institutional leaders, managers, and employees for a program's success. Offers specific recommendations for controlling risk through administrative procedures, facility design, engineering controls, and periodic evaluations.

National Library of Medicine, National Institutes of Health
Alternatives to the Use of Live Vertebrates in Biomedical Research and Testing
National Library of Medicine, Bethesda, MD

This bibliographic series with abstracts provides references to literature dealing with refining procedures to

reduce pain and discomfort to animals, reducing the number of animals required for testing, and replacing live vertebrates when an alternative methodology is feasible. Available from the National Library of Medicine (see Organizations) at *http://sis.nlm.nih.gov/pagebpub.htm.*

National Research Council, Institute for Laboratory Animal Resources (1995)
Guide for the Care and Use of Laboratory Animals
National Research Council, Washington, DC

Provides information to promote the humane care of animals used in biomedical and behavioral research, teaching, and testing. It includes institutional policies and responsibilities, including the monitoring of the care and use of animals. It focuses on animal housing and environment, behavioral management, husbandry, and population management. It discusses veterinary medical care and responsibilities of the attending veterinarian.

National Research Council (1996)
Rodents
National Academy Press, Washington, DC

Prepared by the Council's Committee on Rodents, this is a thorough resource guide for the management of laboratory rodents. The monograph examines animal selection, sources of rodents, nomenclature and record keeping, management of genetically and nongenetically defined colonies, and management of animals with special needs.

Ritchie, B. W., Harrison, G. J., and Harrison, L. R. (1994)
Avian Medicine: Principles and Application
Wingers, Lake Worth, FL

Contains seven sections: companion birds, patient evaluation, treatment, internal medicine, disease etiologies (including toxins and biotoxins), surgery, and comparative medical management.

Rollin, B. E., and Kesel, M. L. (Eds.) (1995)
The Experimental Animal in Biomedical Research, Vols. 1 and 2
CRC Press, Boca Raton, FL

Presents an overview of issues and concepts needed to do good animal research from both a scientific and an ethical perspective (Vol. 1). Volume 2 provides researchers with basic information about the needs and natures of the diverse animal species used in research, including husbandry, common diseases, pain control, and basic biology.

Stoskopf, M. K. (1993)
Fish Medicine
Saunders, Philadelphia

Focuses on clinical fish medicine which is distinct from fish pathology, fisheries biology, and fisheries management. The first section of the book covers basic clinical knowledge applicable to fishes in general from fish anatomy, histology, and morphology to techniques and methodology. The second portion of the book covers specific groups of fishes.

Suckow, M. A. (Ed.) (1997–)
Laboratory Animal Pocket Reference Series
CRC Press, Boca Raton, FL

Titles to date and envisioned include the following: *The Laboratory Rabbit* (M. A. Suckow and F. A. Douglas, 1997), *The Laboratory Mouse* (T. L. Cunliffe-Beamer, 1997), *The Laboratory Guinea Pig* (L. Terril 1997), *The Laboratory Rat* (P. Sharp and M. LaRegina, 1997), *The Laboratory Hamster and Gerbil* (K. Field and A. L. Sibold, 1998), *The Laboratory Cat* (B. J. Martin, 1997), *The Laboratory Non-Human Primate* (J. D. Fortman, B. T. Bennett, and T. A. Hewett, 1998), and *The Laboratory Small Ruminant* (G. L. Borkowski and P. Eness, 1998). Each volume is aimed at assisting those who work with laboratory animals, enabling them to provide the most humane, responsible care. Each contains information relating to important biological feature, husbandry, management, veterinary care, experimental methodology, and resources.

Svendsen, P., and Hau, J. (Eds.) (1994)
Handbook of Laboratory Animal Science: Vol. 1. Selection and Handling of Animals in Biomedical Research
CRC Press, Boca Raton, FL

Textbook covering the approved methods for the humane housing, handling, and uses of animals in biomedical research. A total of 14 chapters cover topics such as ethics, pertinent legislation, good laboratory practice, facilities, genetics, health status, health monitoring, nutrition, treatments and pain, and *in vitro* models.

Svendsen, P., and Hau, J. (Eds.) (1994)
Handbook of Laboratory Animal Science: Vol. 2. Animal Models
CRC Press, Boca Raton, FL

Volume explains in detail the comparative considerations underlying the choice of animal species and strains in different research disciplines. Topics include principles, specific end-point biologies such as reproduction and neurotoxicity, disease models such as diabetes, pain research, and models in virology, bacteriology, mycology, and cancer research.

Tucker, M. (1997)
Diseases of the Wistar Rat
Taylor & Francis, Bristol, PA

Describes the spontaneous diseases of a closed colony of specific, pathogen-free Wistar rats which have been bred and used continuously for 40 years. A large database has been collected from over 10,000 animals used as controls in experiments. The book focuses on spontaneous diseases of the strain by anatomical system and includes information on many aspects of laboratory data, including the incidence of tumors. It also compares and contrasts the diseases with those in other strains of rat.

Tuffery, A. A. (Ed.) (1995)
Laboratory Animals: An Introduction for Experimenters, 2nd ed.
Wiley, New York

Presents the basic requirements for anyone conducting animal experiments; animals must be handled with care and understanding, the elements of husbandry, feeding, dosing, anesthesia, and surgery. Special topics such as experimental design and ethical issues are discussed in detail.

VanHoosier, G. L., and McPherson, C. W. (Eds.) (1987)
Laboratory Hamsters
Academic Press, New York

Focuses on the Syrian golden hamster, but includes sections on Chinese, European, and other hamsters used in the laboratory. Chapters on the Syrian golden hamster cover basic biology and care, diseases, biomethodology, and drug therapy. Additional chapters cover the biology, care, and diseases of the other strains.

Wagner, J. E., and Manning, P. J. (Eds.) (1976)
The Biology of the Guinea Pig
Academic Press, New York

Provides comprehensive coverage of material on the applied care and management of guinea pigs and their diseases. There are exhaustive chapters on guinea pig behavior, genetics, specific pathogen-free technique, biomethodology, and colony husbandry. There are also review chapters on the use of guinea pigs in nutrition research, otologic research, toxicology, and teratology.

World Health Organization (WHO) Expert Committee (1985)
International Guiding Principles for Biomedical Research Involving Animals
WHO, Geneva

Statement of principles offering guidance to those engaged in animal experimentation. The objective of the conference was to provide a conceptual and ethical framework, acceptable both to the international biomedical community and to the responsible animal welfare groups.

See Also:
Section on Testing Methods and Toxicity Assessment

Balls: *Animals and Alternatives in Toxicology: Present Status and Future Prospects* (Testing Methods and Toxicity Assessment)

Benirschke: *Pathology of Laboratory Animals* (Pathology)

Boorman: *Pathology of the Fischer Rat* (Pathology)

Evans: *Animal Clinical Chemistry* (Target Sites—Hematopoetic)

Evans: *Animal Clinical Chemistry: A Primer for Toxicologists* (Clinical Toxicology)

Faccini: *Mouse Histopathology, a Glossary for Use in Toxicity and Carcinogenicity Studies* (Pathology)

Gad: *Animal Models in Toxicology* (Testing Methods and Toxicity Assessment)

Goldberg: *The World Congress on Alternatives* (Testing Methods and Toxicity Assessment)

Haschek: *Handbook of Toxicologic Pathology* (Pathology)

Heath: *Water Pollution and Fish Physiology* (Environmental Toxicology—Aquatic)

Hochachka: *Analytical Techniques* (Analytical Toxicology)

International Agency for Research on Cancer: *Pathology of Tumours in Laboratory Animals* (Pathology)

Jones: *Monographs on Pathology of Laboratory Animals* (Pathology)

Jubb: *Pathology of Domestic Animals* (Pathology)

Loeb: *Clinical Chemistry of Laboratory Animals* (Target Sites—Hematopoetic)

Mohr: *Pathobiology of the Aging Mouse* (Pathology)

Mohr: *Pathobiology of the Aging Rat* (Pathology)

Percy: *Pathology of Laboratory Rodents and Rabbits* (Pathology)

Szabo: *Congenital Malformations in Laboratory and Farm Animals* (Developmental and Reproductive Toxicology)

Woodman: *Laboratory Animal Endocrinology* (Target Sites—Endocrine)

Journals

American Journal of Veterinary Research

Journal of Animal Science

Lab Animal

Laboratory Animal Science

Laboratory Animals

Journal Articles

Calabrese, E. J. (1996). Striking the balance between the role of animal model and human data in hazard assessment. ***Hum. Exp. Toxicol.*** **16**(4), 186–187.

Collick, A., *et al.* (1998). Current and future contributions of transgenic mice to the analysis of germline toxicology. ***Adv. Exp. Med. Biol.*** **444,** 119–125.

Gad, S. C. (1990, July). Recent developments in replacing, reducing, and refining animal use in toxicologic research and testing. ***Fundam. Appl. Toxicol.*** **15,** 8–16.

Goldsworthy, T. L., *et al.* (1994). Transgenic animals in toxicology. ***Fundam. Appl. Toxicol.*** **22,** 8–19.

Hammond, A. C. (1994). Animal well-being in pharmacology and toxicology research. ***J. Anim. Sci.*** **72**(2), 523–527.

Hart, R. W., *et al.* (1995). Caloric restriction and toxicity. ***Fundam. Appl. Toxicol.*** **25,** 184–195.

Mirsalis, J. C., *et al.* (1995). Transgenic animal models for detection of *in vivo*. ***Annu. Rev. Pharmacol. Toxicol.*** **35,** 145–164.

Oberdorster, G. (1996). Evaluation and use of animal models to assess mechanisms of fibre carcinogenicity. ***IARC Sci. Publ.*** **140,** 107–125.

Olson, H. M., *et al.* (1996). From teachers to toxicologists: Answering the tough questions about animal research. ***Fundam. Appl. Toxicol.*** **34,** 5–16.

Purchase, I. F. H., Botham, P. A., Bruner, L. H., Flint, O. P., Frazier, J. M., and Stokes, W. S. (1998). Workshop overview: Scientific and regulatory challenges for the reduction, refinement, and replacement of animals in toxicity testing (36th Annual Meeting of the Society of Toxicology, Cincinnati, OH; *In vitro* toxicity specialty section). ***Toxicol. Sci.*** **43**(2), 86–101.

Sande, P., and Svendsen, O. (1998). Animal burdens versus human benefits—How should the ethical limits be drawn for use of animals as models in toxicology? ***Arch. Toxicol. Suppl.*** **20,** 31–40.

Sandoe, P., and Svendsen, O. (1998). Animal burdens versus human benefits—how should the ethical limits be drawn for use of animals as models in toxicology? ***Arch. Toxicol. Suppl.*** **20,** 31–40.

Svendsen, O., *et al.* (1997). Laboratory animal science, welfare and ethics in pharmacology and toxicology. ***Pharmacol. Toxicol.*** **80,** 3–5.

BIOMONITORING/BIOMARKERS

Baselt, R. C. (1988)
Biological Monitoring Methods for Industrial Chemicals, 2nd ed.
Year Book Med. Pub., Littleton, MA

Compiles into manageable form the existing data on the human disposition of chemicals which are amenable to biological monitoring. Also provides practical analytical methods for these chemicals or their metabolites in the appropriate specimens. Over 90 specific industrial chemicals or environmental agents are included in this book.

Blancato, J. N., Brown, R. N., Dary, C. C., and Saleh, M. A. (Eds.) (1996)
Biomarkers for Agrochemicals and Toxic Substances
American Chemical Society, Washington, DC

Outlines the usefulness of biomarkers to accurately measure individual exposure. From a symposium in 1995, the text focuses on measurement techniques and applications and on new and innovative thinking regarding the interpretation of measurement results. A number of new physiologic end points as markers of either (or both) effect and exposure are presented.

Butterworth, F. M., Corkum, L. D., and Guzman-Rincon, J. (Eds.) (1995)
Biomonitors and Biomarkers as Indicators of Environmental Change: A Handbook
Plenum, New York

Documents recent developments and applications in biomonitor and biomarker research. It covers 20 biomonitor/biomarker systems that include a range of end points in a variety of laboratory and sentinel organisms exhibiting greater reliability, shorter turnaround time, and lower cost. In addition to describing the background and principles, it provides protocols for immediate application.

Carson, B. L., Ellis, H. V., and McCann, J. L. (1986)
Toxicology and Biological Monitoring of Metals in Humans
Lewis, Boca Raton, FL

Serves to bring toxicological, exposure, and monitoring information about the metals together in a brief, uniform format. After an introduction, separate chapters for each metal are presented.

Clarkson, T. W., Friberg, L., Nordberg, G. F., and Sager, P. R. (1988)
Biological Monitoring of Toxic Metals
Plenum, New York

Defines and evaluates the scientific basis for the biological monitoring of metals. The first part is an overview. The second part focuses on specific metals, sampling and monitoring procedures, and analyses.

Fiserova-Bergerova, V., and Ogata, M. (Eds.) (1990)
Biological Monitoring of Exposure to Industrial Chemicals
American Conference of Governmental Industrial Hygienists, Cincinnati, OH

Presents a series of papers comparing the approaches to biological monitoring in Japan and the United States. In both countries, the concept of biological monitoring was developed similarly and the basis for and practice of it is discussed with both theory and practice considered. The three main topics are concepts and implementation of monitoring industrial chemicals, reviews of recent research, and concepts of reference values and action levels for proper control. The book is a valuable working guide to the subject.

Lauwerys, R. R., and Hoet, P. (1993)
Industrial Chemical Exposure: Guidelines for Biological Monitoring, 2nd ed.
Lewis, Boca Raton, FL

Discusses the objective of biological monitoring, the types of biological monitoring methods, their advantages and limitations, and practical aspects that must be considered before initiating a program. Examines inorganic and organometalic substances.

Mendelsohn, M. L., Peeters, J. P., and Normandy, M. J. (Eds.) (1995)
Biomarkers and Occupational Health. Progress and Perspectives
Joseph Henry, Washington, DC

Properties of biomarkers offer an approach to monitoring individuals in an environmental or occupational setting and thereby estimating future, current, or integrated risk. The development and application of such methods is presented, recognizing the goal of protecting workers, documenting their individual exposure histories, identifying threatening work situations, reducing the potential for adverse effects, and assigning some degree of risk to exposure that has occurred or will occur.

Minear, R. A., Ford, A. M., Needham, L. L., and Karch, N. J. (1995)
Applications of Molecular Biology in Environmental Chemistry
Lewis, Boca Raton, FL

Presents findings on human biomonitoring and molecular biological tools in environmental chemistry. Covers assessment of potential exposure, dose to humans, and the molecular basis for some of the affected biological mechanisms.

Peakall, D. (1992)
Animal Biomarkers as Pollution Indicators
Chapman & Hall, London

Examines animal biomarkers (xenobiotically induced cellular or biochemical indicators reflecting chemical exposure) currently available to assess the health of the individual in the environment. Events such as adduct formation by covalent DNA linkage and sister chromatid exchanges are two good examples. Each section gives a brief overview of the biochemistry and physiology of the system, natural factors that influence, and experimental information. Ten sections are included which do an excellent job of bringing the novice reader up to speed.

Que Hee, S. S. (Ed.) (1993)
Biological Monitoring: An Introduction
Van Nostrand–Reinhold, New York

Designed to introduce students to the basic concepts of biological monitoring in humans. The essentials of chemistry and biochemistry are well developed. The major sections include basic mechanisms, routes of exposure and distribution, medical/health surveillance, and miscellaneous topics such as adducts, immunomarkers, and AIDS.

Rogers, K. R., Mulchandani, A., and Zhou, W. (Eds.) (1995)
Biosensor and Chemical Sensor Technology: Process Monitoring and Control
American Chemical Society, Washington, DC

Discusses the use of chemical sensors and biosensors for process and environmental monitoring and for medical applications. The book covers advances in enzyme and antibody-based biosensors including enzyme electrodes and optical immunosensors.

Travis, C. C. (Ed.) (1993)
Use of Biomarkers in Assessing Health and Environmental Impacts of Chemical Pollutants
Plenum, New York

Includes papers from a workshop on the uses of biomarkers in assessing human health. The major sections include molecular dosimetry, dose–response relationships, and biomarkers for environmental exposure toxicity reproductive toxicology, neurotoxicity, and cancer.

See Also:

Greim: *Biological Exposure Values for Occupational Toxicants and Carcinogenic Substances* (Occupational Health)

Hulka: *Biological Markers in Epidemiology* (Epidemiology)

Kintz: *Drug Testing in Hair* (Clinical Toxicology)

National Research Council: *Biologic Markers in Immunotoxicology* (Target Sites—Immune)

National Research Council: *Biologic Markers in Pulmonary Toxicology* (Target Sites—Respiratory)

National Research Council: *Biologic Markers in Reproductive Toxicology* (Developmental and Reproductive Toxicology)

National Research Council: *Biologic Markers in Urinary Toxicology* (Target Sites—Kidney)

Saleh: *Biomarkers of Human Exposure to Pesticides* (Chemicals—Pesticides)

Journal

Biomarkers

Journal Articles

Albertini, R. J. (1998). The use and interpretation of biomarkers of environmental genotoxicity in humans. ***Biotherapy*** **11**(23), 155–167.

Chan, P.-C., and Hsieh, L.-L. (1994). Macromolecular adducts: Biomarkers for toxicity and carcinogenesis. ***Annu. Rev. Pharmacol. Toxicol.*** **34,** 41–68.

Decaprio, A.P. (1997). Biomarkers: Coming of age for environmental health and risk assessment. ***Environ. Sci. Technol.*** **31,** 1837–1848.

dell' Omo, M., and Lauwerys, R. R. (1993). Adducts to macromolecules in the biological monitoring of workers exposed to polycyclic aromatic hydrocarbons. ***Crit. Rev. Toxicol.*** **23,** 111–126.

Griffiths, S. A., and Lumley, C. E. (1998). Non-clinical safety studies for biotechnologically-derived pharmaceuticals: Conclusions from an international workshop. ***Hum. Exp. Toxicol.*** **17**(2), 63–83.

Groopman, J. D., and Kensler, T. W. (1999). The light at the end of the tunnel for chemical-specific biomarkers: Daylight or headlight? ***Carcinogenesis*** **20**(1): 1–11.

Hemminki, K., *et al.* (1996). Future research directions in the use of biomarkers. ***Environ. Health Perspect.*** **104**(Suppl. 3), 459–464.

Herkimer, M., Kinnear, D., Krauth, P., Loader, K., Okey, R., Rawlings, L., and Reynolds, F. (1998). ***Water Environ. Res.*** **70**(4), 954–962.

Holian, A. (1996). Air toxics: Biomarkers in environmental applications—Overview and summary of recommendations. ***Environ. Health Perspect.*** **104**(Suppl. 5), 851–855.

Knopp, D. (1995). Application of immunological methods for the determination of environmental pollutants in human biomonitoring: A review. ***Anal. Chim. Acta*** **311**(3), 383–392.

Kreps, S. E., Banzet, N., Christiani, D. C., and Polla, B. S. (1997). Molecular biomarkers of early responses to environmental stressors: Implications for risk assessment and public health. ***Rev. Environ. Health*** **12**(4), 261–280.

Meyer, M. J., and Bechtold, W. E. (1996). Protein adduct biomarkers: State of the art. ***Environ. Health Perspect.*** **104**(Suppl. 5), 879–882.

Needham, L. L., *et al.* (1995). Case studies of the use of biomarkers to assess exposures. ***Toxicol. Lett.*** **82,** 373–378.

Nelson, E. (1992). Determination of mercapturic acid excretions in exposure control to toxicants. ***Crit. Rev. Toxicol.*** **22,** 341–390.

Ryan-Harshman, M. (1997). Food biotechnology: Food industry, nutrition and public health. ***Proc. Nutr. Soc.*** **56**(3), 845–854.

Saracci, R. (1997). Comparing measurements of biomarkers with other measurements of exposure. ***IARC Sci. Publ.*** **142,** 303–312.

Suk, W. A. *et al.* Human biomonitoring: Research goals and needs. ***Environ. Health Perspect.*** **104**(Suppl. 3), 479–483.

Timbrell, J. A. (1998). Biomarkers in toxicology. ***Toxicology*** **129,** 1–12.

Vainio, H. (1998). Use of biomarkers—new frontiers in occupational toxicology and epidemiology. ***Toxicol. Lett.*** 102–103, 581–589.

van Delft, J. H. M., Baan, R. A., and Roza, L. (1998). Biological effect markers for exposure to carcino-

genic compounds and their relevance for risk assessment. ***Crit. Rev. Toxicol.* 28,** 477–510.

van Welie, R. T. H. *et al.* (1992). Mercapturic acids, protein adducts and DNA adducts as biomarkers of electrophilic chemicals. ***Crit. Rev. Toxicol.* 22,** 271–306.

Walker, C. H. (1998). Biochemical biomarkers and potentiation of toxicity. ***Biotherapy,* 11**(23), 113–117.

Walker, C. H. (1998). The use of biomarkers to measure the interactive effects of chemicals. ***Ecotoxicol. Environ. Safety* 40**(12), 65–70.

BIOTECHNOLOGY

Anonymous (1989)
Field-Testing Engineered Organisms: Genetic and Ecological Issues
Technomic, Lancaster, PA

Addresses some of the genetic and ecological questions raised by the planned introduction of genetically engineered organisms. Provides an historical background and reviews the types of planned introductions: plants, animals, and microbes. Discusses regulatory issues, risk assessment, benefits, and potential consequences.

Bazin, M. J., and Lynch, J. M. (Eds.) (1994)
Environmental Gene Release: Models, Experiments and Risk Assessment
Chapman & Hall, London

Volume begins by giving the background to the construction of mathematical models to model plant and crop growth. This moves to specific models which identify that microbial populations grow in association with plants as do these populations in soil. The final section discusses the risk associated with genetically modified organisms.

Fields, B., Martin, M., and Kamely, D. (Eds.) (1985)
Genetically Altered Viruses and the Environment (Banbury Report No. 22)
Cold Spring Harbor Laboratory Press, Cold Spring Harbor, NY

Reviews viral genetic mechanisms and assesses the state-of-the-art knowledge of viruses. Reports on cell interactions, consideration of the extent to which engineered viruses present novel infectious entities, an assessment of possible public health, and environmental hazards.

Fiksel, J., and Covello, B. T. (Eds.) (1988)
Safety Assurance for Environmental Introductions of Genetically-Engineered Organisms
Springer-Verlag, Berlin

This report summarizes the consensus of an international group of scientific and regulatory experts. A major objective of the group was to evaluate the available safety assurance and risk assessment methods for environmental introductions of genetically engineered organisms.

Frankel, A. E. (Ed.) (1992)
Genetically Engineered Toxins
Dekker, New York

Provides methods and experiences in the molecular biology of genetically engineered toxins. Additionally, the book assembles the data and theories associated with structure–function relationships of individual amino acid residues.

Klingmuller, W. (Ed.) (1988)
Risk Assessment for Deliberate Releases: The Possible Impact of Genetically Engineered Microorganisms on the Environment
Springer-Verlag, Berlin

Discusses activities involving biological materials and processes in which new cellular and molecular methods, coupled with the application of information technologies, are expected to generate major technological progress. The 20 chapters deal mainly with the projected risks associated with these genetically modified biologicals.

Krimsky, S., and Wrubel, R. (1996)
Agricultural Biotechnology and the Environment
Univ. of Illinois Press, Urbana, IL

Organized around generic product types such as disease-resistant crops and transgenic animals. Each chapter provides a systematic overview of scientific developments. The technical analysis of research and product development leads to consideration of other contextual issues such as economic benefits, environmental effects, public perceptions, and social and ethical considerations.

Redenbaugh, K., *et al.* (1992)
Safety Assessment of Genetically Engineered Fruits and Vegetables: A Case Study of the FLAVR SAVR Tomato
CRC Press, Boca Raton, FL

This document addresses the safety of FLAVR SAVR tomatoes as food. The safety concerns that have been identified for FLAVR SAVR tomatoes are based on possible differences between FLAVR SAVR tomatoes and conventionally bred tomatoes.

Schmauder, H. P., and Schweizer, M. (Eds.) (1997)
Methods in Biotechnology
Taylor & Francis, Washington, DC

Provides a grounding in the experimental techniques applicable to biotechnology. The introductory section describes procedures for analysis of materials, strain maintenance, and experiments in gene manipulation. Other chapters deal with fermentation techniques, microbial sensors, the demonstration of oil degradation by bacteria, statistical planning, and scale-up methods.

Thomas, J. A. (1998)
Biotechnology and Safety Assessment, 2nd ed.
Taylor & Francis, Philadelphia

Explains how advances in mammalian and plant genetics contribute to better therapeutic agents and more wholesome foods. Addresses issues such as agribiotechnology, safety evaluation of biotechnology-derived drugs, food safety, and environmental aspects.

Walker, J. M., and Cox, M. (1995)
The Language of Biotechnology, 2nd ed.
American Chemical Society, Washington, DC

Attempts to define routinely used specialized language in the various areas of biotechnology. The diverse application of biotechnological processes range from waste treatment to diagnosis and treatment of diseases. This book attempts to put solid definitions behind the current jargon.

See Also:
Engel: *Genetically Modified Foods* (Food and Nutrition)

Meyers: *Molecular Biology and Biotechnology* (Molecular, Cellular, and Biochemical)

Journal Articles

Acuff, G. R., *et al.* (1991). Implications of biotechnology, risk assessment, and communications for the safety of foods of animal origin. ***J. Am. Vet. Med. Assoc.*** **199,** 1714–1721.

Bull, A. T. (1996). Biotechnology for environmental quality: Closing the circles. ***Biodiversity Conservation*** **5,** 1–25.

Caprino, L., and Togna, G. (1993). The problems of the safety evaluation of biotechnology derived drugs. ***Biomed. Environ. Sci.*** **6,** 413–418.

Cavagnaro, J. A. (1995). Immunotoxicity assessment of biotechnology products: A regulatory point of view. ***Toxicology*** **105,** 1–6, [Editorial]

Claude, J. R. (1992). Difficulties in conceiving and applying guidelines for the safety evaluation of biotechnologically-produced drugs: Some examples. ***Toxicol. Lett.*** **64/65,** 349–355.

Clayson, D. B. (1993). Food safety: Are human activities really worse than nature's? ***Regul. Toxicol. Pharmacol.*** **17,** 145–156.

Colwell, R. R. (1991). Risk assessment in environmental biotechnology ***Curr. Opin. Biotechnol.*** **2**(3), 470–475.

Conclusions of the satellite symposium of the Eurotox '91 Congress of Safety Aspects of Biotechnology-Derived Drugs (1992). ***Hum. Exp. Toxicol.*** **11,** 369–372.

Dayan, A. D. (1995). Safety evaluation of biological and biotechnology-derived medicines. ***Toxicology*** **105,** 59–68.

Dempster, A. M. (1995). Pharmacological testing of recombinant human erythropoietin: Implications for other biotechnology products. ***Drug Dev. Res.*** **35,** 173–178.

Edgington, S. M. (1994). Environmental biotechnology. ***Bio/Technology*** **12,** 1338–1342.

Frederick, R. J., and Egan, M. (1994). Environmentally compatible applications of biotechnology using living organisms to minimize harmful human impact on the environment. ***Bioscience*** **44,** 529–535.

Kessler, D. A., *et al.* (1992). The safety of foods developed by biotechnology. ***Science*** **256,** 1747–1749.

Kopchick, J. J. (1992). Biotechnology and food safety. ***J. Am. Vet. Med. Assoc.*** **201,** 228–234.

Lelieveld, H. L., *et al.* (1995). Safe biotechnology. Part 6. Safety assessment, in respect of human health, of microorganisms used in biotechnology. ***Appl. Microbiol. Biotechnol.*** **43**(3), 389–393.

Maki, E. (1996) Safety assessment of biotechnology-derived pharmaceutical products. ***J. Toxicol. Sci.*** **21,** 531–533.

Murano, G. (1997). FDA perspective on specifications for biotechnology products—from IND to PLA. ***Dev. Biol. Stand.*** **91,** 3–13.

Pras, N., *et al.* (1995). Plant biotechnology: Possibilities. ***Pharmaceutisch Weekblad*** **130,** 727–736.

Smith, J. (1994). New opportunities in food biotechnology. ***Australasian Biotechnol.*** **4,** 285–291.

Stacey, G. N., and Sheeley, H. J. (1994). Have bio-safety issues in cell culture been overlooked? ***J. Chem. Technol. Biotechnol.*** **61,** 95–96.

Terrell, T. G., and Green, J. D. (1994). Issues with biotechnology prodcuts in toxicologic pathology. ***Toxicol. Pathol.*** **22**(2), 187–193.

Thomas, J. A. (1995). Recent developments and perspectives of biotechnology-derived products. ***Toxicology* 105,** 7–22.

Zbinden, G. (1990). Safety evaluation of biotechnology products. ***Drug Safety* 5,** 58–64.

BIOTOXINS

Bidlack, W. R., and Omaye, S. T. (Eds.) (1995)
Natural Protectants against Natural Toxicants
Technomic, Lancaster, PA

Part 1 provides a brief review of natural toxicants. Part 2 focuses on a fumonisin. Concerns about human exposure, carcinogenic potential, and removal of the toxin from the contaminated food supply are discussed.

Blum, M. S. (Ed.) (1995)
The Toxic Action of Marine and Terrestrial Alkaloids
Alaken, Fort Collins, CO

Focuses on recent developments in both toxicology and chemistry of candidate alkaloids derived from a variety of sources. The chapters treat the toxicologic aspects in great detail. The wide spectrum of alkaloids covered ranges from those found in marine invertebrates to teratogenic alkaloids in foods.

Bresinsky, A., and Besl, H. (1996).
A Colour Atlas of Poisonous Fungi
Manson, London [Translated by N. G. Bisset]

For the researcher in poisonous fungi, knowledge of taxonomy, chemistry, pharmacology, toxicology, and medicine all combine in this book to give a clear picture of the subject. Color photographs with descriptions facilitate identification of fungi.

Bucherl, W., Buckley, E. E., and Deulofeu, V. (Eds.) (1968–1971)
Venomous Animals and Their Venoms, 3 vols.
Academic Press, New York

Classic text covering animal venoms. Offers a comprehensive presentation of the entire field of venomous members of the animal kingdom, the chemistry of the venoms, their physiologic properties, and their antigenicity. The medical aspects of diagnosis and therapy are included.

Cheeke, P. R. (1998)
Natural Toxicants in Feeds, Forages, and Poisonous Plants, 2nd ed.
Interstate, Danville, IL

Covers metabolic effects, metabolism, and ecological roles of plant toxins; toxicants in animal feeds; forage-induced toxicoses; and plants poisonous to livestock.

Cole, R. J., and Cox, R. H. (1981)
Handbook of Toxic Fungal Metabolites
Academic Press, New York

Provides comprehensive coverage of the chemical, physical, spectral, and biological data on toxic fungal metabolites and related chemicals that elicit a toxic response in vertebrate animals. There are 21 sections of metabolites, grouped on the basis of chemical relationships.

Colegate, S. M., and Dorling, P. R. (Eds.) (1994)
Plant-Associated Toxins: Agricultural, Phytochemical, and Ecological Aspects
CAB International, Wallingford, UK

From the proceeding of a symposium on poisonous plants. Main subject headings include regional, epidemiologic, and legal issues, methods for isolation and characterization, the liver, the reproductive system including the embryo, the nervous system as a target, control and treatment of poisoning, and miscellaneous topics.

D'Mello, J. P. F. (Ed.) (1997)
Handbook of Plant and Fungal Toxicants
CRC Press, Boca Raton, FL

Discusses the role of plant and fungal toxicants in carcinogenesis. It provides the reader with a comprehensive range of compounds used as medicinal agents. Also contains information relating to their impact on the immune and reproductive system. Over 2000 specific references are included for more detailed readings.

Dorner, F., and Drews, J. (Eds.) (1986)
Pharmacology of Bacterial Toxins
Pergamon, Oxford, MA

Section 119 of the *International Encyclopedia of Pharmacology and Therapeutics.* Contains a summary of the major bacterial toxins. Introductory chapters on nomenclature, genetics, toxigenesis, and toxin–receptor interactions are followed by detailed chapters on specific toxins or syndromes.

Dvorackova, I. (1990)
Aflatoxins and Human Health
CRC Press, Boca Raton, FL

Provides available data concerned with health risks due to aflatoxins in humans. It includes a history of mycotoxin diseases, Reye's syndrome, and potential carcinogenic effects of aflatoxins. Includes bibliographic references.

Eaton, D. L., and Groopman, J. D. (Eds.) (1994)
The Toxicology of Aflatoxins: Human Health, Veterinary, and Agricultural Significance
Academic Press, San Diego

Comprehensive review of the acute toxic effects of aflatoxins, current levels of understanding of human exposure and effects, agricultural and veterinary aspects, analysis of contamination in foods, and a discussion about quantitative risk assessment.

Foster, S., and Caras, R. A. (Eds.) (1994)
A Field Guide to Venomous Animals and Poisonous Plants, North America
Houghton Mifflin, Boston

Provides a survey of animals and plants dangerous to humans in a field guide format. The book includes black-and-white illustrations of over 300 poisonous plants. Venomous mammals, reptiles, spiders, scorpions, centipedes, and insects are covered and color-plate illustrations are provided.

Halstead, B. W., and Halstead, L. G. (Eds.) (1988)
Poisonous and Venomous Marine Animals of the World, 2nd ed.
Darwin Press, Princeton, NJ

Provides a systematic, organized source of technical data on marine biotoxicology, covering the total world literature. A phylogenetic arrangement is used in this 1000-plus-page compendium. A classic in the field.

Harborne, J. B., Baxter, H., and Moss, G. P. (Eds.) (1996)
Dictionary of Plant Toxins
Wiley, New York

Contains over 1400 compounds with indexes of names, botanical species, molecular formulas, and common plant names. This is a readily usable, current resource.

Harvey, A. L. (Ed.) (1991)
Snake Toxins
Pergamon, New York

Reviews the advances in the knowledge of snake toxins, particularly with regard to the structure, pharmacology, immunology, and genetics of these agents. The focus is on the molecular mechanisms that are known to produce the end-point activity of these agents.

Keeler, R. F., and Mandava, N. B. (1990)
Natural Toxins: Toxicology, Chemistry, and Safety
Alaken, Fort Collins, CO

Presents selected papers from a symposium on natural toxins sponsored by the American Chemical Society. The papers cover a wide variety of natural toxins with most emphasis placed on snake venoms.

Kingsbury, J. M. (1964)
Poisonous Plants of the United States and Canada
Prentice Hall, Englewood Cliffs, NJ

A classic text with an extensive bibliography, supplemented with photographs and line drawings. Chapters discuss algae, fungi, ferns, horsetails, gymnosperms, and grass tetany. Bacteria are excluded.

Lee, C. Y. (Ed.) (1979)
Snake Venoms
Springer-Verlag, Berlin

Volume 52 of the *Handbook of Experimental Pharmacology*. Reviews research on snake venoms. Topics covered include history, chemistry, biochemistry, pharmacologic effects, and clinical/immunologic factors.

Levine, M. I., and Lockey, R. F. (Eds.) (1995)
Monograph on Insect Allergy, 3rd ed.
American Academy of Allergy and Immunology, Milwaukee, WI

Provides a handy, concise, authoritative, and up-to-date source of information on insect allergy. Includes the rapidly expanding information on clinical, immunological, and therapeutic sciences. This edition adds three chapters on the history of insect allergy, the Africanized bee, and European experience with insect allergy.

McGuffin, M. (Ed.) (1998)
American Herbal Products Association's Botanical Safety Handbook
CRC Press, Boca Raton, FL

Provides readily accessible safety data in an easy to use classification system for more than 600 commonly sold herbs. The handbook features information on international regulatory status, standard dosage, and common toxicity concerns.

Potter, R. L., and Ueckert, D. (1997)
Epidermal Cellular Characteristics of Selected Livestock-Poisoning Plants in North America
Texas Experimental Station Press, San Angelo

Useful in identification of plant fragments consumed by domestic animals for diagnostic purposes. Most of the book contains reproductions of microscopic plant fragments found in the digestive system of animals consuming the plants. A useful handbook for veterinary diagnostic laboratories and practitioners.

Russell, F. E. (1983)
Snake Venom Poisoning
Scholium, Great Neck, NY

Introductory text to toxinology. Covers data on the general biology of venomous snakes, their distribution,

the structure of their venom apparatus, the chemical nature of their toxins, and their modes and sites of action, and immunological phenomena.

Russell, F. E. (1984)
Bibliography of Venomous and Poisonous Marine Animals and Their Toxins
University of Southern California Medical Center, Los Angeles

Contains nearly 7000 citations on venomous and poisonous marine organisms and their toxins published before 1981, listed by major phyletic group.

Shier, W. T., and Mebs, D. (Eds.) (1990)
Handbook of Toxinology
Dekker, New York

Designed for the clinician who is presented with toxin-induced disease cases and needs to identify the responsible agent for purposes of therapy. It is also useful for the pharmacologist who wishes to select an agent for his or her particular research or for students seeking information. The 11 chapters are presented by examining in detail the system affect, e.g., cytolyic toxins.

Singh, B. R., and Tu, A. T. (Eds.) (1996)
Natural Toxins 2: Structure, Mechanism of Action, and Detection
Plenum, New York

Based on an American Chemical Society Symposium on Natural Toxins. Provides an overview of toxins from all four major classes. It covers the origin and structure–function aspects of toxins, mechanisms of action, scientific and medical tools, and detection, diagnostics, and therapy. A volume based on the first symposium, also under the title ***Natural Toxins,*** was edited by Keeler.

Spoerke, D. G., and Rumack, B. H. (Eds.) (1994)
Handbook of Mushroom Poisoning: Diagnosis and Treatment, 2nd ed.
CRC Press, Boca Raton, FL

Includes 26 chapters ranging from introductory material and glossary to specific examples of mushroom toxins. Identification, occurrence, diagnosis, and treatment of toxins are all included. International in scope, the contributors are from America, Europe, and Asia.

Teranishi, R., Buttery, R. G., and Sugisani, H. (1993)
Bioactive Volatile Compounds from Plants
American Chemical Society, Washington, DC

Presents information on studies of volatile compounds in relation to human from simple offensive recognition to examination of medicinal properties and physiological and psychological effects. Plant and insect research to correlate volatile compounds from plants to insect responses such as attraction or repulsion is covered. The book also includes offerings from perfumery and flavor chemists to allow the reader an insight into what is and is not known about volatile compounds of plant origin.

Torsell, K. B. G. (1997)
Natural Product Chemistry, 2nd ed.
Taylor & Francis, London

Presents a mechanistic, biosynthetic, and ecological approach to the study of natural product chemistry. Intended for students and researchers, the book contains chapters on chemical ecology and evolution as well as recent advances in the field.

Tu, A. T. (1983–)
Handbook of Natural Toxins
Dekker, New York

This important ongoing monographic series is a prime resource for natural toxins information. The following volumes have been published through 1995:

1. *Plant and Fungal Toxins*
2. *Insect Poisons*
3. *Marine Toxins and Venoms*
4. *Bacterial Toxins*
5. *Reptile Venoms and Toxins*
6. *Toxicology of Plant and Fungal Compounds*
7. *Food Poisoning*
8. *Bacterial Toxins and Virulence Factors in Disease*

Tu, A. T. (Ed.) (1993)
Toxin-Related Diseases: Poisons Originating from Plants, Animals, and Spoilage
Intercept, Hampshire, UK

Presents 14 chapters describing the different aspects of toxin-related disease. Most of the information covered is on diseases in Asia, not America or Europe. The four parts cover toxic plants and fungi, food spoilage, marine animals from Asia, and terrestrial poisonous animals and their venoms.

Turner, N. J., and Szczawinski, A. F. (1991)
Common Poisonous Plants and Mushrooms of North America
Timber Press, Portland, OR

Provides general information about potentially poisonous plants. Suggested treatments listed for different types of plant poisoning are for guidance purposes and to give a better understanding to physicians and hospital staff. The material in the book is organized alphabetically and includes a useful glossary.

World Health Organization (WHO) (1990)
Selected Mycotoxins: Ochratoxins, Trichothecenes, Ergot, Environmental Health Criteria. No. 105
WHO, Geneva

Evaluates the risks to human health posed by the consumption of food contaminated with ochratoxins, trichothecenes, or ergot. Health effects possibly linked to these mycotoxins range from gastrointestinal disturbances and throat irritation to gangrene, nephropathy, and tumors of the renal pelvis and ureters.

See Also:
Kuhlmann: *Food–Drug Interactions* (Food and Nutrition)

Lovell: *Plants and the Skin* (Target Sites—Skin)

Meir: *Handbook of Clinical Toxicology of Animal Venoms and Poisons* (Clinical Toxicology)

Prakash: *Botanical Pesticides in Agriculture* (Chemicals—Pesticides)

Journals

Journal of Toxicology—Toxin Review

Natural Toxins

Journal Articles

Anderson, P. C. (1998). Missouri brown recluse spider: A review and update. ***Mol. Med.*** **95,** 318–322.

Bahrami, S., *et al.* (1996). Involvement of bacteria/endotoxin translocation in the development of multiple organ failure. ***Curr. Top. Microbiol. Immunol.*** **216,** 239–258.

Barton, E. D., *et al.* (1995). Ciguatera fish poisoning. A southern California epidemic. ***West J. Med.*** **163,** 31–35.

Blythe, L. L., and Craig, A. M. (1994). Role of the liver in detoxification of poisonous plants. ***Vet. Hum. Toxicol.*** **36,** 564–566.

Brin, M. F. (1997). Botulinum toxin: chemistry, pharmacology, toxicity, and immunology. ***Muscle Nerve Suppl.*** **6,** S146–168.

Campbell, G. D. (1996). Mycotoxicosis—Humankind's greatest affliction? ***Nutritional Health*** **10,** 323–329.

Clark, R. F., *et al.* (1992). Clinical presentation and treatment of black widow spider envenomation: A review of 163 cases. ***Ann. Emergency Med.*** **21**(7), 782–787.

Díez Gómez, M. L., *et al.* (1995). Venom immunotherapy: Tolerance to a 3-day protocol of rush-immunotherapy. ***Allergy Immunopathol.*** **23,** 277–284.

Dodd, C. S., and Burgess, N. R. (1995). Why do insects bite? A review of blood sucking behavior. ***J. R. Army Medical Corps*** **141,** 151–156.

Fadda, G., and Volterra, L. (1994). Algal biotoxins. ***Igiene Moderna*** **101,** 487–511.

Gelder, C., *et al.* (1996) Allergy to bee and wasp venom. ***Br. J. Hospital Med.*** **55,** 349–352.

Glaziou, P., and Legrand, A. M. (1994) The epidemiology of ciguatera fish poisoning. ***Toxicon*** **32,** 863–873.

Gold, B. S., and Wingert, W. A. (1994). Snake venom poisoning in the United States: A review of therapeutic practice. ***Southern Med. J.*** **87**(6), 579–589.

Hartigan-Go, K., and Bateman, D. N. (1994). Redtide in the Philippines. ***Hum. Exp. Toxicol.*** **13,** 824–830.

Hawdon, G. M., and Winkel, K. D. (1997). Spider bite. A rational approach. ***Aust. Family Physician*** **26**(12), 1380–1385.

Ismail, M. (1995). The scorpion envenoming syndrome. ***Toxicon*** **33,** 825–858.

Jerrard, D. A. (1996). ED management of insect stings. ***Am. J. Emergency Med.*** **14,** 429–433.

Krenzelok, E. P., *et al.* (1996). Plant exposures: A state profile of the most common species. ***Vet. Hum. Toxicol.*** **38,** 289–298.

Kuiper-Goodman, T. (1995). Mycotoxins: Risk assessment and legislation. ***Toxicol. Lett.*** **82/83,** 853–859.

Kulkarni, M. L. and Anees, S. (1994) Snake venom poisoning: Experience with 633 cases. ***Indian Pediatr.*** **31,** 1239–1243.

Kumar, T. K., Jayaraman, G., Lee, C. S., Arunkumar, A. I., Sivaraman, T., Samuel, D., and Yu, C. (1997). Snake venom cardiotoxins—Structure, dynamics, function and folding. ***J. Biomol. Struct. Dyn.*** **15**(3), 431–463.

Levine, D. Z. (1995). Ciguatera: Current concepts. ***J. Am. Osteopathol. Assoc.*** **95,** 193–198.

Liao, W. (1996). Endotoxin: Possible roles in initiation and development of atherosclerosis. ***J. Lab. Clin. Med.*** **128,** 452–460.

Marasas, W. F. (1995). Fumonisins: Their implications for human and animal health. ***Nat. Toxins*** **3,** 193–198.

McConnell, I. R., and Garner, R. C. (1994). DNA adducts of aflatoxins, sterigmatocystin and other mycotoxins. ***IARC Sci. Publ.* 125,** 49–55.

McCormack, D. R., *et al.* (1995). Mosquito bite anaphylaxis: Immunotherapy with whole body extracts. ***Ann. Allergy Asthma Immunol.* 74,** 39–44.

Meier, J., and Stocker, K. (1991). Effects of snake venoms on hemostasis. ***Crit. Rev. Toxicol.* 21,** 171–182.

Montecucco, C., and Schiavo, G. (1995). Structure and function of tetanus and botulinum neurotoxins. ***Q. Rev. Biophysiol.* 28,** 423–472.

Morris, J. A. (1996). Schizophrenia, bacterial toxins and the genetics of redundancy. ***Med. Hypothesis* 46,** 362–366.

Motohiro, T. (1992). Biotoxins in seafood. ***Dev. Food Sci.* 30,** 243–258.

Murthy, K. R., and Hase, N. K. (1994). Scorpion envenoming and the role of insulin. ***Toxicon* 32,** 1041–1044.

Olney, J. W. (1994). Excitotoxins in foods. ***Neurotoxicology* 15,** 535–544.

Ownby, C. L. (1998). Structure Function and Biophysical aspects of the myotoxins from snake venoms. ***Toxicol. Toxin Rev.* 17**(2), 213–238.

Robens, J. F., and Richard, J. L. (1992). Aflatoxins in animal and human health. ***Rev. Environ. Contam. Toxicol.* 127,** 69–94.

Rylander, R. (1995). Endotoxins in the environment. ***Prog. Clin. Biol. Res.* 392,** 79–90.

Schardein, J. L. (1993). Toxins. ***Chemically Induced Birth Defects* 2,** 800–822.

Scholl, P., *et al.* (1995). Molecular biomarkers for aflatoxins and their application to human liver cancer. ***Pharmacogenetics* 5,** 171–176.

Sears, C. L., and Kaper, J. B. (1996). Enteric bacterial toxins: Mechanisms of action and linkage to intestinal secretion. ***Microbiol. Rev.* 60,** 167–215.

Seiler, J. G., III (1994). Venomous snake bite: Current concepts of treatment. ***Orthopedics* 17,** 707–714.

Smith, J. E., *et al.* (1995). Role of mycotoxins in human and animal nutrition and health. ***Nat. Toxins* 3,** 187–192.

Speijers, G. J. (1995). Toxicological data needed for safety evaluation and regulation on inherent plant toxins. ***Nat. Toxins* 3,** 199–203.

Stewart, J. E., and Jellett, J. F. (1991). A review of marine and freshwater biotoxins of importance to human health. ***Can. Tech. Rep. Fish Aquatic Sci.* 1799,** 26–44.

Tester, P. A. (1994). Harmful marine phytoplankton and shellfish toxicity. Potential consequences of climate change. ***Ann. N.Y. Acad. Sci.* 740,** 69–76.

Theakston, R. D. (1997). An objective approach to antivenom therapy and assessment of first-aid measures in snake bite. ***Ann. Trop. Med. Parasitol.* 91,** 857–865.

Vasanthi, S., and Bhat, R. V. (1998). Mycotoxins in foods—occurrence, health and economic significance and food control measures. ***Indian J. Med. Res.* 108,** 212–224.

Warner, J. S. (1990). **Review of reactions of biotoxins in water.** Battelle Columbus Labs. NTIS AD-A225 908.

CANCER

Anders, M. W., and Dekant, W. (Eds.) (1994)
Conjugation-Dependent Carcinogenicity and Toxicity of Foreign Compounds
Academic Press, New York.

Presents thorough and detailed discussion of the importance of conjugation-dependent activation of xenobiotics to reactive molecules (and the converse) with particular emphasis on those that lead to carcinogenic end points. The authors make good use of specific examples to explain the principles that are involved in xenobiotic metabolism and cancer.

Arcos, J. C. (Ed.) (1995)
Chemical Induction of Cancer: Modulation and Combination Effects
Birkhauser, Boston

Covers fundamentals of the induction of cancer by chemicals and how the process might be interrupted so as to prevent cancer. The book selectively highlights the major properties and metabolism of and tissue responses induced by chemical agents. It offers a perspective for the development of a testable hypothesis that can explain the process-related sequences leading to cancer.

Beral, V., Roman, E., and Bobrow, M. (1996)
Childhood Cancer and Nuclear Installations
BMJ, London

Useful to anyone interested in the epidemiology of populations exposure to radiation. Written in lay terms using several case studies as supporting material.

Brugge, J. (1991)
Origins of Human Cancer: A Comprehensive Review
Cold Springs Harbor Laboratory Press, Plainview, NY

Following several overviews, chapters are divided into sections such as growth control, carcinogenesis and mutagenesis, epidemiology, oncogenes, tumor suppressor genes, regulation of hematopoeisis, leukemia, and carcinomas.

Butterworth, B. E., Slaga, T. J., Farland, W., and McClain, M. (Eds.) (1991)
Chemically-Induced Cell Proliferation
Wiley–Liss, New York

Provides a better understanding of cellular responses in relation to the carcinogenic process. There are sections on cell proliferation in human cancer, basic mechanisms of cell proliferation, regeneration and programmed cell death, and specific examples.

Cockburn, A., and Smith, L. (Eds.) (1994)
Nongenotoxic Carcinogenesis
Springer-Verlag, Berlin

Written to increase our understanding of the mechanism by which this diverse class of agents produces carcinogenic effects. The 11 chapters present the variety of chemicals which produce cancer via a nongenotoxic mechanism. Kidney and thyroid tumors of the rat, peroxisome proliferation, direct oxidative damage, and interaction of genes and hormones are some of the examples presented.

D'Amato, R., Slaga, T. J., Farland, W. H., and Henry, C. (1992)
Relevance of Animal Studies to the Evaluation of Human Cancer Risk
Wiley–Liss, New York

Compilation of presentations given at a conference in 1990. The main sections include carcinogens with both strong animal and human data, chemotherapeutic agents, drugs and environmental agents, carcinogenic enhancing agents, and animal–human comparisons.

European Chemical Industry Ecology and Toxicology Centre (ECETOC) (1980)
Monograph No. 2: A Contribution to the Strategy for the Identification and Control of Occupational Carcinogens
ECETOC, Brussels

Deals with issues and principles which are key contributors to the strategy of identifying and controlling chemical carcinogens. Includes a critical assessment of the techniques used (epidemiology, animal tests, and short-term tests) to identify the carcinogenic potential of chemicals. Then, the nature and limitations of the scientific evidence derived from these techniques are discussed.

European Chemical Industry Ecology and Toxicology Centre (ECETOC) (1982)
Monograph No. 4: Hepatocarcinogenesis in Laboratory Rodents: Relevance for Man
ECETOC, Brussels

Examines one aspect of human carcinogenicity and risk assessment. Critically examines the relevance to man of liver cancers experimentally induced in rodents by exposure to chemicals. Chapters cover mechanisms of carcinogenicity, comparative aspects of animal and human hepatic neoplasia, and areas for future investigations.

European Centre for Ectoxicology and Toxicology of Chemicals (ECETOC) (1994)
Technical Report No. 57: Polypropylene Production and Colorectal Cancer
ECETOC, Brussels

Presents the findings of the task force investigating any association between polypropylene production and colorectal cancer. Examining the toxicological and epidemiological evidence, the report finds no association.

Foye, W. O. (Ed.) (1995)
Cancer Chemotherapeutic Agents
American Chemical Society, Washington, DC

Authoritative treatment on the discovery, development, and understanding of cancer chemotherapeutic agents. It addresses the major classes of agents, including antimetabolites, agents that react with DNA, inhibitors of transcription enzymes, topoisomerase inhibitors, and others. The book provides an overview of the various classes of agents now considered important in the field.

Gold, L. S., and Zeiger, E. (Eds.) (1997)
Handbook of Carcinogenic Potency and Genotoxicity Databases
CRC Press, Boca Raton, FL

Analyzes the results of decades of animal cancer tests, including all those performed in the National Toxicology Program (NTP). The book also includes a summary of the NTP genetic toxicity test results on 1500 chemicals. Available on The Web at *http://potency.berkeley.edu/cpdb.html.*

Graham, J. D., Green, L. C., and Roberts, M. J. (1988)
In Search of Safety: Chemicals and Cancer Risk
Harvard Univ. Press, Cambridge, MA

Describes the controversies in the regulation of chemicals that are known or suspected to cause cancer. The book attempts to dissect these through an intellectual

approach called scientific conflict mapping. The authors conclude with a series of recommendations.

Greim, H., Jung, R., Kramer, M., Marquardt, H., and Oesch, F. (Eds.) (1984)
Biochemical Basis of Chemical Carcinogenesis
Raven, New York

Examines the various steps by which chemicals may induce cancer, using as its basis the multistage model of chemical carcinogenesis. Makes the assumption that many dose-dependent or saturable enzymatic reactions are involved in this process.

Griffiths, K., Adlercreutz, H., Boyle, P., Denis, P., Nicholson, R. I., and Morton, M. S. (1996)
Nutrition and Cancer
Isis Medical Media, Oxford, UK

Concerns endocrine cancer, specifically in relation to prostate and breast cancer. The essential theme is that certain dietary constituents may play a role in the molecular events leading to the development of cancers.

Higginson, J., Muir, C. S., and Munoz, N. (1992)
Human Cancer: Epidemiology and Environmental Causes
Cambridge Univ. Press, Cambridge, UK

Summarizes the epidemiology of human cancer, including both the geographical distribution and the known or suspected causes. Chapters cover epidemiological methods, causative factors in human cancer, legal issues, tissue-specific neoplasms, and cancer in children. This book is invaluable to those wanting a balanced presentation of cancer and cancer causation.

Hodges, G. M., and Rowlatt, C. (1994)
Developmental Biology and Cancer
CRC Press, Boca Raton FL

Proposes that the processes which control both development and the neoplastic state are similar. The book is intended to provide a conceptual basis for a comprehensive understanding of the topic and its multidisciplinary character should allow the reader to integrate specific information from diverse areas.

Homburger, F. (Ed.) (1983)
Skin Painting Techniques and in Vivo Carcinogenesis Bioassays
Karger, Basel

Includes skin bioassays in tobacco carcinogenesis, total exposure of mice to powdered test substances, studies in Syrian hamsters, and ''accelerated'' methods for carcinogen evaluation. Carcinogenesis topics include design of lifetime studies in Syrian hamsters, tumor rates of control rats and mice, and refinements of rodent pathology.

International Agency for Research on Cancer, (IARC) (1972–)
IARC Monographs on the Evaluation of Carcinogenic Risk to Humans
IARC, Lyon

This acclaimed series of critically evaluated monographs presents critical reviews of data on carcinogenicity for agents to which humans are known to be exposed and on specific exposure situations.

International Agency for Research on Cancer (IARC) (1979–)
IARC Scientific Publications
IARC, Lyon

A monographic series with issues focusing on many specialized areas of cancer, including carcinogenesis. Within this series are regularly published, several large compendia, e.g. *Cancer Incidence in Five Continents, Trends in Cancer Incidence and Mortality,* and *Directory of Ongoing Research in Cancer Epidemiology.*

Iversen, O. H. (Ed.) (1988)
Theories of Carcinogenesis
Hemisphere, Washington, DC

Covers the information on the various theories of carcinogenesis discussed at a conference in 1986. The book gives excellent grounding for the various theories and presents objectively the differing point of view. The section divisions are enlightening: philosophy of science—impact of paradigms, oncogenes, two-stage theory, aging and oxidative DNA damage, phenotypic cellular changes, and growth control. This is must reading for the serious cancer researcher.

Kitchin, K. T. (Ed.) (1998)
Carcinogenicity: Testing, Predicting, and Interpreting Chemical Effects
Dekker, New York

Integrates the latest developments in carcinogenic mechanisms as well as interspecies and interorgan differences in experiments. The text discusses why and how tests are conducted, protocol history, advantages and disadvantages of methodologies, contrasting scientific opinions, chemically induced cancers, animal predictive systems, and transgenic models.

Lewis, R. J. (1991)
Carcinogenically Active Chemicals
Van Nostrand–Reinhold, New York

Preliminary chapters on identifying carcinogens, risk assessment, and implanted materials are followed by

chemical entities alphabetically ordered within the following classes: Confirmed Carcinogens, Suspected Carcinogens, and Questionable Carcinogens. Includes toxicity data and references, safety profiles, and consensus report listings.

Li, J. J., Nandi S., and Li, S. A. (Eds.) (1992)
Hormonal Carcinogenesis
Springer-Verlag, New York

Discusses the causal association of hormones, both endogenous and exogenously administered, and a variety of human cancers. Chapters cover all aspects of neoplastic transformation, including initiation, promotion, and progression, and the inhibition of these processes.

Milman, H. A., and Weisburger, E. K. (Eds.) (1994)
Handbook of Carcinogen Testing, 2nd ed.
Noyes, Park Ridge, IL

Based on the experience in developing and evaluating data derived from cancer bioassays at the National Cancer Institute. Recognizing that enumeration and counting of tumors was only a part of the assessment, the authors added chapters covering important adjunct information such as DNA interaction, limitations of structure–activity relationships, and statistical methodologies. The need for considering all aspects of the bioassay program is carefully developed in this text.

National Academy of Sciences (1996)
Carcinogens and Anticarcinogens in the Human Diet: A Comparison of Naturally Occurring and Synthetic Substances
National Academy Press, Washington, DC

Assembles the best available information on the magnitude of potential cancer risk, and potential anticarcinogenic effects, from naturally occurring chemicals, compared with risk from synthetic chemical constituents. The book offers recommendations for epidemiological and diet research, clarifies the issues, and sets the direction for further investigations into diet and cancer.

National Cancer Institute, National Institutes of Health, Department of Health and Human Services
Survey of Compounds Which Have Been Tested for Carcinogenic Activity
National Cancer Institute, Bethesda, MD

[For sale by the U.S. Government Printing Office, Superintendent of Documents, Mail Stop: SSOP, Washington, DC 20402-9328]. Formerly known as Public Health Service Publication No. 149, the massive volumes of this series containing carcinogenicity data date back more than 50 years. In a highly structured format, the **survey** presents in tabular form the reference, types of animal used, preparation and dose, route and site of administration, pathology examination level, the number or percentage of animals with tumors of specific types, survival, duration of experiment, and other detailed information. A variety of indexes provide efficient access to the data. Available on CD-ROM as Cancer Chem (see Databases section of Chapter 6).

National Toxicology Program, Department of Health and Human Services
Annual Report on Carcinogens
U.S. Department of Health and Human Services, Washington, DC

An annual report containing a list of substances which either are known to be carcinogens or may reasonably be anticipated to be carcinogens and to which a significant number of persons residing in the United States are exposed. For each chemical, data includes carcinogenicity, properties, production, exposure, regulations, and references. Available on the Web through the NTP home page *http://ehis.niehsnih.gov.*

Olin, S., Farland, W., Park, C., Rhomberg, L., Scheuplein, R., Starr, T., and Wilson, J. (Eds.) (1995)
Low-Dose Extrapolation of Cancer Risks: Issues and Perspectives
ILSI Press, Washington, DC

Focuses on the critical issues in the extrapolation and use of experimental data in regulatory decision making. It concerns the methods of cancer risk assessment and the interpretation of the results. It provides a historical perspective, a commentary on the present, and some views on future directions.

Parkin, D. M., Muir, C. S., Whelan, S. L., Gao, Y. T., Ferlay, J., and Powell, J. (Eds.) (1992)
Cancer Incidence in Five Continents, Vol. VI
IARC, Lyon

Provides health professionals with reliable, comparable information on the incidence of cancer in populations from many diverse geographical locations. Incidence rates for identified subpopulations are included where considered reliable.

Schwab, M., *et al.* (Eds.) (1998)
Genes and Environment in Cancer
Springer, Berlin

Volume 154 of ***Recent Results in Cancer Research.*** Presents an integrated view of the various environmental, epidemiological, and genetic determinants that contribute to cancer.

Searle, C. E. (Ed.) (1984)
Chemical Carcinogens, 2nd ed.
American Chemical Society, Washington, DC

A selection of papers on topics such as cancer epidemiology, polynuclear aromatic carcinogens, soots, tars, and oils as causes of occupational cancer, chemical carcinogens as laboratory hazards, mineral fiber carcinogenesis, N-nitroso carcinogens, triazenes, aflatoxins, carcinogens in food, inhibition of chemical carcinogenesis, and bioassay of carcinogens. This serves as a useful background to examining current issues.

Sluyser, M. (Ed.)
Apoptosis in Normal Development and Cancer (1996)
Taylor & Francis, Washington, DC

Apoptosis defines the finite life span of a cell. Cancer cells escape this programmed life/death, but an understanding of apoptosis might be helpful. This text discusses the effect on cancer treatment and provides a detailed view of apoptosis in mammalian systems.

Somogyi, A., Appel, K. E., and Katenkamp, A. (Eds.) (1993)
Chemical Carcinogenesis, the Relevance of Mechanistic Understanding in Toxicological Evaluation
Bga-Schriften, Munich

Deals with the application of recent advances in chemical carcinogenesis, especially in extrapolating effects in animals to man. This becomes more important as our tools to analyze and find chemicals in our environment at increasingly lower concentrations becomes greater. Emphasis is on mechanistic rather than descriptive carcinogenesis and this is presented as the likely solution to the human relevance question.

Tomatis, L. (Ed.) (1993)
Indoor and Outdoor Air Pollution and Human Cancer
Springer-Verlag, Berlin

Includes an overview of the issue, sources and levels of both outdoor and indoor air pollutants, environmental carcinogens, experimental evidence for carcinogenic activity, epidemiological evidence for the influence of both indoor and outdoor environments, and the economics of controlling air pollution.

Vainio, H., Magee, P., McGregor, D., and McMichael, A. (Eds.) (1992)
Mechanisms of Carcinogenesis in Risk Identification
IARC, Lyon

Discusses the use of critical biological events considered to be related to cancer-correlated end effects in the assessment of the carcinogenicity of some specified exposure agent. This is a consensus report from a large panel of experts and includes sections on critical molecular targets, mechanisms of carcinogenicity, animal tests and interpretation, biological markers in exposed humans, and data analysis and modeling.

Waalkes, M. P., and Ward, J. M. (Eds.) (1994)
Carcinogenesis
Lippincott–Raven, New York

Offers a variety of reviews that focus on the factors that are involved in tissue-specific induction of cancer by chemicals. Current information on the important processes dictating sensitivity in the various organs is covered in the 13 chapters.

World Health Organization (WHO) (1990)
Summary Report on the Evaluation of Short-Term Tests for Carcinogens, Environmental Health Criteria No. 109
WHO, Geneva

Summarizes the methodology and findings of a large international collaborative study designed to establish the most useful short-term *in vivo* tests for confirming the mammalian genotoxicity and carcinogenic potential of chemicals. The study, which involved the collaboration of 97 investigators from 16 countries, evaluated approximately 50 different *in vivo* techniques.

Zervos, C. (Ed.) (1992)
Oncogene and Transgenic Correlates of Cancer Risk Assessments
Plenum, New York

Reviews the current state of cancer risk assessments. It focuses on the research advances in the biochemistry and physiology of oncogenes (oncogenes research) and in the construction and utilization of transgenic animals (transgenics research). Recommendations for future research are included.

See Also:
Banbury Reports (Miscellaneous)

Coulston: *Human Epidemiology and Animal Laboratory Correlations in Chemical Carcinogenesis* (Epidemiology)

Creasey: *Diet and Cancer* (Food and Nutrition)

De Serres: *Evaluation of Short-Term Tests for Carcinogens* (Genetic Toxicology)

Duffus: *Substances of Abuse: An Assessment of Carcinogenicity* (Chemicals—Drugs)

ECETOC: *Technical Report No. 37: Tetrachloroethylene: Assessment of Human Carcinogenic Hazard* (Chemicals—Solvents)

ECETOC: *Technical Report No. 38: A Guide to the Classification of Preparations Containing Carcinogens, Muta-*

gens, and Teratogens (Testing Methods and Toxicity Assessment)

ECETOC: *Technical Report No. 52: Styrene Toxicology. Investigations on the potential for carcinogenicity* (Chemicals—Solvents)

ECETOC: *Technical Report No. 57: Polypropylene Production and Colorectal Cancer* (Occupational Health)

ECETOC: *Technical Report No. 60: Trichloroethylene: Assessment of Human Carcinogenic Hazard* (Chemicals—Solvents)

ECETOC: *Technical Report No. 65: Formaldehyde and Human Cancer Risk* (Chemicals—Selected Chemicals)

ECETOC: *Monograph No. 3: Risk Assessment of Occupational Chemical Carcinogens* (Risk Assessment)

Farland: *Low-Dose Extrapolation of Cancer Risks: Issues and Perspectives* (Risk Assessment)

Greim: *Biological Exposure Values* (Occupational Health)

Grice: *Interpretation and Extrapolation of Chemical and Biological Carcinogenicity Data to Establish Human Safety Standards; The Use of Short-Term Test for Mutagenicity and Carcinogenicity in Chemical Hazard Evaluation* (Testing Methods and Toxicity Assessment)

Grice: *The Selection of Doses in Chronic Toxicity/Carcinogenicity Studies: Age-Associated (Geriatric) Pathology: Its Impact on Long-Term Toxicity Studies* (Testing Methods and Toxicity Assessment)

Hadjiliadis: *Cytotoxic, Mutagenic, and Carcinogenic Potential of Heavy Metals Related to Human Environment* (Chemicals—Metals)

Hammink: *DNA Adducts* (Molecular, Cellular, and Biochemical Toxicology)

Hart: *Dietary Restriction* (Testing Methods and Toxicity Assessment)

Hendry: *Radiation Toxicology: Bone Marrow and Leukemia* (Radiation)

Henschler: *Occupational Toxicants: Critical Data Evaluation for MAK Values and Classification of Carcinogens* (Occupational Health)

Hill: *Epidemiology of Diet and Cancer* (Epidemiology)

International Agency for Research on Cancer: *Pathology of Tumours in Laboratory Animals* (Pathology)

Kraybill: *Aquatic Pollutants and Biological Effects with Emphasis on Neoplasia* (Environmental—Aquatic)

Lipsky: *Mechanistic Basis and Relevance of Kidney Tumors in Male Rats for Use in Risk Assessment* (Target Sites—Kidney)

Mauderly: *Particle Overload in the Rat Lung and Lung Cancer* (Target Sites—Respiratory)

Mohr: *International Classification of Rodent Tumours, Part I: The Rat Respiratory System* (Target Sites—Respiratory)

Mohr: *Toxic and Carcinogenic Effects of Solid Particles in the Respiratory Tract* (Target Sites—Respiratory)

National Toxicology Program: *NTP Reports* (Chemical Compendia)

Powis: *Anticancer Drugs: Reactive Metabolism and Drug Interactions* (Pharmacokinetics and Metabolism)

Scarpelli: *Experimental Pancreatic Carcinogenesis* (Target Sites—Pancreas)

Sittig: *Handbook of Toxic and Hazardous Chemicals and Carcinogens* (Chemical Compendia)

Thomassen: *Biology, Toxicology, and Carcinogenesis of Respiratory Epithelium* (Target Sites—Respiratory)

Journals

Cancer Causes and Control

Carcinogenesis

Environmental and Molecular Mutagenesis

Journal of Environmental Science and Health. Part C: Environmental Carcinogenesis and Ecotoxicology

Molecular Carcinogenesis

Mutagenesis

Mutation Research

Teratogenesis, Carcinogenesis and Mutagenesis

Journal Articles

Abernathy, C. O., *et al.* (1996). Is ingested inorganic arsenic a ''threshold'' carcinogen? ***Fundam. Appl. Toxicol.* 29,** 168–175.

Ahlborg, U. G., *et al.* (1995). Organochlorine compounds in relation to breast cancer, endometrial cancer, and endometriosis: An assessment of the biological and epidemiological evidence. ***Crit. Rev. Toxicol.* 25,** 462–532.

Ahlgren, J. D. (1996). Epidemiology and risk factors in pancreatic cancer. ***Sem. Oncol.* 23,** 241–250.

Alexandrov, V., Aiello, C., and Rossi, L. (1990, September/October). Modifying factors in prenatal carcinogenesis (review). ***In vivo*** **4**(5), 327–335.

Ashby, J. (1997). Identifying potential human carcinogens—The role of genetically altered rodents. ***Toxicol. Pathol.*** **25**(2); 241–243.

Bull, R. J., *et al.* (1995). Water chlorination: Essential process or cancer hazard? ***Fundam. Appl. Toxicol.*** **28,** 155–166.

Butterworth, B. E., *et al.* (1995, June 29). A strategy for establishing mode of action of chemical carcinogens as a guide for approaches to risk assessments. ***Cancer Lett.*** **93,** 19–46.

Cherian, M. G., *et al.* (1994). Role of metallothionein in carcinogenesis. ***Toxicol. Appl. Pharmacol.*** **126,** 1–5.

Dement, J. M., Hensley, L., and Gitelman, A. (1997). Carcinogenicity of gasoline: A review of epidemiological evidence. ***Ann. N.Y. Acad. Sci.*** **837,** 53–76. Preventive strategies for living in a chemical world: A symposium in honor of Irving J. Selikoff; International symposium, Washington, DC, November 2–5, 1995. (E. Bingham and D. P. Rall, Eds.). New York Academy of Sciences, New York.

Di Marco, P. N., Priestly, B. G., and Buckett, K. J. (1998). Carcinogen risk assessment. Can we harmonise. ***Toxicol. Lett.*** **102–103,** 241–246.

Doll, R. (1996). Nature and nurture: Possibilities for cancer control. ***Carcinogenesis*** **17,** 177–184.

Doll, R. (1998). Epidemiological evidence of the effects of behaviour and the environment on the risk of human cancer. ***Recent Results Cancer Res.*** **154,** 3–21.

Enzmann, H., and Brunnemann, K. D. (1997). The *in ovo* carcinogenicity assay (IOCA): A review of an experimental approach for research on carcinogenesis and carcinogenicity testing. ***Frontiers Biosci.*** **2,** 30–39.

Foster, J. R. (1997). The role of cell proliferation in chemically induced carcinogenesis. ***J. Comp. Pathol.*** **116**(2), 113–144.

Garro, A. J., and Lieber, C. S. (1990). Alcohol and cancer. ***Annu. Rev. Pharmacol. Toxicol.*** **30,** 219–249.

Grasso, P., *et al.* (1991). Role of persistent non-genotoxic tissue damage in rodent cancer and its relevance to humans. ***Annu. Rev. Pharmacol. Toxicol.*** **31,** 253–287.

Hecht, S. S. (1999). Chemoprevention of cancer by isothiocyanates, modifiers of carcinogen metabolism. ***J. Nutr.*** **129**(2), 768S–774S.

Hopkins, J. (1994, February). The role of cancer mechanism in IARC carcinogen classification. ***Food Chem. Toxicol.*** **32**(2), 193–198.

Huber, W. W., *et al.* (1996). Hepatocarcinogenic potential of di(2-ethylhexyl)phthalate in rodents and its implications on human risk. ***Crit. Rev. Toxicol.*** **26,** 365–481.

Huff, J. E., *et al.* (1991). Scientific concepts, value, and significance of chemical carcinogenesis studies. ***Annu. Rev. Pharmacol. Toxicol.*** **31,** 621–652.

Huff, J., *et al.* (1994). Carcinogenicity of TCDD: Experimental, mechanistic, and epidemiological evidence. ***Annu. Rev. Pharmacol. Toxicol.*** **24,** 343–372.

Johannsen, F. R. (1990). Risk assessment of carcinogenic and noncarcinogenic chemicals. ***Crit. Rev. Toxicol.*** **20,** 341–368.

Lai, C., and Shields, P. G. (1999). The role of interindividual variation in human carcinogenesis. ***J. Nutr.*** **129** (2S Suppl.), 552S–555S.

Lake, B. G. (1995). Mechanisms of hepatocarcinogenicity of peroxisome-proliferating drugs and chemicals. ***Annu. Rev. Pharmacol. Toxicol.*** **35,** 483–508.

Lamm, D. L., and Torti, F. M. (1996). Bladder cancer. ***CA: A Cancer J. Clinicians*** **46,** 93–112.

Lee, C. T. (1995). Gene therapy for lung cancer. ***Ann. Oncol.*** **6,** 61–63.

Maekawa, A., and Mitsumori, K. (1990). Spontaneous occurrence and chemical induction of neurogenic tumors in rats—Influence of host factors and specificity of chemical structure. ***Crit. Rev. Toxicol.*** **20,** 287–310.

Magi-Galluzi, C., *et al.* (1998). Proliferation, apoptosis and cell cycle regulation in prostatic carcinogenesis. ***Anal. Quant. Cytol. Histol.*** **20**(5), 343–350.

Mason, J. M., *et al.* (1990). Ability of short term tests to predict carcinogenesis in rodents. ***Annu. Rev. Pharmacol. Toxicol.*** **30,** 149–168.

Monro, A. (1992). What is an appropriate measure of exposure when testing drugs for carcinogenicity in rodents? ***Toxicol. Appl. Pharmacol.*** **112,** 171–181.

Nelson, E. (1996). Laboratory probing of oncogenes from human liquid and solid specimens as markers of exposure to toxicants. ***Crit. Rev. Toxicol.*** **26,** 483–550.

Neumann, H. G., *et al.* (1998). Changes in the classification of carcinogenic chemicals in the work area. Sec-

tion III of the German List of MAK and BAT values. ***Int. Arch. Occup. Environ. Health*** **71**(8), 566–574.

Page, N. P., *et al.* (1997). Implementation of EPA revised cancer assessment guidelines: Incorporation of mechanistic and pharmacokinetic data. ***Fundam. Appl. Toxicol.*** **37,** 16–36.

Perrera, F. P. (1998). Molecular epidemiology of environmental carcinogenesis. ***Recent Results Cancer Res.*** **154,** 39–46.

Roberfroid, M. B., *et al.* (1991). Modulation of hepatocarcinogenesis. ***Annu. Rev. Pharmacol. Toxicol.*** **31,** 163–175.

Sanner, T. *et al.* (1996, April). Carcinogen classification systems: Similarities and differences. ***Regul. Toxicol. Pharmacol.*** **23**(2), 128–138.

Schulte-Hermann, R., *et al.* (1997). Concepts of cell death and application to carcinogenesis. ***Toxicol. Pathol.*** **25,** 89–93.

Sengstag, C. (1994). The role of mitotic recombination in carcinogenesis. ***Crit. Rev. Toxicol.*** **24,** 323–354.

Snyder, R., and Kalf, G. F. (1994). A perspective on benzene leukemogenesis. ***Crit. Rev. Toxicol.*** **24,** 177–210.

Spivack, S. D., Fasco, M. I., Walker, V. E., and Kaminsky, L. S. (1997). The molecular epidemiology of lung cancer. ***Crit. Rev. Toxicol.*** **27,** 319–365.

Stellman, J. M., and Stellman, S. D. (1996). Cancer and the workplace. ***CA: A Cancer J. Clinicians*** **46,** 70–92.

Tanaka, T. (1997). Effect of diet on human carcinogenesis. ***Crit. Rev. Oncol./Hematol.*** **25**(2), 73–95.

Taningher, M., *et al.* (1997). Methods for predicting carcinogenic hazards: New opportunities coming from recent developments in molecular oncology and SAR studies. ***Mutat. Res.*** **391**(1/2), 3–32.

Tomatis, L. (1994). Transgeneration carcinogenesis. A review of the experimental and epidemiological evidence. ***Jpn. J. Cancer Res.*** **85**(5), 443–454.

Toth, B. (1997). Facts, myths, and reflections on the use of maximum tolerated dose in chemical carcinogenesis. ***Int. J. Oncol.*** **10**(3), 529–553.

Turusov, V. S., and Cardis, E. (1989). Review of experiments on multigeneration carcinogenicity: Of design, experimental models and analyses. ***IARC Sci. Publ.*** **96,** 105–120.

Vainio, H. (1994). Use of mechanistic and other data in identifying carcinogens: A review based on the IARC Monographs programme. ***Arch. Toxicol.*** **16,** 281–294.

Vamvakas, S., Vock, E. H., and Lutz, W. K. (1997). On the role of DNA double-strand breaks in toxicity and carcinogenesis. ***Crit. Rev. Toxicol.*** **27,** 155–174.

Van Delft, J. H., Baan, R. A., Roza, L. (1998). Biological effect markers for exposure to carcinogenic compounds and their relevance for risk assessment. ***Crit. Rev. Toxicol.*** **28**(5), 477–510.

Van Deun, K., Van Cauteren, H., Vandenberghe, J., Canning, M., Vanparys, P., and Coussement, W. (1997). Review of alternative methods of carcinogenicity testing and evaluation of human pharmaceuticals. ***Adverse Drug React. Toxicol. Rev.*** **16**(4), 215–233.

Wolff, G. L. (1996). Variability in gene expression and tumor formation within genetically homogeneous animal populations in bioassays. ***Fundam. Appl. Toxicol.*** **29,** 176–184.

Yager, J. D., and Liehr, J. G. (1996). Molecular mechanisms of estrogen carcinogenesis. ***Annu. Rev. Pharmacol. Toxicol.*** **36,** 203–232.

CHEMICAL COMPENDIA

Agency for Toxic Substances and Disease Registry (ATSDR)

Miscellaneous publications
ATSDR, Atlanta

ATSDR publishes a variety of valuable chemical-specific documents. They have published or have under development more than 200 *Toxicological Profiles* for hazardous substances found at National Priorities List (NPL) sites. These are thorough technical manuals characterizing the toxicology of chemicals (available on CD-ROM from CRC Press: *http://www.crcpress.com*). ATSDR's *Fact Sheets on Hazardous Substances* are one-page summaries on hazardous substances condensed from the Profiles' Public Health Statement sections. ATSDR's *Case Studies in Environmental Medicine* are self-instructional educational materials designed to guide health professionals through the diagnosis, treatment, and surveillance of persons exposed to hazardous substances. Copies of some of these documents are available at no charge to qualified (determined by ATSDR) individuals by writing ATSDR, 1600 Clifton Road, Atlanta, GA 30333. Many of these documents are also available for sale through the National Technical Information Service, 5285 Port Royal Road, Springfield, VA 2161 (Phone: 800-553-6847 or 703-487-4650). ATS-

DR's *Toxicological Profiles* (with annual updates) are available for sale from CRC Press as part of their CRCnetBase through a variety of CD-ROM products.

Ash, M., and Ash, I. (Eds.) (1994)
Gardner's Chemical Synonyms and Trade Names, 10th ed.
Gower, Hant, UK

Includes industrial chemicals, polymers, plastics, resins, elastomers, plastic, resin, elastomer additives, coating and paints, adhesives, inks, pigments, dyes, textiles, surfactants, fillers and fibers, pharmaceuticals, agricultural chemicals, food additives, and cosmetic additives.

BG Chemie (1990–)
Toxicological Evaluations: Potential Health Hazards of Existing Chemicals
Springer-Verlag, New York

English edition of the German BG Chemie toxicological assessments of widely used chemicals. These evaluations are based on documentation found in the scientific literature, on experimental studies commissioned by the BG Chemie, and on experience of the expert panel. Each evaluation includes a summary and assessment, physical properties, and results of toxicity testing. Volume 14 was published in 1997.

Bretherick, L. (1990)
Handbook of Reactive Chemical Hazards, 4th ed.
Butterworths, London

Covers a large amount of information on hazards in laboratories from chemical use and exposure. The text is easy to use with alphabetical chemical-by-chemical listings covering the first 1477 pages of the book. Classes, groups, and special topics, again in alphabetical order, comprise the last 500 pages.

Cooper, A. R. (Ed.) (1996)
Cooper's Toxic Exposures Desk Reference
CRC Press, Boca Raton, FL

Contains up-to-date summations of hundreds of the most hazardous substances used in industry and found in the workplace. The book (and CD-ROM) is arranged alphabetically and contains the physical properties and warnings, health hazards, exposure routes and effects, protective equipment, medical management, and workplace monitoring.

Cooper, A. R. (1998)
Properties of Hazardous Industrial Materials and Cooper's Chemical Dictionary and Spell Check Database
Lewis, Boca Raton, FL

A CD-ROM listing of over 25,000 hazardous materials, including details on their health hazards, storage, and handling.

Davis, D. J., and Davis, J. A. (1996)
Hazardous Material Reference Book Cross Index
Van Nostrand–Reinhold, New York

Tool to help locate information in case of a hazardous material incident or accident. The book is an index and is streamlined by inclusion of chemical synonyms and also directs the user to the specific source of the detailed information.

Environmental Protection Agency, U. S. (EPA)
Miscellaneous publications

The U.S. EPA publishes an extensive variety of paper and online documents on individual chemicals. Among these documents are the *IRIS Toxicological Reviews*. Recent chemicals covered in this series are acetonitrile, barium and compounds, bentazon, beryllium and compounds, chlordane, chromium (III) insoluble salts, chromium (VI), cumene, methyl methacrylate, methylene diphenyl diisocyanate, naphthalene, and tributyltin. For more information on EPA chemical compilations, visit their web site at *http://www.epa.gov*.

European Chemical Industry Ecology & Toxicology Centre (ECETOC) (1983–)
Joint Assessment of Commodity Chemicals Series
ECETOC, Brussels

Produced by the ECETOC program for preparing critical reviews of the toxicology and ecotoxicology of existing industrial commodity chemicals. Commodity chemicals (i.e., chemicals produced in large tonnage by several companies and having widespread and multiple uses) are jointly reviewed by an expert panel. Summary data and conclusions of the expert panel are included. Past reports include the following:

JACC No. 1, Melamine, 2/83
JACC No. 2, 1,4-Dioxane, 2/83
JACC No. 3, Methyl Ethyl Ketone, 2/83
JACC No. 4, Methylene Chloride, 1/84
JACC No. 5, Vinylidene Chloride, 8/85
JACC No. 6, Xylenes, 6/86
JACC No. 7, Ethylbenzene, 8/86
JACC No. 8, Methyl Isobutyl Ketone, 5/87
JACC No. 9, Chlorodifluoromethane, 10/89
JACC No. 10, Isophorone, 9/89
JACC No. 11, (HFA-132b) 1,2-Dichloro-1,1-Difluoromethane, 5/90
JACC No. 12, (HFA-124) 1-Chloro-1,2,2,2-Tetrafluoroethane, 5/90
JACC No. 13, (HFA-123) 1,1-Dichloro-2,2,2-Trifluoroethane, 5/90

JACC No. 14, (HFA-133a) 1-Chloro-2,2,2-Trifluoromethane, 8/90
JACC No. 15, (HFA-141b) 1-Fluoro-1,1-Dichloroethane, 8/90
JACC No. 16, (HCFC-21) Dichlorofluoromethane, 8/90
JACC No. 17, (HFA-142b) 1-Chloro-1,1-Difluoroethane, 2/91
JACC No. 18, Vinylacetate, 2/91
JACC No. 19, Dicyclopentadiene, 7/91
JACC No. 20, Tris-/Bis-/Mono-(2-Ethylhexyl)Phosphate, 5/92
JACC No. 21, Tris-(2-Butoxyethyl)-Phosphate, 3/92
JACC No. 22, Hydrogen Peroxide, 1/93
JACC No. 23, Polycarboxylate Polymers as Used in Detergents, 11/93
JACC No. 24, (HFC-125) Pentafluoroethane, 5/94
JACC No. 25, (HCFC-124) 1-Chloro-1,2,2,2-Tetrafluoroethane, 7/94
JACC No. 26, Linear Polydimethylsiloxanes (Viscosity 10–100,000 Centistokes), 9/94
JACC No. 27, *n*-Butyl Acrylate, 8/94
JACC No. 28, Ethyl Acetate, 9/94
JACC No. 29, (HCFC-141b) 1,1-Dichloro-1-Fluoroethane, 2/95
JACC No. 30, Methyl Methacrylate, 2/95
JACC No. 31, (HFC-134a) 1,1,1,2-Tetrafluoroethane, 2/95
JACC No. 32, (HFC-32) Difluoromethane, 5/95
JACC No. 33, (HCFC-123) 1,1-Dichloro-2,2,2-Trifluoroethane, 9/95
JACC No. 34, Acrylic Acid, 9/95

Gangolli, S. (Ed.) (1999)
The Dictionary of Substances and Their Effects, 2nd ed. **(*DOSE*)**
Royal Society of Chemistry, Cambridge, UK

A major compilation of data on chemicals with environmental impact, providing a unique combination of all the data required for the assessment of risks associated with the use of those chemicals. Includes new data from toxicity and ecotoxocity studies; results of recent carcinogenicity, mutagenicity, and environmental fate studies; occupational exposure data for France, Germany, Sweden, and Japan, as well as the UK and USA; new risk and safety phrases; and recent relevant legislation. In seven volumes.

Howard, P. H., and Meylan, W. M. (Eds.) (1997)
Handbook of Physical Properties of Organic Chemicals
Lewis, Boca Raton, FL

Contains data of physical and chemical properties on approximately 13,000 organic chemicals. Data include chemical structure, formula, molecular weight, melting/freezing point, boiling point, water solubility, octanol water partition coefficient, vapor pressure, acid dissociation constant, Henry's law constant, and atmospheric hydroxyl radical reaction rate constant.

Lewis, R. J. (1996)
Sax's Dangerous Properties of Industrial Materials, 9th ed.
Van Nostrand–Reinhold, New York

Continues to promote safety by providing up-to-date hazard information on a chemical by chemical basis. Over 20,000 materials are included in alphabetical order. The information is cross-referenced and complete bibliographic citations are included for further reading. A 1998 CD-ROM version is also available.

Lewis, Sr., R. J. (1997)
Hazardous Chemicals Desk Reference, 4th ed.
Wiley, New York

Offers access to over 6,000 compounds commonly used in industry, manufacturing, laboratories, and the workplace. Provides new or updated profiles for each chemical, assessing their hazard potential as poisons, irritants, corrosives, explosives, and carcinogens.

Lide, D. R. (Editor-in-chief) (1999)
CRC Handbook of Chemistry and Physics
CRC Press, Boca Raton, FL

Perhaps the world's most widely used scientific reference, the handbook contains all the most frequently used data in science. Everything from aqueous solubility of organic compounds to flash point data of common substances. Now available in CD-ROM as part of CRCnetBase.

Mackay, D., Shiu, W. Y., and Ma, K. C. (1992–1998)
Illustrated Handbook of Physical–Chemical Properties of Environmental Fate for Organic Chemicals
CRC Press, Boca Raton, FL

Volume I—Monoaromatic Hydrocarbons, Chlorobenzenes, and PCBs, Volume II—Polynuclear Aromatic Hydrocarbons, Polychlorinated Dioxins, and Dibenzofurans, Volume III—Volatile Organic Chemicals, Volume IV—Oxygen, Nitrogen, and Sulfur-Containing Compounds, Volume V—Pesticides.

Mackay, D., Ying Shiu, W., and Ma, K. C. (1999).
Environmental Fate and Degradation Handbook
CRC Press, Boca Raton, FL

Part of CRC's CRCnetBase, an electronic product available either via a CD-ROM subscription product with annual updates, as a site license program, or as a CD-ROM stand-alone product. Brings together physical–

chemical data for similarly structured groups of chemical substances. Synthesizes and continues the ***Illustrated Handbook of Physical–Chemical Properties of Environmental Fate for Organic Chemicals.***

National Toxicology Program (NTP)
NTP Technical Report Series
NTP, Research Triangle Park, NC

Studies of chemicals designed and conducted to characterize and evaluate the toxicologic potential, including carcinogenic activity, of selected chemicals in laboratory animals (usually two species—rats and mice.) Chemicals selected for NTP toxicology and carcinogenesis studies are chosen primarily on the bases of human exposure, level of production, and chemical structure. The interpretive conclusions presented in the reports are based only on the results of the NTP studies. For sale from the National Technical Information Service (NTISH) (703-487-4650). Single copies are available for a limited time from NTP Central Data Management (see the following listing). The abstracts and other study information for 2-year studies are also available at the NTP's World Wide Web site: *http://ntp-server.niehs.nih.gov*.

National Toxicology Program (NTP), Division of Toxicology Research and Testing
Management Status Report
NTP, Research Triangle Park, NC

A periodical publication that provides the status of chemicals studied by the NTP. For copies, contact the Central Data Management, Mail Drop E1-02, NIEHS, P.O. Box 12233, Research Triangle Park, NC 27709 (Phone: 919-541-3419; Fax: 919-541-3687; e-mail: CDM @NIEHS.NIH.GOV). Also available through the NTP web site (*http://ntp-server.niehs.nih.gov*).

Pohanish, R. P. (1997)
Rapid Guide to Hazardous Chemicals in the Environment
Wiley, New York

Collects in one place detailed guidance on regulations, standards, and other pertinent information on chemicals of environmental concern. Approximately 1500 chemicals are covered and the applicable regulations are identified and cross-referenced for ease of use. A CD-ROM version is available.

Pohanish, R. P., and Green, S. A. (1996)
Hazardous Materials Handbook
Van Nostrand–Reinhold, New York

Covers more than 1240 substances and presents technical data as well as chemical properties for widely used and transported industrial materials. This easy to use text also includes a CAS and synonym section. A CD version is available from Wiley.

Prager, J. C. (1995–1998)
Environmental Contaminant Reference Databook
Wiley, New York

In three volumes, identifies regulated chemicals and chemicals of special interest to environmental professionals. Provides information such as CAS number, sampling, analysis, detection limits, manufacturers, odor thresholds, firefighting procedures, and remediation methods. It is available in print and CD-ROM versions.

Proctor, N. H., and Hughes, J. P. (1996)
Proctor and Hughes' Chemical Hazards of the Workplace, (G. J. Hathaway, Ed.), 4th ed.
Van Nostrand–Reinhold, New York

Information on over 600 potentially dangerous chemicals. For each chemical there is provided a profile, formula, CAS No., TLV, synonyms, physical properties, exposure sources and routes, information on dose- responses, target organs, and signs and symptoms of exposure (acute and chronic). References are included.

Ryan, R., and Terry, C. E. (Eds.) (1997)
Toxicology Desk Reference, 4th ed.
Taylor & Francis, New York

In three volumes, with an extensive cross-reference index. Intended to provide a comprehensive source of medical, legal, and technical information concerning human exposure to metals and chemicals and to be a first resource for professionals involved in medical monitoring, industrial hygiene, environmental control, and toxic tort litigation. Information provided on the listed chemicals includes air monitoring reference ranges, kinetics, clinical effects, critical sites of toxicity, biological monitoring tests, laboratory tests and interpretation, federal and state requirements, and case reports. Available on CD-ROM.

Sittig, M. (1991)
Handbook of Toxic and Hazardous Chemicals and Carcinogens, 3rd ed.
Noyes, Park Ridge, NJ

Presents concise chemical, health, and safety information on approximately 1300 toxic and hazardous chemicals. Data are furnished on exposure, permissible limits in air, permissible concentrations in water, routes of entry, harmful effects and symptoms, first air, personal protective methods, storage, shipping, etc.

U.S. Department of Transportation (1996)
1996 North American Emergency Response Guidebook
U.S. Department of Transportation, Washington, DC

Developed jointly by the U.S. Department of Transportation, Transport Canada, and the Secretariat of Communications and Transportation of Mexico for use by firefighters, police, and other emergency services personnel who may be the first to arrive at the scene of a transportation incident involving a hazardous material. It may be purchased from the U.S. Government Printing Office, Superintendent of Documents, Stop: SSMB, Washington, DC 20402 (Fax: 301-489-8995). A new version is planned for publication in the year 2000.

Verschueren, K. (1996)
Handbook of Environmental Data on Organic Chemicals, 3rd ed.
Van Nostrand–Reinhold, New York

Contains information needed to prudently use potentially dangerous chemicals. Each substance (alphabetically) is categorized by physical and chemical properties, air pollution factors, water and soil pollution factors, and biological effects, including aquatic toxicity data, odor thresholds, sampling and analysis information, and structural formulas. Also issued in 1998 as a CD-ROM.

World Health Organization (WHO) (1976–)
Environmental Health Criteria
WHO, Geneva

A distinguished series of over 200 monographs intended to provide critical reviews on the effects on human health and the environment and of chemicals and physical and biological agents. It is published under the joint sponsorhip of the United Nations Environment Programme, the International Labour Organisation, and the World Health Organization. Monographs were recently completed on chlorendic acid and anhydride, thallium, methomyl, 1,2-dibromoethane, and 1,2-dichloroethane. Available from WHO Distribution and Sales, WHO Headquarters, CH-1211 Geneva 27, Switzerland. (E-mail: bookorders@who.ch.) Also note that these criteria documents, the chemical assessment documents below, and many others produced by WHO's International Programme on Chemical Safety and available on the ''IPCS INCHEM'' CD-ROM and on the web (*http://www.inchem.org*.) by subscription.

World Health Organization (WHO) (1998)
Concise International Chemical Assessment Documents (CICAD)
WHO, Geneva

Begun in 1998 and produced within the framework of the Inter-Organization Programme for the Sound Management of Chemicals. CICADs are concise documents providing summaries of relevant scientific information concerning the potential effects of chemicals on human health and the environment. They are based on selected national or regional evaluation documents or existing WHO *Environmental Health Criteria* documents. Their primary objective is to characterize hazard and dose–response from exposure to a chemical.

See Also:
Commission of the Investigation: *List of MAK and BAT Values 1997* (Occupational Health)

Gold: *Handbook of Carcinogenic Potency and Genotoxicity Databases* (Cancer)

Howard: *Handbook of Environmental Fate* (Environmental Toxicology—General)

Lewis: *Carcinogenically Active Chemicals* (Cancer)

Lewis: *Reproductively Active Chemicals* (Developmental and Reproductive Toxicology)

Montgomery: *Groundwater Chemicals Desk Reference* (Environmental Toxicology—Aquatic)

National Cancer Institute: *Survey of Compounds Which Have Been Tested for Carcinogenic Activity* (Cancer)

National Institute for Occupational Safety and Health: NIOSH Publications (Occupational Toxicology)

National Toxicology Program: *Annual Report on Carcinogens* (Cancer)

Shepard: *Catalog of Teratogenic Agents* (Developmental and Reproductive Toxicology)

Vincoli: *Risk Management for Hazardous Chemicals* (Risk Assessment)

Wenninger: *International Cosmetic Ingredient Dictionary* (Chemicals—Cosmetics and Other Consumer Products)

CHEMICALS—COSMETICS AND OTHER CONSUMER PRODUCTS

Cosmetic Ingredient Review Expert Panel
Safety Assessment of Cosmetic Ingredients
Published as special issues of the ***Journal of the American College of Toxicology*** Lippincott–Raven, Philadelphia.

These outstanding reports are the results of an expert panel's public review of data and publication of safety assessments in the peer-reviewed scientific literature. The Cosmetic Ingredient Review Expert Panel, which

celebrated its twentieth anniversary in 1996, may make one of four determinations: (i) that the ingredient is safe as currently used, (ii) that the ingredient is safe with qualifications (e.g., up to a given concentration), (iii) that the ingredient is unsafe, or (iv) that there is insufficient information for the panel to make a determination. Volume 15, Issue 6 (1996) included a final report on butoxyethanol and an amended final report on cocamide DEA. Also, check the Cosmetic Ingredient Review home page (*http://www.ctfa-cir.org*).

Draelos, Z.D. (1995)
Cosmetics in Dermatology, 2nd ed.
Churchill Livingstone, New York

Text is organized by the type of cosmetic or skin care product. A general discussion of the history, formulation, application, and adverse reactions in a given cosmetic category is provided. This is intended to help the physician understand patient questions, provide appropriate advice, and recognize cosmetic-related problems.

European Chemical Industry Ecology and Toxicology Centre (ECETOC) (1990)
Technical Report No. 41: Human Exposure to N-Nitrosamines, Their Effects, and a Risk Assessment for N-Nitrosodiethanolamine in Personal Care Products
ECETOC, Brussels

Reviews the available data on the toxicology of N-nitrosodiethanolamine relative to other N-nitrosamines with particular reference to absorption, metabolism, mechanistic considerations, and animal carcinogenicity.

European Chemical Industry Ecology and Toxicology Centre (ECETOC) (1991)
Monograph No. 42: Critical Evaluation of Methods for the Determination of N-Nitrosamines in Person Care and Household Products
ECETOC, Brussels

Evaluates the available methods for the analysis of N-nitrosamines in personal care and household products. It also discusses the sensitivity and specificity of each of the methods.

Frosch, P. J., *et al.* (Eds.) (1998)
Fragrances: Beneficial and Adverse Effects
Springer, Berlin

Presents numerous aspects of fragrance use and safety. Includes detailed information on recent neuropharmacological and psychosocial findings, chemistry, and identification of sensitizers by various assays, and skin absorption studies and environmental issues.

Leung, A. Y. (1995)
Encyclopedia of Common Natural Ingredients Used in Food, Drugs, and Cosmetics, 2nd ed.
Wiley, New York

The new edition of a text concentrating on natural ingredients commonly used in food, over-the-counter drugs, and cosmetic products.

Loprieno, N. (1995)
Alternative Methodologies for the Safety Evaluation of Chemicals in the Cosmetic Industry
CRC Press, Boca Raton, FL

Presents current thinking on *in vitro* methodologies that might be helpful in the safety evaluation of cosmetic formulations. The chapter titles are instructive: Introduction, Animal Toxicity Studies, Alternative Methods to Animal Testing, Guidelines for Such Assays, Future Developments, and An *in vitro* Toxicity Database.

Opdyke, D. L. J. (Ed.) (1974–)
Monographs on Fragrance Raw Materials
Pergamon, Oxford

A monographic series, each volume of which covers the chemistry, physical properties, and toxicology of agents used in cosmetics.

Wenninger, J. A., and McEwen, G. N., Jr. (1997)
International Cosmetic Ingredient Dictionary and Handbook, 7th ed.
Cosmetic, Toiletry and Fragrance Association, Washington, DC

In three volumes, this dictionary has been recognized in the national laws and regulations of many countries as the primary source of uniform names for ingredients of cosmetics, toiletries, and other personal care products. Includes, when available, CAS and EINECS numbers, empirical formulas, definitions, information sources (including CFR citations) technical and trade names, and trade name mixtures. Extensive indexes by chemical/trade name, CAS Registry number, EINECS Registry number, and empirical formula. Includes a list of suppliers. CD-ROM version available with the print copy.

See Also:
DeGroot: *Unwanted Effects of Cosmetics and Drugs Used in Dermatology,* 3rd ed. (Target Sites—Skin)

Journals

Contact Dermatitis

Food and Chemical Toxicology

Journal of Cosmetic Science

Journal of Toxicology: Cutaneous and Ocular Toxicology

Journal Articles

Andersen, F. A. (1998). Safety assessment of cosmetic ingradients: Final report on the safety assessment of glycolic acid, ammonium, calcium, potassium, and sodium glycolates, methyl, ethyl, propyl, and butyl glycolates, and lactic acid, ammonium, calcium, potassium, sodium, and tea-lactates, methyl, ethyl, isopropyl, and butyl lactates, and lauryl, myristyl, and cetyl lactates. ***Int. J. Toxicol.*** **17** (Suppl. 1), 1–241.

Barker, M. O. (1998). Newer cosmetic ingredients—New patch testing problems? ***Am. J. Contact Dermatol.*** **9**(2), 130–135.

Berne, B., *et al.* (1996). Adverse effects of cosmetics and toiletries reported to the Swedish Medical Products Agency 1989–1994. ***Contact Dermatitis*** **34**(5), 359–362.

Cerezo, G. A. (1995). Cosmetics: Innocuousness and efficacy. ***Ciencia Farmaceutica*** **5,** 127–131.

Dawber, R. (1996). Hair: Its structure and response to cosmetic preparations. ***Clin. Dermatol.*** **14,** 105–112.

De Groot, A. C. (1998). Fatal attractiveness: The shady side of cosmetics. ***Clin. Dermatol.*** **16,** 167–179.

De Groot, A. C., *et al.* (1996). Methyldibromoglutaronitrile (Euxyl K 400): An important ''new'' allergen in cosmetics. ***J. Am. Acad. Dermatol.*** **35,** 743–747.

Dooms-Goossens, A., and Blockeel, I. (1996). Allergic contact dermatitis and photoallergic contact dermatitis due to soaps and detergents. ***Clin. Dermatol.*** **14,** 67–76.

Elmore, J. G., and Horwitz, R. I. (1995). Oral cancer and mouthwash use: Evaluation of the epidemiologic evidence. ***Otolaryngol Head Neck Surg.*** **113,** 253–261.

Fox, C. (1997, December). Cosmetic and pharmaceutical vehicles: Antiperspirants, cleansers and emulsions. ***Cosmet. Toiletries*** **112,** 31–34, 37–40, 43–48.

Fox, C. (1998, January). Cosmetic and pharmaceutical vehicles: Skin care, hair care, makeup and sunscreens. ***Cosmet Toiletries.*** **113,** 45–46, 48, 50–54, 56.

Freeman, S., *et al.* (1995). Adverse contact reactions to sculptured acrylic nails: 4 case reports and a literature review. ***Contact Dermatitis*** **33,** 381–385.

Funk, J. O., *et al.* (1995). Sunscreen intolerance. Contact sensitization, photocontact sensitization, and inrritancy of sunscreen agents. ***Dermatol. Clin.*** **13,** 473–781.

Gasparro, F. P., *et al.* (1998). A review of sunscreen safety and efficacy. ***Photochem. Photobiol.*** **68**(3), 243–256.

Goodman, J. I. (1995). An analysis of the National Toxicology Program's (NTP) Technical Report (NTP TR 412) on the toxicology and carcinogenesis studies of talc. ***Regul. Toxicol. Pharmacol.*** **21,** 244–249.

Guidetti, M. S. *et al.* (1994). Contact dermatitis due to oleyl alcohol. ***Contact Dermatitis*** **31,** 260–261.

Hallagan, J. B., *et al.* (1995). The safety and regulatory status of food, drug and cosmetics colour additives exempt from certification. ***Food Chem. Toxicol.*** **33**(6), 515–528.

Kersemaekers, W. M., *et al.* (1995). Reproductive disorders due to chemical exposure among hairdressers. ***Scand. J. Work Environ. Health*** **21,** 325–334.

La Vecchia, C., and Tavani, A. (1995). Epidemiological evidence on hair dyes and the risk of cancer in humans. ***Eur. J. Cancer Prev.*** **4,** 31–43.

Li, Y. (1996). Biological properties of peroxide-containing tooth whiteners. ***Food Chem. Toxicol.*** **34,** 887–904.

Oberdorster, G. (1995). The NTP talc inhalation study: A critical appraisal focused on lung particle overload. ***Regul. Toxicol. Pharmacol.*** **21,** 233–241.

Rieger, M. M. (1998, March). Hyaluronic acid in cosmetics: Review of its chemistry and biochemistry. ***Cosmet. Toiletries*** **113,** 35–40, 42.

Sainio, E. L. and Kabani, S. (1995). Adverse effects of mouthwash use. A review. ***Oral Surg. Oral Med. Oral Pathol. Oral Radiol. Endod.*** **80,** 432–439.

Sanchez, P. A., *et al.* (1995). Prevalence of cosmetic sensitivity among beauticians. ***Allergol. Immunopathol.*** **23,** 148–152.

Sanchez-Guerrero, J., *et al.* (1996). Hair dye use and the risk of developing system lupus erythematosus. ***Arthritis Rheum.*** **39,** 657–662.

Scheinmam, P. L. (1996). Allergic contact dermatitis for fragrance: A review. ***Am. J. Contact Dermatol.*** **7,** 65–76.

Sprinkle, R. V. (1995) Leaded eye cosmetics: A cultural cause of elevated lead levels in children. ***J. Family Pract.*** **40,** 358–362.

Tada, J., *et al.* (1994). Atopic dermatitis with severe facial lesions exacerbated by contact dermatitis from topical medicaments. ***Contact Dermatitis*** **31,** 261–263.

Tlachac, C. A. (1994). Cosmetics and contact lenses. ***Optomol. Clin.* 4,** 35–45.

Wehner, A. P. (1994). Biological effects of cosmetic talc. ***Food Chem. Toxicol.* 32,** 1173–1184.

CHEMICALS—DRUGS

Adverse Effects of Herbal Drugs
Springer-Verlag, Berlin

A monographic series concerned with the adverse effects of botanical medicines. Volume 3 (1997) opens with a chapter on herbal postmarketing surveillance and is followed by 18 sections on specific medicinal herbs and important plant constituents.

American Society of Health-System Pharmacists (annual)
AHFS Drug Information
American Society of Health System Pharmacists, Bethesda, MD

First published almost 40 years ago, this is an extensive compendium of drug information. The AHFS (American Hospital Formulary Service) monographs included herein are prepared by a professional staff and undergo extensive review. Discusses chemistry and stability, pharmacology, pharmacokinetics, uses, cautions, acute and chronic toxicities, drug interactions, dosage and administration, and preparation.

Ansell, G. (Ed.) (1997)
Imaging Drug Reactions and Toxic Hazards, 3rd ed.
Chapman & Hall, London.

From the preface: ''Imaging can often be valuable in confirming a suspected diagnosis; however, toxic changes may also cause appearances which closely mimic other more common disorders.'' Of unrivaled value for clinicians and radiologists.

Asamovics, J. A. (Ed.) (1995)
Analysis of Addictive and Misused Drugs
Dekker, New York

First section of this book covers enzyme immunoassays, development of biosensors, chromatographic techniques of analysis, and developing methodologies. The appendix is a comprehensive alphabetic tabulation of over 400 drugs requiring controlled use.

Atlee, J. L. (Ed.) (1999)
Complications in Anesthesia
Saunders, Philadelphia

Details all of the complications likely to be encountered in clinical practice. Explains the nature, likelihood, and causes of each problem, followed by a discussion of appropriate treatment measures.

Bennett, P. N. (1996)
Drugs and Human Lactation, 2nd ed.
Elsevier, Amsterdam

Guide to the content and consequences of drugs, micronutrients, radiopharmaceuticals, and environmental and occupational chemicals in human milk. The main sections discuss breast milk vs formula, effects of drugs on milk secretion and composition, drug transfer determinants, drug disposition in infants, monographs on individual drugs, vitamins, minerals, and trace elements, radiopharmaceuticals, and environmental and occupational chemicals.

Bruce, D. L. (1980)
Functional Toxicity of Anesthesia. The Scientific Basis of Clinical Anesthesia
Grune & Stratton, New York

Teaches anesthesiologists to anticipate, treat, and, most important, avoid the ill effects attendant to anesthetics. Sections include functions of central nervous system, circulation, respiration, kidney, liver, endocrine system, and cell division.

Brust, J. C. (1996)
Neurotoxic Side-Effects of Prescription Drugs
Butterworth-Heinemann, Boston

Provides an up-to-date discussion of those drugs for which a major component of the adverse reactions involves the central nervous system. A most useful volume for those seeking a better appreciation of the major impact of central nervous system effects, both wanted and unwanted, on humans.

Budavari, S. (Ed.) (1996)
The Merck Index: An Encyclopedia of Chemicals, Drugs, and Biologicals, 12th ed.
Merck Research Laboratories, Whitehouse Station, NJ

For years this has been the handy reference for drugs (and industrial chemicals to a lesser extent) for ''first-pass'' information. Over 10,000 monograph-like paragraphs include basic information on each of the entry chemicals in a standard format for easy access and use. Chapman and Hall publishes a CD-ROM version. Also available online by several licensed vendors.

Ciraulo, D. A., Shader, R. I., Greenblatt, D. J., and Creelman, W. (1995)
Drug Interactions in Psychiatry, 2nd ed.
Williams & Wilkins, Baltimore

In-depth coverage of clinically important drug interactions in psychiatry. Each chapter provides a review of

the published data on specific drug interactions and discusses their clinical significance.

Collins, R. D. (1985)
Atlas of Drug Reactions
Churchill Livingstone, New York

Presents adverse reactions, contraindications, precautions for use, and interactions with other drugs. Accompanied by color illustrations which display the reactions to the drugs.

Coulson, C. J. (1993)
Molecular Mechanisms of Drug Action, 2nd ed.
Taylor & Francis, Washington, DC

Knowledge of drug action, from enzymes in a pathway to membrane-bound receptors and ion channels, is brought together with inhibition and receptor binding by drugs, drugs that modulate biochemical pathways, and the organizational structures of the cell.

D'Arcy, P. F., *et al.* (Eds.) (1996)
Mechanisms of Drug Interactions
Springer, Berlin

Volume 122 of the *Handbook of Experimental Pharmacology.* Deals with ''mechanisms of *in vitro* and *in vivo,* drug–drug, drug–food, and drug–herbals interactions and those that cause drugs to interfere with diagnostic laboratory tests.''

Davies, D. M. (Ed.) (1991)
Textbook of Adverse Drug Reactions, 4th ed.
Oxford Medical, Oxford

Encyclopedic presentation of the adverse effects of drugs. The presentations follow specific organ or organ systems and the modification of their function by unwanted side reactions is discussed. Also included are chapters on epidemiology and drug–drug interactions.

Duffus, J. H. (Ed.) (1997)
Substances of Abuse: An Assessment of Carcinogenicity
Royal Society of Chemistry Information Services, Cambridge, UK.

Prepared by the Edinburgh Centre for Toxicology and organized into three main sections—drugs, anaesthetics, and industrial solvents. Each entry provides a comprehensive review of the published literature of direct relevance to the carcinogenicty of the substance under consideration.

Dukes, M. N. G., (Series Ed.) (1985–).
Drug-Induced Disorders
Elsevier, Amsterdam

Titles already published in this monographic series are *Drug-Related Hepatic Injury, Drug-Related Diseases of the Elderly, Treatment-Related Respiratory Disorders, Drug-Related Immune Diseases,* and *Drug-Related Hepatic Injury,* 2nd ed.

Dukes, M. N. G. (Ed.) (1996)
Meyler's Side Effects of Drugs, 13th ed.
Elsevier, Amsterdam

Provides the clinician and medical investigator with a thorough and critical review of all that is known about adverse reactions and interactions of drugs. Data are arranged in the form of monographs, each dealing with a drug group as a whole or with one of its primary representatives, and supplemented by specific data. Kept up to date between editions by *Side Effects of Drugs Annual,* a worldwide yearly survey of new data and trends, also published by Elsevier. These publications constitute *SEDBASE,* a full-text database available through DIALOG and other vendors, and as a CD-ROM from Silver Platter.

El-Mallakh, R. S. (1996)
Lithium: Actions and Mechanisms
American Psychiatric Press, Washington, DC

Examines the neurochemical and cellular consequences of lithium. The main use of this drug is discussed as is the current state of knowledge integrating not just the effects of lithium but also the interactive effects in the control of manic-depressive illness.

Friedman, H., *et al.* (Eds.) (1996)
Drugs of Abuse, Immunity, and Infections
CRC Press, Boca Raton, FL

Focuses attention on possible relationships among the drugs of abuse, such as marijuana, morphine, cocaine, and alcohol, and immune response function or altered resistance to microorganisms, especially opportunistic ones.

Gad, S. C. (Ed.) (1996)
Safety Assessment for Pharmaceuticals
Van Nostrand–Reinhold, New York

Comprehensive discussion of regulatory requirements, projects, management essentials, and methodologies (irritation, acute through chronic toxicity, cancer, and developmental) are covered as well as emerging areas such as immunotoxicology, nonrodent experimentation designs, and *in vitro* techniques.

Gravenstein, N., and Kirby, R. R. (1996)
Complications in Anesthesiology, 2nd ed.
Lippincott–Raven Press, Philadelphia

Main sections deal with the adverse effects of surgically used anesthetics and the postoperative complications.

The text is well referenced for more detailed information if desired.

Griffin, J. P., and D'Arcy, P. F. (1997)
A Manual of Adverse Drug Interactions, 5th ed.
Elsevier, Amsterdam

A respected source of information on adverse drug interactions. Part 1 comments on drug interactions and their mechanisms, on a pharmacokinetic and pharmacodynamic level, whereas part 2 consists of drug interaction tables, divided and subdivided into categories of disorders and the drugs used in the treatment of these disorders.

Hansten, P. D., and Horn, J. R. (1990)
Drug Interactions and Updates
Lea & Febiger, Malvern, PA

Presents a drug-by-drug listing of adverse reactions found in the literature when two or more drugs are used together. Convenient style for quick information—references will allow more thorough literature search when desired.

Hardman, J.G., and Limbird, L. E. (Ed.) (1996)
Goodman and Gilman's the Pharmacological Basis of Therapeutics, 9th ed.
McGraw-Hill, New York

The classic text in pharmacology/medicine regarding the application of drugs to clinical settings. The three main goals are to correlate pharmacology with related medical sciences, to interpret the actions and uses of drugs from the impact on medical practice in general, and to place emphasis on the applications of pharmacodynamics to therapeutics. The book is divided into the following sections: general principles, drugs acting at neuroeffector sites, the central nervous system, therapy of inflammation, renal and cardiovascular function, gastrointestinal function, uterine motility, parasitic infections, microbial diseases, neoplastic diseases, immunomodulation, blood organs, hormones and antagonists, vitamins, dermatology, ophthalmology, and toxicology. A CD-ROM version is also available.

Harvey, J. A., and Kosofsky, B. E. (Eds.) (1998)
Cocaine: Effects on the Developing Brain
New York Academy of Sciences, NY

Volume 846 of the Annals of the New York Academy of Sciences. Considers maternal–fetal effects, postnatal effects, and neurobehavioral models, developmental mechanisms, functional deficits, longitudinal studies in humans, and public policy.

Hollinger, M. (1997)
Introduction to Pharmacology
Taylor & Francis, London

Deserves inclusion here because the author closely links pharmacologic and toxicologic responses. Covers the principles of drug action and presents the concept of drug classification based on drugs that cure, replace physiological inadequacies, and/or treat symptoms. An excellent text for both pharmacologists and toxicologists, particularly those in the pharmaceutical arena.

Holt, G. A. (1992)
Food and Drug Interactions: A Health Care Professional's Guide
Precept Press, Chicago

Attempts to provide a current listing of food and drug interactions which have appeared in literature sources. Reports the information as presented in the original citation and does not serve as a substitute for clinical assessment and judgment regarding the management of an individual patient. Approximately 120 examples are included in this handbook.

Karch, S. B. (Ed.) (1996)
The Pathology of Drug Abuse
CRC Press, Boca Raton, FL

Guide to the pathology, toxicology, and pharmacology of commonly used drugs. Emphasis is placed on the investigation of drug-related deaths and on practical approaches to the detection of drug abuse.

Kimball, E. S. (Ed.) (1995)
Immunopharmaceuticals
CRC Press, Boca Raton, FL

Highlights some of the most recently developed pharmaceuticals that hold promise as immunotherapeutics by examining the preclinical and pharmacological models used in their development and evaluating the predictive value of these tests by correlating them with clinical data.

Korting, H. C., and Schafer-Korting, M. (Ed.) (1998)
The Benefit/Risk Ratio: A Handbook for the Rational Use of Potentially Hazardous Drugs
CRC Press, Boca Raton, FL

Provides a single source of data in assessing the risk/benefit ratio of drugs. The aim is to compile and present both the risk and the benefit side regarding the use of commonly prescribed drugs to allow the treating physician access to the data that will optimize their decision in selecting effective, low-risk treatments.

Lancaster, J. R., Jr. (1996)
Nitric Oxide: Principles and Action
Academic Press, New York

Serves to bridge the well-established chemistry of nitric oxide with the new and exciting role of the chemical as an effector molecule in numerous biological systems. The text relates the chemical properties of the molecule to its possible effects on biological systems, under both normal and pathophysiological conditions.

Lee, W. M. (1994)
Drug-Induced Hepatotoxicity
University of Texas Southwest Medical Center, Dallas

An excellent short snapshot of drug-induced liver effects. Background physiology and enzyme function is covered along with specific examples of drug-modifying cases. Both classic well-known liver/drug dysfunctions are covered as well as effects of newer therapies on the function of the organ and its effect on the organism and on the levels of the agent.

Li, A. P. (Ed.) (1997)
Drug–Drug Interactions: Scientific and Regulatory Perspectives
Academic Press, San Diego

Presents a comprehensive review of the scientific and regulatory aspects of drug interactions from the point of view of academia, industry, and government. Topics include drug metabolizing enzymes, toxicology, and *in vitro* mechanistic approaches as well as the regulatory perspective of drug–drug interactions. The book is intended for those interested in mechanistic understanding of, prediction of, and avoidance of unwanted drug–drug interactions.

Miller, L. G., and Murray, W. J. (Eds.) (1998)
Herbal Medicines: A Clinician's Guide
Pharmaceutical Products Press (Haworth Press), NY

Provides an understanding of herbal remedies and how they interact, favorably or unfavorably, with conventional medicines. A variety of cases add extra insight into this subject.

Niesink, R. J. M. (1998)
Drugs of Abuse and Addiction: Neurobehavioral Toxicology
CRC Press, Boca Raton, FL

Examines drugs of abuse and addiction and how they affect behavior. Emphasis is on acute and chronic effects, reversible and irreversible consdquences, functional disorders of the nervous system, and more.

Parfitt, K. (Ed.) (1999)
Martindale: The Complete Drug Reference, 32nd ed.
Pharmaceutical Press, London

Comprehensive compendium of unbiased information on substances used in medicine and pharmacy. Part 1 contains monographs on drugs and groups of drugs that have similar uses or actions. Part 2 consists of short monographs on new drugs and drugs not easily classified. Part 3 contains proprietary preparations from a range of countries. Includes a directory of manufacturers, nomenclature, and pharmaceutical, pharmacological, and therapeutic information. Now available electronically also.

PDR Guide to Drug Interactions, Side Effects, Indications (annual)
Medical Economics, Montvale, NJ

Entries in this guide are fully indexed to the following volumes of the PDR (Physicians Desk Reference): *Physicians Desk Reference, PDR for Nonprescription Drugs,* and *PDR for Ophthalmology*. Indexed by interactions, side effects, and indications.

Pliska, V., Testa, B., and van de Waterbeemd, H. (1996)
Lipophilicity in Drug Action and Toxicology
VCH, New York

Volume 4 of *Methods and Principles in Medicinal Chemistry*. Examines the many aspects of lipophilicity. It encompasses an historical perspective, methodologies, and technologies as well as physicochemical concepts.

Poch, G. (1993)
Combined Effects of Drugs and Toxic Agents: Modern Evaluation in Theory and Practice
Springer-Verlag, Vienna

Covers the methodology and information derived from studies on drug–drug or drug–agent interactions. The basic principles are described and then specific applications are presented. Examples including isobologram approaches are given and the limitations of each are well described. An excellent book for those considering working on experiments involving more than one agent at a time.

Powis, G. (Ed.) (1994)
Anticancer Drugs, Reactive Metabolism and Drug Interactions
Pergamon, Oxford

Provides a comprehensive review of the metabolism of anticancer drugs. The book emphasizes the relation of metabolism to the therapeutic and toxic effects of these drugs using primarily human studies.

Rice, S. A., and Fish, K. J. (Eds.) (1994)
Anesthetic Toxicity
Raven Press, New York

Covers the field with a series of chapters from introduction and background through specific agents. This is

a valuable resource for those involved in either clinical or research-based practice.

Roberts, J., Snyder, D. L., and Freidman, E. (1996)
Handbook of Pharmacology on Aging, 2nd ed.
CRC Press, Boca Raton, FL

Up-to-date source that includes the major drug groups, the disorders they treat, and the age-associated changes in cellular processes that affect drug action. Extensive attention is given to disorders prevalent in older persons, such as Alzheimer's and Parkinson's disease. A wide range of drug families are covered. Also included is a chapter providing insight into future research problems dealing with the expanding aging population, their drug usage, and increasing adverse drug reactions.

Rodrigues, A. D., Ferrero, J. L., and Levy, R. H. (1997)
Drug–Drug Interactions
IBC, Southborough, MA

Focuses on the use of *in vitro* data to predict metabolism-based drug–drug interactions and the relevance of *in vitro–in vivo* correlations. Many therapeutic classes of drugs are described to illustrate the successes and failures of *in vitro–in vivo* correlations.

Roe, D. A., and Campbell, T. C. (1994)
Handbook on Drug and Nutrient Interactions: A Reference and Study Guide, 5th ed.
American Dietetic Association, Chicago

Textbook on drug–nutrient interactions. Part 1 covers the effects of food and of nutrient intake on the disposition of foreign compounds. Part 2 deals with the effects of drugs on nutrition.

Salem, H., and Baskin, S. I. (Ed.) (1993)
New Technologies and Concepts for Reducing Drug Toxicities
CRC Press, Boca Raton, FL

Provides concepts and technologies that encourage a more rational utilization of pharmacologically useful substances. It covers modeling, alternative delivery systems, and statistical considerations.

Stern, E. L. (1993)
Prescription Drugs and Their Side Effects, 7th ed.
Body Press/Perigee Books, New York

Covers 400 of the most frequently prescribed drugs. Listed alphabetically, each entry includes dosage forms, information on when prescribed, precautions and warnings, and side effects and adverse reactions.

Stockley, I. H. (1996)
Drug Interactions: A Source Book of Adverse Interaactions, Their Mechanisms, Clinical Importance and Management, 4th ed.
Pharmaceutical Press, London

A detailed source of information on adverse drug interactions. Over 200 monographs with information such as summary, details of interaction, mechanism, and clinical importance and management. There are extensive bibliographies. This is a thorough reference book.

Taylor, T. H., and Major, E. (1993)
Hazards and Complications of Anesthesia
Churchill Livingstone, Edinburgh, UK

Provides a thorough overview describing the extreme care that needs to be used with anesthetic agents. The text is organized such that easy access to information on a specific agent or the effects of individual agents is possible.

Vogel, H. G., and Vogel, W. (Eds.) (1997)
Drug Discovery and Evaluation: Pharmacological Assays
Springer, Berlin

Contains a selection of the most frequently used assays for detecting the pharmacological effects of potential drugs. The main sections regard cardiovascular, analgesic, endocrine, psychotropic, respiratory, renal, and immunomodulatory. Each of the over 700 assays comprises a detailed protocol with the purpose and rationale of the method, a critical assessment of the results, and their pharmacologic and clinical relevance.

Wichtl, M. (Ed.) (1995)
Herbal Drugs and Phytopharmaceuticals
CRC Press, Boca Raton, FL.

Provides references to pharmacopeal monographs, sources, synonyms, constituents, indications, side effects, preparations, regulatory status, and analytical techniques for each herbal drug.

World Health Organization (WHO) Expert Committee (1997)
The Use of Essential Drugs, 9th list
WHO, Geneva.

Intended to guide the selection of drugs in countries where the need is great and the resources are small. The list identifies a core group of prophylactic and therapeutic substances judged capable of meeting most health needs.

See Also:
Section on Clinical Toxicology

Albert: *Selective Toxicity* (Molecular, Cellular, Biochemical)

Baselt: *Disposition of Toxic Drugs and Chemicals in Man* (Pharmacokinetics and Metabolism)

Bennett: *Drugs and Human Lactation* (Developmental & Reproductive Toxicology)

Breathnach: *Adverse Drug Reactions and the Skin* (Target Sites—Skin)

Briggs: *Drugs in Pregnancy and Lactation* (Developmental & Reproductive Toxicology)

Brust: *Handbook of Neurotoxic Side Effects of Prescription Drugs* (Target Sites—Kidney)

DeGroot: *Unwanted Effects of Cosmetics and Drugs Used in Dermatology*, 3rd ed. (Target Sites—Skin)

Farrell: *Drug-Induced Liver Disease* (Target Sites—Liver)

Forman: *Drug-Induced Infertility and Sexual Dysfunction* (Developmental and Reproductive Toxicology)

Friedman: *Teratogenic Effects of Drugs: A Resource for Clinicians* (Developmental and Reproductive Toxicology)

Friedman: *The Effects of Drugs on the Fetus and Nursing Infant* (Developmental and Reproductive Toxicology)

Friedman: *The Effects of Neurologic and Psychiatric Drugs* (Developmental and Reproductive Toxicology)

Gilstrap: *Drugs and Pregnancy* (Developmental and Reproductive Toxicology)

Goldstein: *Adverse Reactions to Medication* (Target Sites—Skin)

Haddad: *Clinical Management of Poisoning and Drug Overdose* (Clinical Toxicology)

Jain: *Drug-Induced Neurological Disorders* (Target Sites—Nervous System)

Jeffery: *Human Drug Metabolism* (Pharmacokinetics and Metabolism)

Karch: *Drug Abuse Handbook* (Clinical Toxicology)

Kauppinen: *Skin Reactions to Drugs* (Target Sites—Skin)

Kavlock: *Drug Toxicity in Embryonic Development* (Developmental and Reproductive Toxicology).

Konkol: *Prenatal Cocaine Exposure* (Developmental and Reproductive Toxicology)

Kuhlmann: *Food–Drug Interactions* (Food and Nutrition)

Langston: *Handbook of Ocular Drug Therapy and Ocular Side Effects of Systemic Drugs* (Target Sites—Sensory)

Leung: *Encyclopedia of Common Natural Ingredients Used in Food, Drugs, Cosmetics* (Chemicals—Cosmetics)

McGuffin: *American Herbal Product Association's Botanical Safety Handbook* (Biotoxins)

Powis: *Anticancer Drugs: Reactive Metabolism and Drug Interactions* (Pharmacokinetics and Metabolism)

Rice-Evans: *Free Radicals and Oxidative Stress: Environment, Drugs and Food Additives* (Molecular, Cellular and Biochemical Toxicology)

Stricker: *Drug-Induced Hepatic Injury*, 2nd ed. (Target Sites—Liver)

Walters: *Pharmaceutical Skin Penetration Enhancement* (Target Sites—Skin)

Welling: *Drug Toxicokinetics* (Pharmacokinetics and Metabolism)

World Health Organization: *IARC Monograph on the Evaluation of Carcinogenic Risks to Humans, Some Pharmaceutical Drugs* (Cancer)

Journals

Adverse Drug Reaction Bulletin

Annual Review of Pharmacology and Toxicology

Drug and Chemical Toxicology

Drug Metabolism and Disposition

Drug Metabolism and Drug Interactions

Drug Metabolism Reviews

Drug Safety

Food and Drug Law Journal

Immunopharmacology and Immunotoxicology

Journal of the Association of Food and Drug Officials

Journal of Pharmacological and Toxicological Methods

Journal of Toxicology, Clinical Toxicology

Pharmacology and Toxicology

Research Communications in Pharmacology and Toxicology

Toxicology and Applied Pharmacology

Journal Articles

Ahlner, J., *et al.* (1991). Organic nitrate esters: Clinical use and mechanisms of actions. ***Pharm. Rev.* 43,** 353–420.

Bach, P. H., *et al.* (1998). A safety assessment of fixed combinations of acetaminophen and acetylsalicylic acid, coformulated with caffeine. ***Renal Failure*** **20**(6), 749–762.

Bateman, J., *et al.* (1998). Possible toxicity of herbal remedies. ***Scot. Med. J.*** **43**(1):7–15.

Billman, G. E. (1995). Cocaine: A review of its toxic actions on cardiac function. ***Crit. Rev. Toxicol.* 25,** 113–132.

Breckenridge, A. (1996). A clinical pharmacologist's view of drug toxicity. ***Br. J. Clin. Pharmacol.* 42,** 53–58.

Chan, T. Y. (1997). Monitoring the safety of herbal medicines. ***Drug Safety* 17**(4):209–215.

Ebi, K. L., and Rice, S. A. (1994). Reproductive and developmental toxicity of anesthetics in humans. ***Anesthetic Toxicity* 24,** 175–198.

Ford, J. M., and Hait, W. N. (1990). Pharmacology of drugs that alter multidrug resistance in cancer. ***Pharm. Rev.* 42,** 156–201.

Gupta, A., and Waldhauser, L. K. (1997). Adverse drug reactions from birth to early childhood. ***Pediatr. Clin. North Am.* 44,** 79–92.

Hama, R. (1996). Clinical cases and problems of delayed (tardive) reactions to drugs—For pharmaceuticals in general. ***J. Toxicol. Sci.* 21,** 81–91.

Hill, S. J. (1990). Distribution, properties, and functional characteristics of three classes of histamine receptor. ***Pharm. Rev.* 42,** 46–83.

Horie, T., *et al.* (1996). Basic strategy for avoiding drug interaction during stage of drug development; Proposals relative to planning of non-clinical and clinical studies and how clinical trials should be planned. ***J. Toxicol. Sci.* 21**(5), 331–339.

Hollinger, M. A. (1996). Toxicological aspects of topical silver pharmaceuticals. ***Crit. Rev. Toxicol.* 26,** 255–260.

Kando, J. C. *et al.* (1995). Gender as a risk factor for adverse events to medications. ***Drugs* 50,** 1–6.

Katz, A. M. (1998). Selectivity and toxicity of antiarrhythmic drugs: Molecular interactions with ion channels. ***Am. J. Med.* 104**(2), 179–195.

Knasmuller, S., Parzefall, W., Helma, C., Kassis, F., Ecker, S., and Schulte-Hermann, R. (1997). Toxic effects of griseofulvin: Disease models, mechanisms, and risk assessment. ***Crit. Rev. Toxicol.* 27,** 495–537.

Lee, M. (1996). Drugs and the elderly: Do you know the risks? ***Am. J. Nursing* 96**(7), 24–31.

Lee, T. N. H. (1996). Molecular approaches to drug abuse research. ***Recent Adv. Emerging Strategies,*** Vol. 3, NTIS/PB96-177472.

Mathelier-Fusade, P., and Leynadier, F. (1995). The management of adverse drug reactions. ***Clin. Rev. Allergy Immunol.* 13**(3), 281–290.

Matsuzawa, T. (1996). Issues and problems regarding the prediction of delayed side-effects (toxicity) of pharmaceutical compounds. ***J. Toxicol. Sci.* 21,** 59–80.

McCarthy, D. (1998). Nonsteroidal anti-inflammatory drug-related gastrointestinal toxicity: Definitions and epidemiology. ***Am. J. Med.* 105**(5A), 3S–9S.

Miller, M. B. (1998). Arrhythmias associated with drug toxicity. ***Emerg. Med. Clin. N. Am.* 16**(2), 405–417.

Moncada, S., *et al.* (1991). Nitric oxide: Physiology, pathophysiology, and pharmacology. ***Pharm. Rev.* 43,** 109–142.

Monks, T. J., and Serrine, S. L. (1992). Toxicology of quinone-thioethers. ***Crit. Rev. Toxicol.* 22,** 243–270.

Pensabeni-Jasper, T., and Panush, R. S. (1996). Review: Corticosteroid usage: Observations at a community hospital. ***Am. J. Med. Sci.* 311,** 234–239.

Philip, A. T., and Gerson, B. (1998). Toxicology and adverse effects of drugs used for immunosuppression in organ transplantation. ***Clin. Lab. Med.* 18**(4), 755–765.

Pirmohamed, M., *et al.* (1998). Adverse drug reactions. ***BMJ* 316**(7140), 1295–1298.

Ray, W. A. (1996). Clinical studies of drug effects in humans. ***Clin. Chem.* 8**(Part 2), 1306–1311.

Rodgers, K., *et al.* (1997). Immunotoxicity of medical devices. ***Fundam. Appl. Toxicol.* 36,** 1–14.

Sawynok, J., and Yaksh, T. L. (1993). Caffeine as an analgesic adjuvant: A review of pharmacology and mechanisms of action. ***Pharm. Rev.* 45,** 45–86.

Schraag, S., *et al.* (1995). Intravenous anesthesia—Current aspects. ***Anasthesiol. Intensivmedizin Notfallmedizin Schmerztherapie* 30,** 469–478.

Settle, E. C., Jr. (1998). Antidepressant drugs: Disturbing and potentially dangerous adverse effects. ***J. Clin. Psychiatry* 59**(Suppl. 16), 25–30.

Sharma, V. K., and Sethuraman, G. (1996). Adverse cutaneous reactions to drugs: An overview. ***J. Postgrad. Med.* 42**(1), 15–22.

Simon, L. S. (1998). Biology and toxic effects of nonsteroidal anti-inflammatory drugs. ***Curr. Opin. Rheumatol.* 10**(3), 153–158.

Stewart, M. J., Steenkamp, V., and Zuckerman, M. (1998). The toxicology of African herbal remedies. ***Ther. Drug Monit.* 20**(5), 510–516.

Thompson, D. F., and Pierce, D. R. (1999). Drug-induced nightmares. ***Ann. Pharmacother.*** **33**(1), 93–98.

Uetrecht, J. P. (1997). Current trends in drug-induced autoimmunity. ***Toxicology*** **119,** 37–43.

Van der Klauw, M. M., *et al.* (1996). Drug-associated anaphylaxis: 20 years of reporting in The Netherlands (1974–1994) and review of the literature. ***Clin. Exp. Allergy*** **26**(12), 1355–1363.

Vanhoutte, P. H. (1992). International union of pharmacology committee on receptor nomenclature and drug classification. ***Pharm. Rev.*** **44,** 349–458.

Welling, P. G. (1995). Differences between pharmacokinetics and toxicokinetics. ***Toxicol. Pathol.*** **23**(2), 143–147.

Wilson, D. W., *et al.* (1992). Mechanisms and pathology of monocrotaline pulmonary toxicity. ***Crit. Rev. Toxicol.*** **22,** 307–326.

Wolff, R. K., and Dorato, M. A. (1993). Toxicologic testing of inhaled pharmaceutical aerosols. ***Crit. Rev. Toxicol.*** **23,** 343–370.

Woods, J. H., *et al.* (1992). Benzodiazepines: Use, abuse, and consequences. ***Pharm. Rev.*** **44,** 155–186.

CHEMICALS—DUSTS AND FIBERS

Brautbar, N., Campbell, A., and Mehlman, M. (Eds.) (1994)
Health Effects of Toxic Chemicals, Silicone, Asbestos, and Man-Made Fibers
Princeton Scientific, Princeton, NJ

Presents case studies on the health effects to silicone, asbestos, man-made fibers, and oil and petroleum industrial compounds. It covers animal test data and epidemiological findings.

Brown, R. C., Chamberlain, M., Davies, R., and Gormley, I. P. (Eds.) (1980)
The in Vitro Effects of Mineral Dusts
Academic Press, London

Covers *in vitro* reactivity of mineral dusts, macrophages, dust–biological membrane interactions, chemical modifications, primary cell and organ culture, and inflammatory response and fibrosis.

Castleman, B. I. (1996)
Asbestos: Medical and Legal Aspects
Aspen, Englewood Cliffs, NJ

Provides a fascinating public health and historical framework of asbestos, covering asbestosis, cancer, compensation, thresholds and standards, product use, alternatives to asbestos insulation, ''bystander'' asbestos disease, brake repair workers, and more.

Castranova, V., Vallyathan, V., and Wallace, W. E. (1996)
Silica and Silica-Induced Lung Diseases
CRC Press, Boca Raton, FL

Provides a comprehensive overview of silica and human health. It provides background, definitions, and current concepts of physiochemical properties of silica. Additional coverage is on pathogenesis of silicosis, surface modifications and disease prevention modalities, and cancer.

Davis, J. M. G., and Jaurand, M. C. (Eds.) (1994)
Cellular and Molecular Effects of Mineral and Synthetic Dusts and Fibres
Springer-Verlag, New York

Emphasizes the use of cell and organ culture, and lavage cell populations obtained from man and laboratory animals, to elucidate cellular and molecular events occurring after their interaction with fibrous and nonfibrous particulates including metal compounds. Findings presented are on the cellular and metabolic changes caused by mineral dusts, molecular changes and DNA alterations produced by mineral dusts, *in vivo* dust-related pathological expressions, correlations between *in vitro* and *in vivo* data, and physicochemical properties of minerals in relation to their biologic effects.

Fisher, G. L., and Gallo, M. A. (Eds.) (1987)
Asbestos Toxicity
Dekker, New York

The manuscripts included in this text represent the current thinking regarding physical factors and biological processes associated with asbestos toxicity. Emphasis is on the fundamental properties of surfaces which may result in biological interaction through binding and catalytic sites. Potential mechanisms for fiber/tissue interaction are presented.

International Agency for Research on Cancer (1995)
Wood Dust and Formaldehyde
World Health Organization, Lyon

This is Vol. 62 of the *IARC Monographs on the Evaluation of Carcinogenic Risks to Humans.* Explores the adverse effects, particularly neoplasia, in relation to exposure to wood dust and formaldehyde.

Kayser, K., and Hagemeyer, O. (1994)
Natural and Synthetic Mineral Fibers Affecting Man
B. I. Wissenschaftsverlag, Mannheim, Germany

Focuses on both mineralogical and medical data of commercially important fibers. Sections including comments on involved populations, interactions of respired fibers with pulmonary defense mechanisms, outcome of disease, and morphological findings in the lungs are presented. The book should be of value to both the mineralogist and the physician involved in lung-related diseases.

Landsberger, S., and Creatchman, M. (Eds.) (1998)
Elemental Analysis of Airborne Particles
Gordon & Breach, Berkshire, UK

Detailed collection of works covering analytical methods in elemental analysis of airborne particle. Methods discussed include atomic absorption spectrometry, inductively coupled plasma, atomic emission, particle-induced gamma ray analysis, and neutron activation analysis. Sections on quality control are included.

Selikoff, I. J., and Hammond, E. C. (Eds.) (1979)
Health Hazards of Asbestos Exposure, Annals of the New York Academy of Sciences, Vol. 330
New York Academy of Science, New York

Covers occupational and other environmental exposures with discussions on epidemiology, regulations, standard setting, the shipyard industry, mesothelioma, high-risk groups, and interactions.

Warheit, D. B. (Ed.) (1993)
Fiber Toxicology
Academic Press, San Diego

Presents a series of chapters covering recent findings and research associated with fiber toxicology. A careful presentation of concepts and methods for evaluating the physiology and potential toxic effects of fibrous materials on a variety of systems within the respiratory tract is given. In the last section, work aimed at examining the underlying mechanisms for the induced responses is presented. This is the first volume dealing specifically with fibers other than asbestos with regard to potential human health implications and is a valuable reference.

World Health Organization (WHO) (1983)
Biological Effects of Man-Made Mineral Fibres
WHO, Copenhagen

Provides a discussion of man-made mineral fibers, surveys their airborne occurrence in the workplace, biological effects, assessment and prospects, and offers recommendations. The report is followed by a series of brief papers including many interesting case studies.

World Health Organization (WHO) (1993)
Selected Synthetic Organic Fibres, Environmental Health Criteria No. 151
WHO, Geneva

Evaluates the risks to human health posed by occupational and environmental exposure to selected synthetic organic fibres. Fibres covered include carbon and graphite fibres, aramid fibres, and polyolefin fibres.

See Also:
Section on Target Sites—Respiratory
Section on Environmental Toxicology—Atmosphere

Journal Articles

Addison, J. (1995). Vermiculite: A review of the mineralogy and health effects of vermiculite exploitation. ***Regul. Toxicol. Pharmacol.*** **21**(3), 397–405.

Allison, A. C. (1996). Fibrogenic and other biological effects of silica. ***Curr. Topics Microbiol. Immunol.*** **210,** 147–158.

Blot, W. J., *et al.* (1997). Wood dust and nasal cancer risk. A review of the evidence from North America. ***J. Occup. Environ. Med.*** **39**(2), 148–156.

Churg, A., and Vedal, S. (1994). Fiber burden and patterns of asbestos-related disease in workers with heavy mixed amosite and chrysotile exposure. ***Am. J. Respir. Crit. Care Med.*** **150,** 663–669.

Coggon, D., *et al.* (1995). Differences in occupational mortality from pleural cancer, peritoneal cancer, and asbestosis. ***Occup. Environ. Med.*** **52,** 775–777.

De Vuyst, P., *et al.* (1995). Respiratory health effects of man-made vitreous (mineral) fibres. ***Eur. Respir. J.*** **8**(12); 2149–2173.

Health and Safety Executive (1995). ***Asbestos—Exposure Limits and Measurement of Airborne Dust Concentrations.*** Available from HSE Books, P.O. Box 1999, Sudbury, Suffolk, C010 6FS, United Kingdom.

International Agency for Research on Cancer (1996). Consensus report. Mechanisms of fibre carcinogenesis. ***IARC Sci. Publ.*** **140,** 1–9.

Kane, A. B. (1996). Mechanisms of mineral fibre carcinogenesis. ***IARC Sci. Pub.*** **140,** 11–34.

Liou, S.-H., *et al.* (1996). Respiratory symptoms and pulmonary function in mill workers exposed to wood dust. ***Am. J. Ind. Med.*** **30**(3), 293–299.

Malmbert, P., and Rask-Andersen, A. (1993). Organic dust toxic syndrome. ***Sem. Respir. Med.*** **14,** 38–48.

McDonald, C. (1995). Mineral dusts and fibres. ***Epidemiol. Work Related Dis.,*** 87–116.

Roller, M., *et al.* (1996). Results of current intraperitoneal carcinogenicity studies with mineral and vitreous fibres. ***Exp. Toxicol. Pathol.* 48,** 3–12.

Soutar, C. A., *et al.* (1997). Assessment of human risks from exposure to low toxicity occupational dusts. ***Ann. Occup. Hygiene* 41**(2), 123–133.

Steenland, K., and Stayner, L. (1997). Silica, asbestos, man-made mineral fibers, and cancer. ***Cancer Causes Control* 8**(3), 491–503.

Steenland, K., *et al.* (1996). Review of occupational lung carcinogens. ***Am. J. Ind. Med.* 29,** 474–490.

Vu, V. T., and Lai, D. Y. Approaches to characterizing human health risks of exposure to fibers. ***Environ. Health Perspect.* 105** (Suppl. 5) 1329–1336.

Warheit, D. B., *et al.* (1995). Contemporary issues in fiber toxicology. ***Fundam. Appl. Toxicol.* 25,** 171–183.

CHEMICALS—METALS

Bergman, H., Dorward-King, E., Allen, H., DiToro, D., Erickson, R., Mattice, J., and Reiley, M. (Eds.) (1997)
Reassessment of Metals Criteria for Aquatic Life Protection
Society of Environmental Toxicology and Chemistry, Pensacola, FL

Integrates metals toxicology, environmental chemistry, and chemical fate modeling to assess the scientific basis for regulating metals in the aquatic environment. Sound permitting decisions demand input from mathematical models that integrate fundamental changes in target tissues with site-specific metal chemistry allowing the proper link to receiving stream exposure models.

Breen, J. J., and Stroup, C. R., (Eds.) (1995)
Lead Poisoning: Exposure, Abatement, Regulation
Lewis, Boca Raton, FL

Highlights issues on lead abatement, exposure, programs and policies, chemical measurements and sampling methods, and statistical analysis. Part I assesses lead exposure from paint, dust, soil, and lead battery recycling operations. Part II is a collection of federal policy statements. Part III covers analytical issues in the measurement of lead in blood, paint, dust, and soils. Sampling strategies and methods are presented in Part IV.

Brown, S. S., and Sunderman, F. W., Jr. (Eds.) (1980)
Nickel Toxicology
Academic Press, London

Covers experimental and epidemiological aspects in carcinogenesis, uptake, distribution, excretion, pharmacology, and analysis of nickel. Includes a reference method for analysis of nickel in serum and urine via electrothermal atomic absorption spectrometry.

Casdorph, H. R., and Walker, M. (1995)
Toxic Metal Syndrome
Avery, Garden City Park, NY

Written from the viewpoint of complementary medicine, this book integrates practical advice regarding issues described as connections. The specific connections covered include the brain, aluminum (Alzheimer's syndrome), heavy metal, chelation, and dietary.

Castellino, N., Castellino, P., and Sannolo, N. (Eds.) (1995)
Inorganic Lead Exposure: Metabolism and Intoxication
Lewis, Boca Raton, FL

The need to regulate environmental exposure to lead has yielded highly sophisticated monitoring and control systems. This, coupled with the need to correlate extremely low-level exposures with extremely subtle if real effects, has produced a wealth of information.

Chadwick, D. J., and Whelan, J. (Eds.) (1992)
Aluminum in Biology and Medicine
Wiley, Chichester, UK

The chemistry and biology of aluminum compounds are reviewed in connection with their known toxicity. The distribution of aluminum in the environment, its chemical form in relation to its biology, absorption and transport, and etiology of Alzheimer's disease are discussed. Volume 169 in the *Ciba Foundation Symposia.*

Chang, L. W., Magos, L., and Suzuki, T. (1996)
Toxicology of Metals
CRC Press, Boca Raton, FL

Discusses not only the basic toxicology of metals but also special toxic end points such as neurotoxicity, renal toxicity, and cancer induction. It provides monitoring and assessment guidelines for metal contaminants in waters and sediments, air, and soil. Extensive coverage of clinical aspects of human exposure to numerous metals is included. Mechanistic aspects of metal-induced damage such as oxidative DNA damage, metal-induced gene expression, and neoplastic transformations are discussed.

Clarkson, T. W., Nordberg, G. F., and Sager, P. R. (Eds.) (1983)
Reproductive and Developmental Toxicity of Metals
Plenum, New York

Reviews effects of metals on the male and female reproductive systems. Discusses birth defects and perinatal toxicity and the developing central nervous system. Concluding chapters cover prenatal and postnatal aspects of metabolism.

Connor, J. R. (Ed.) (1997)
Metals and Oxidative Damage in Neurological Disorders
Plenum, New York

Reviews metals and their role in oxidative injury in the nervous system, with special attention paid to iron, the mechanisms by which the brain protects itself from oxidative harm, the clinical diseases in which oxidative injury is known to contribute to the pathogenic process, antioxidant therapeutic strategies in neurological disorders, and a proposed common pathway for oxidative injury in the brain.

Dragun, J., *et al.* (1996)
Chromium in Soil: Perspectives in Chemistry, Health, and Environmental Regulation
CRC Press, Boca Raton, FL

Considers chromium chemistry and implications for environmental fate and toxicity, human exposure studies, dermatitis hazard posed by Cr(VI) in soil and water, state and federal standards, etc.

European Chemical Industry Ecology and Toxicology Centre (ECETOC) (1992)
Technical Report No. 45: Nickel, Cobalt and Chromium in Consumer Products: Allergic Contact Dermatitis
ECETOC, Brussels

Reviews data from the published literature and unpublished industry data on transition metal contamination of consumer products and assesses the hazard to man.

Foulkes, E. C. (Ed.) (1986)
Cadmium
Springer-Verlag, Berlin

Volume 80 of the *Handbook of Experimental Pharmacology*. Presents an analysis of the mechanism of action of cadmium on biological systems, with chapters on the estimation of cadmium in biological samples, cadmium in the environment, and its entry into terrestrial food chain crops.

Foulkes, E. C. (Ed.) (1990)
Biological Effects of Heavy Metals
CRC Press, Boca Raton, FL

Focuses on the neurotoxicity of heavy metals. Chapters include effects of metals on calcium channels, lead and mercury and neurotransmitter release, calmodulin regulation, nutritional influences, organotin neurotoxicity, renal damage and lead, and behavioral effects of metal exposure.

Friberg, L., and Vostal, J. (Eds.) (1972)
Mercury in the Environment: An Epidemiological and Toxicological Appraisal
CRC Press, Cleveland, OH

Detailed review of the toxicity of mercury, including analytical methods, transport, environmental transformation, metabolism, and clinical signs of intoxication.

Friberg, L., Elinder, C. G., Kjellstrom, T., and Nordberg, G. F. (Eds.) (1985)
***Cadmium and Health: A Toxicological and Epidemiological Appraisal,* 2 vols.**
CRC Press, Boca Raton, FL

Presents analysis of cadmium, its uses and occurrence in the environment, cadmium and metallothionein, normal values in human tissues and fluids, and metabolism. Comprehensively covers toxicology of cadmium to all organ systems. Carcinogenic and genetic effects are treated in a separate chapter, as are the concepts of critical organ and critical concentration for cadmium.

Friberg, L., Nordberg, G. F., and Vouk, V. B. (1986)
Handbook on the Toxicology of Metals, 2nd ed.
Elsevier, Amsterdam

This two-volume work provides easy access to basic toxicological data and gives an in-depth picture of the hazards associated with use and exposure. For each of the metals discussed, the following information is supplied: properties, analysis, production and use, environmental levels, metabolism, levels in tissues and body fluids, effects and dose–response relationships, and mutagenic, teratogenic, and carcinogenic information.

Goyer, R. A., and Cherian, M. G. (Eds.) (1995)
Toxicology of Metals: Biochemical Aspects
Springer-Verlag, New York

Focuses on essential metals at the levels at which exposure exceeds biologic requirements and excess exposure becomes toxic. Metals covered include aluminum, cadmium, chromium, lead, and mercury. Many chapters are concerned with metal–protein interactions.

Goyer, R. A., and Mehlman, M. A. (Eds.) (1977)
Toxicology of Trace Elements
Hemisphere, Washington, DC

Volume 2 of ***Advances in Modern Toxicology.*** Covers the toxic effects of mercury, lead, arsenic, copper, nickel, vanadium, and tellurium.

Goyer, R. A., Klaassen, C. D., and Waalkes, M. P. (Eds.) (1995)
Metal Toxicology
Academic Press, San Diego

Addresses the topic of metal toxicology from two different aspects. Introductory chapters consider the conceptual aspects, whereas later chapters focus on specific organ toxicity. Many toxic and essential metals are included in this book. The objective is to provide a basis for differentiating adverse from normal biological responses. Quantitative information as well as biomarkers or indicators of organ effects are provided.

Grandjean, P. (Ed.) (1984)
Biological Effects of Organolead Compounds
CRC Press, Boca Raton, FL

Reviews the toxicological significance of organic lead compounds. Chapters detail gasoline additives, microbial methylation of lead, organic lead in the aquatic environment, and toxic effects in plant organisms. Metabolism and toxicokinetics, genotoxic effects, effects on mitochondria, effects on reproduction, neurotoxicity, the gasoline sniffing syndrome, preventive measures, and governmental regulations are also discussed.

Guy, R. H., Hostynek, J. J., Hinz, R. S., and Lorence, C. R. (1999)
Metals and the Skin: Topical Effects and Systemic Absorption
Marcel Dekker, New York

A thorough compendium of studies on the health hazards of toxic, nonessential metals absorbed through the skin. Looks at skin permeation factors, presents international research, reviews data on carcinogenic metals, evaluates the permeability coefficient as a parameter for comparison of percutaneous flux, examines penetrating metal salts in their ionic form, and explores much more.

Hadjiliadis, N. D. (Ed.) (1997)
Cytotoxic, Mutagenic, and Carcinogenic Potential of Heavy Metals Related to Human Environment
Kluwer, Dordrecht

Volume 26 of the **NATO ASI** series, partnership subseries 2, Environment. Includes sections on metal carcinogenesis, metallothioneins, biological role of aluminum, bioinorganic chemistry, metal transport, heavy metals in the environment, antitumor metal complexes, and metal interactions with oligonucleotides and oligopeptides.

Hanson, M. (1992)
Mercury Bibliography, 3rd ed.
Bio-Probe, Orlando, FL

Presents an alphabetized listing of published material relating to the health effects of mercury. Because of the wide range of both exposures and adverse effects, this volume is useful. Approximately 12,000 papers are cited by effect, affected organ, and mode of action.

Hearn, L. C., Jr. (1994)
Inorganic Lead Guidance Document
American Industrial Hygiene Association, Fairfax, VA

Allows industrial hygienists to implement a consistent approach for each task in the lead management program. Topics covered include competent person designation, lead identification and assessment techniques, and exposure assessment and control.

International Agency for Research on Cancer (1990)
IARC Monograph on the Evaluation of Carcinogenic Risks to Humans
World Health Organization, Lyon.

The following are among the metal-related titles in this monographic series with an emphasis on carcinogenesis:

Aluminum production: V36, 1984; Suppl. 7, 1987
Antimony trioxide: V47, 1989
Antimony trisulfide: V47, 1989
Arsenic: V1, 1972; V2, 1973; V23, 1980; Suppl. 7, 1987
Beryllium: V1, 1972; V23, 1980; Suppl. 7, 1984; V58, 1993
Cadmium: V2, 1973; V11, 1976; Suppl. 7, 1987; V58, 1993
Chromium: V49, 1990
Cobalt: V52, 1991
Iron oxide: V1, 1972; Suppl. 7, 1987
Lead: V1, 1972; V2, 1973; V12, 1976; V23, 1980; Suppl. 7, 1987
Mercury: V58, 1993
Nickel: V2, 1973; Suppl. 7, 1987; V49, 1990
Selenium: V8, 1975; Suppl. 7, 1981.

Katz, S. A., and Salem, H. (1994)
The Biological and Environmental Chemistry of Chromium
VCH, New York

Offers a look at the nutritional benefits, toxicological consequences, and environmental hazards associated with exposure to chromium and its compounds.

Langard, S. (Ed.) (1982)
Biological and Environmental Aspects of Chromium
Elsevier, Amsterdam

Summarizes the toxicological effects of chromium, including production, occupational exposure, chromium in the environment, analysis of the chemical, appli-

cations of chromium-51, and chromium's nutritional role.

Lauffer, R. B. (Ed.) (1992)
Iron and Human Disease
CRC Press, Boca Raton, FL

Topics discussed include chemistry and molecular biology of iron and iron-binding proteins, iron accumulation and metabolism in humans, iron and oxidative stress, iron in cardiovascular and other diseases, and implications for prevention and therapy.

Luckey, T. D., and Vanugopal, B. (1977)
Metal Toxicity in Mammals
Plenum, New York

Presents the basic toxicology issues regarding metals. The chapters include a thorough introductory section, modes of intake and absorption, detoxication and homeostasis, toxicological significance, carcinogenicity, and teratogenicity. A summary and overview by periodic table groups is also provided.

Lynam, D. R., Piantanida, L. G., and Cole, J. F. (1981)
Environmental Lead
Academic Press, New York

Covers seven areas: lead in children, neurologic effects, epidemiologic studies, lead in adults, effects on the kidney, biochemistry, and air and water pollution studies.

Millstone, E. (1997)
Lead and Public Health: Dangers for Children
Taylor & Francis, Washington, DC

Focuses on the evidence concerning the effects of lead on children. The book questions why lead poisoning and lead pollution are important issues, the severity of the problem, and who should be responsible for dealing with them. The background of the scientific debate about the toxicology of lead and the impact or lack of impact on human health is presented.

National Academy of Sciences (1993)
Measuring Lead Exposure in Infants, Children and Other Sensitive Populations
National Academy Press, Washington, DC

As the evidence of lead toxicity at lower concentrations grows, this reference addresses the public health concern about the logistics and feasibility of lead screening in infants and children at such low concentrations.

National Research Council, Committee on Lead in the Human Environment (1980)
Lead in the Human Environment
National Academy of Sciences, Washington, DC

Provides a systematic approach to decision making about lead. Regulatory issues are discussed.

Neve, J., and Favier, A. (Eds.) (1989)
Selenium in Medicine and Biology
de Gruyter, Berlin

Considers selenium intake, metabolism, and homeostasis, biological functions of selenium, assessment of selenium status, selenium in human disease, selenium supplementation and toxicity, and selenium in animals.

Nieboer, E., and Nriagu, J. O. (Eds.) (1992)
Nickel and Human Health: Current Perspectives
Wiley, New York

Volume 25 of the series *Advances in Environmental Science and Technology.* The book addresses the following themes regarding the biology and chemistry of nickel and its compounds: historical perspective, biological utilization of nickel, toxicokinetics in humans, occupational exposure and biological monitoring of workers, renal toxicity, hypersensitivity, and immunotoxicity. Interdisciplinary in approach and aimed at graduate students, researchers, and associated health professionals.

Nordberg, G. F., *et al.* (1992)
Cadmium in the Human Environment: Toxicity and Carcinogenicity
International Agency for Research on Cancer, Lyon [Distributed in the United States by Oxford Univ. Press]

Explores cadmium in terms of human exposure, ecotoxicology, metabolism and toxicology, renal damage and related effects, and carcinogenicity.

Nriagu, J. O. (Ed.) (1994)
Arsenic in the Environment
Wiley, New York

Volumes 26 and 27 of the series *Advances in Environmental Science and Technology.* Part I focuses on the sources, distribution, biotransformation, speciation, and fate of arsenic, especially in soils in the aquatic environment. Part 2 covers the human health and ecosystem effects of arsenic.

Nriagu, J. O. (1998)
Thallium in the Environment
Wiley, New York

Designed to raise public consciousness regarding the potential risks of thallium in our environment. Written by an international panel of experts on the effects of thallium exposure to aquatic and terrestrial ecosys-

tems, human health, and wildlife; this resource explores this topic in a focused manner.

Nriagu, J. O. (1998)
Vanadium in the Environment: Chemistry and Biochemistry, Parts 1 and 2
Wiley, New York

The focus of Vol. 1 is on the effects of the vanadium on the environment, the chemistry and biochemistry of vanadium, the detection of vanadium, and its effects on the lower forms of life. Volume 2 focuses on the effects of vanadium on humans and other mammals and provides information on the use of vanadium in diabetes and cancer prevention.

Nriagu, J. O., and Nieboer, E. (Eds.) (1988)
Chromium in the Natural and Human Environments
Wiley, New York

Volume 20 of the series *Advances in Environmental Science and Technology.* Presents a comprehensive assessment of the uses of chromium, its sources, occurrence in air, water, and soil, and toxicity to terrestrial and aquatic biota and humans.

Proctor, D. M., *et al.* (Eds.) (1998)
Chromium in Soil: Perspectives in Chemistry, Health, and Environmental Regulation
CRC Press, Boca Raton, FL

Covers environmental chromium research, including toxicity, chemistry, environmental fate and transport, remediation technology, and health-based cleanup standards.

Rossman, M. D., *et al.* (Eds.) (1991)
Beryllium: Biomedical and Environmental Aspects
Williams & Wilkins, Baltimore

Considers topics such as the toxicology of beryllium, its human carcinogenicity, acute beryllium-related disease, chronic pulmonary beryllium disease, and medical surveillance.

Sarkar, B. (Ed.) (1995)
Genetic Response to Metals
Dekker, New York

Molecular mechanisms of metal-induced mutagenicity and carcinogenicity are reviewed. Interactions of metals with DNA to examine mechanism and protein products are reviewed. A total of 29 invited chapters cover the field in detail.

Sigel, A., and Sigel, H. (Eds.) (1997)
Mercury and Its Effects on the Environment and Biology
Dekker, New York

Volume 34 of *Metal Ions in Biological Systems.* Details analytical methods for the determination of mercury and covers the biogeochemical cycling of mercury in lakes, rivers, oceans, the soil, and the atmosphere. Also examines food chain accumulation, the toxicology of mercury, the effect on the immune system, and the impact of mercury released from dental fillings.

Sposito, G. (Ed.) (1996)
The Environmental Chemistry of Aluminum
CRC Press, Boca Raton, FL

Provides a full account of the aqueous chemistry of aluminum in the environment.

Stoeppler, M. (Ed.) (1992)
Hazardous Metals in the Environment
Elsevier, Amsterdam

Presents information on the rapid progress in methodology and its influence on research strategies, environmental levels, and evolving techniques. The 17 chapters include sections on sampling and sample storage, elemental analysis for 10 specific metals, and a chapter on quality assurance and validation of results.

Whitford, G. M. (1996)
Metabolism in Toxicity of Fluoride, 2nd ed.
Karger, Farmington, CT

Deals with fluoride metabolism and intake, absorption and plasma and soft tissue concentrations, distribution, renal handling, factors modifying handling, dental effects, and acute and chronic poisoning. This concise overview covers in great detail chronic fluoride effects and is particularly useful to those dealing with this type of exposure.

World Health Organization (WHO) (1976–)
Environmental Health Criteria
WHO, Geneva

Presents information regarding the potential health effects of the specific metal in an orderly fashion and reviewed by an expert committee. The committee presents their evaluation of the data with particular emphasis on human health implications. Also included are a summary of the key information, an evaluation of the strength of this information, and recommendations for future research. Topics covered in detail include chemical properties and analytical methods, source of exposure both natural and man-made, effects on the environment, movement through biological systems, effects on animals, and effects on man:

Aluminum: 194, 1997
Arsenic: 18, 1981
Barium: 107, 1980

Beryllium: 106, 1990
Cadmium: 134, 1992
Cadmium, Environmental Aspects: 135, 1992
Chromium: 61, 1988
Inorganic Lead: 165, 1995
Inorganic Mercury: 118, 1991
Lead: 3, 1977
Lead, Environmental Aspects: 85, 1989
Manganese: 17, 1981
Mercury: 1, 1976
Mercury, Environmental Aspects: 86, 1989
Nickel: 108, 1991
Platinum: 125, 1991
Selenium: 26, 1986
Tin and Organotin Compounds: 15, 1980
Titanium: 24, 1982
Tributyl Tin Compounds: 116, 1990
Vanadium: 81, 1988

Yasui, M., Ota, K., Strong, M. J., and Verity, M. A. (Eds.) (1996)
Mineral and Metal Neurotoxicity
CRC Press, Boca Raton, FL

Describes a wide range of basic and clinical issues regarding the relationship between mineral–metal interactions and neurological disorders. This book covers in great detail interactions that have been identified in a series of chapters prepared by the researcher directly involved in the issue.

Yokel, R. A., and Golub, M. S. (1997)
Research Issues in Aluminum Toxicity
Taylor & Francis, London

Material drawn from an international symposium held in 1995 to review the toxicology of aluminum, particularly as it relates to neurological effects and Alzheimer's disease. The broad areas covered include aluminum in the environment, biologic effects of hypo and hyper states, systemic aluminum needs, relationships between neural function and metal availability, and mechanisms of aluminum action. The last section deals with future research needs and priorities.

Zelicoff, J. T., and Thomas, P. (Ed.) (1998)
Immunotoxicology of Environmental and Occupational Metals
Taylor & Francis, Washington, DC

Describes environmentally and occupationally important metals and their effects on the immune system and host defense. The presentations emphasize the *in vivo* and *in vitro* effects according to history, commercial use, occurrence, biology, and toxicology. Summary tables included in each chapter are particularly useful.

See Also:
Agency for Toxic Substances and Disease Registry: *Toxicological Profiles* (Chemical Compendia)—many of their profiles are on metals

Carson: *Toxicology and Biological Monitoring of Metals in Humans* (Biomonitoring)

Clarkson: *Biological Monitoring of Toxic Metals* (Biomonitoring)

IARC: *Chlorinated Drinking Water, Chlorinated By-Products, Some Other Halogenated Compounds, and Cobalt and Cobalt Compounds* (Food and Nutrition)

Journal Articles

General

Aposhian, H. V. (1997). Enzymatic methylation of arsenic species and other new approaches to arsenic toxicity. ***Annu. Rev. Pharmacol. Toxicol.* 37,** 397–419.

Aschner, M. *et al.* (1997). Metallothioneins in brain—The role in physiology and pathology. ***Fundam. Appl. Toxicol.* 142,** 229–242.

Clarkson, T. (1995). Health effects of metals: A role for evolution? ***Environ. Health Perspect.* 103**(Suppl. 1), 9–12.

Clarkson, T. W. (1993). Molecular and ionic mimicry of toxic metals. ***Annu. Rev. Pharmacol. Toxicol.* 33,** 545–572.

Costa, M. (1997). Toxicity and carcinogenicity of Cr(VI) in animal models and humans. ***Crit. Rev. Toxicol.* 27,** 431–442.

Domingo, J. L. (1994). Metal-induced developmental toxicity in mammals: A review. ***J. Toxicol. Environ. Health* 42**(2), 123–141.

Flint, G. N. (1998). A metallurgical approach to metal contact dermatitis. ***Contact Dermatitis* 39**(5), 213–221.

Foulkes, E. C. (1990). The concept of critical levels of toxic heavy metals in target tissues. ***Crit. Rev. Toxicol.* 20,** 327–340.

Gerhard, I. (1993). Reproductive risks of heavy metals and pesticides in women. ***Reprod. Toxicol.,*** 167–183.

Giller, K. E., Witter, E., and McGrath, S. P. (1998). Toxicity of heavy metals to microorganisms and microbial processes in agricultural soils: A review. ***Soil Biol. Biochem* 30**(10/11), 1389–1414.

Hamasaki, T., *et al.* (1995). Formation, distribution, and ecotoxicity of methylmetals of tin, mercury, and ar-

senic in the environment. ***Crit. Rev. Environ. Sci. Technol.* 25,** 45–92.

Hare, L. (1992). Aquatic insects and trace metals: Bioavailability, bioaccumulation, and toxicity. ***Crit. Rev. Toxicol.* 22,** 327–370.

Hartwig, A. (1995). Current aspects in metal genotoxicity. ***Biometals* 8,** 3–11.

Hayes, R. B. (1997). The carcinogenicity of metals in humans. ***Cancer Causes Control* 8**(3), 371–385.

Hollinger, M. A. (1996). Toxicological aspects of topical silver pharmaceuticals. ***Crit. Rev. Toxicol.* 26,** 255–260.

Hostynek, J. J., *et al.* (1993). Metals and the skin. ***Crit. Rev. Toxicol.* 23,** 171–236.

Hostynek, J. J., (1998, January). Toxic potential from metals absorbed through the skin. ***Cosmet. Toiletries* 113,** 33–34, 37–40, 42.

Jones, M. M. (1991). New developments in therapeutic chelating agents as antidotes for metal poisoning. ***Crit. Rev. Toxicol.* 21,** 209–234.

Moon, J. (1994). The role of vitamin D in toxic metal absorption: A review. ***J. Am. Coll. Nutr.* 13,** 559–564.

O'Flaherty, E. J. (1998). Physiologically based models of metal kinetics. ***Crit. Rev. Toxicol.* 28,** 271–317.

Waalkes, M. P., *et al.* (1992). Toxicological principles of metal carcinogenesis with special emphasis on cadmium. ***Crit. Rev. Toxicol.* 22,** 175–202.

Weis, P., and Weis, J. S. (1991). The developmental toxicity of metals and metalloids in fish. ***Metal Ecotoxicol. Concepts Appl.,*** 145–169.

Zelikoff, J. T. *et al.* (1994). Immunomodulation by metals. ***Fundam. Appl. Toxicol.* 22,** 1–7.

Zelikoff, J. T. *et al.* (1995). Health risks associated with prenatal metal exposure. ***Fundam. Appl. Toxicol.* 23,** 161–174.

Aluminum

Exley, C., *et al.* (1996). Aluminum toxicokinetics. ***J. Toxicol. Environ. Health* 48**(6), 569–584.

Flaten, T. P., *et al.* (1996). Status and future concerns of clinical and environmental aluminum toxicology. ***J. Toxicol. Environ. Health* 48**(6), 527–541.

Beryllium

Aller, A. J. (1990). The clinical significance of beryllium. ***J. Trace Elements Electrolytes Health Dis.* 4,** 1–6.

Anonymous (1991). **Drinking water criteria document for beryllium,** NTIS/PB92-173301.

Anonymous (1993). **Toxicological profile for beryllium,** NTIS/PB93-182392.

Haley, P. J., *et al.* (1994). The comparative pulmonary toxicity of beryllium metal and beryllium oxide in cynomolgus monkeys. ***Immunopharmacol. Immunotoxicol.* 16,** 627–644.

Macmahon, B. (1994). The epidemiological evidence on the carcinogenicity of beryllium in humans. ***J. Occup. Med.* 36,** 15–24.

Meyer, K. C. (1994). Beryllium and lung disease. ***Chest* 106,** 942–946.

Newman, L. S., *et al.* (1996). The natural history of beryllium sensitization and chronic beryllium disease. ***Environ. Health Perspect.* 104**(Suppl. 5), 937–943.

Pappas, G. P. and Newman, L. S. (1993). Early pulmonary physiologic abnormalities in beryllium disease. ***Am. Rev. Respir. Dis.* 148,** 661–666.

Cadmium

Hirano, S., and Suzuki, K. T. (1996). Exposure, metabolism, and toxicity of rare earths and related compound. ***Environ. Health Perspect.* 104,** 85–95.

Jackson, T., and MacGillivray, A. (1995). Accounting for toxic emissions from the global economy: The case of cadmium, NTIS/DE9671132.

Jarup, L., *et al.* (1998). Health effects of cadmium exposure: A review of the literature and a risk estimate. ***Scand. J. Work Environ. Health* 24** (Suppl. 1), 1–52.

Silva, E. D. C. E., *et al.* (1996). Effect of central acute administration of cadmium on drinking behavior. ***Pharmacol. Biochem. Behav.* 53,** 687–693.

Chromium

Cohen, M. D., *et al.* (1993). Mechanisms of chromium carcinogenicity and toxicity. ***Crit. Rev. Toxicol.* 23,** 255–281.

Corbett, G. E., *et al.* (1997). Systemic uptake of chromium in human volunteers following dermal contact with hexavalent chromium (22 mg/l). ***J. Exposure Anal. Environ. Epidemiol.* 7,** 179–189.

Itoh, M., *et al.* (1995). Mechanism of chromium(VI) toxicity in *Escherichia coli:* Is hydrogen peroxide essential in Cr(VI) toxicity. ***J. Biochem.* 117,** 780–786.

Itoh, T., *et al.* (1996). Mortality of chromium plating workers in Japan: A 16-year follow-up study. ***J. UOEH* 18,** 7–18.

Kortenkamp, A., *et al.* (1996). The reductive conversion of the carcinogen chromium (VI) and its role in the formation of DNA lesions. ***Ann. Clin. Lab. Sci.* 26,** 160–175.

Malsch, P. A., *et al.* (1994). Estimation of a chromium inhalation reference concentration using the benchmark dose method: A case study. ***Regul. Toxicol. Pharmacol.* 20,** 58–82.

Rosenman, K. D., and Stanbury, M. (1996). Risk of lung cancer among former chromium smelter workers. ***Am. J. Ind. Med.* 29,** 491–500.

Cobalt

Jensen, A. A., and Tüchsen, F. (1990). Cobalt exposure and cancer risk. ***Crit. Rev. Toxicol.* 20,** 427–438.

Kumagai, S., *et al.* (1996). Cobalt exposure level and variability in the hard metal industry of Japan. ***Am. Ind. Hygiene Assoc. J.* 57,** 365–369.

Lison, D., and Lauwerys, R. (1994). Cobalt bioavailability from hard metal particles: Further evidence that cobalt alone is not responsible for the toxicity of hard metal particles. ***Arch. Toxicol.* 68,** 528–531.

Nordberg, G. (1994). Assessment of risks in occupational cobalt exposures. ***Sci. Total Environ.* 150,** 201–207.

Copper

Harris, Z. L., and Gitlin, J. D. (1996). Genetic and molecular bases for copper toxicity. ***Am. J. Clin. Nutr.* 63,** 836S–841S.

Olivares, M., and Uauy, R. (1996). Limits of metabolic tolerance to copper and biological basis for present recommendations and regulations. ***Am. J. Clin. Nutr.* 63,** 846S–852S.

Sugawara, N., *et al.* (1995). Response of hepatic function to hepatic copper deposition in rats fed a diet containing copper. ***Biol. Trace Elem. Res.* 49,** 161–169.

Lead

Angle, C. R. (1993). Childhood lead poisoning and its treatment. ***Annu. Rev. Pharmacol. Toxicol.* 33,** 409–434.

Beck, B. D. (1992). An update on exposure and effects of lead. ***Fundam. Appl. Toxicol.* 18,** 1–16.

Bellinger, D., (1994). Teratogen update: Lead. ***Teratology* 50**(5), 367–373.

Ehle, A. L., and McKee, D. C. (1990). Neuropsychological effect of lead in occupationally exposed workers: A critical review. ***Crit. Rev. Toxicol.* 20,** 237–256.

Fechner, K., *et al.* (1996). Dietary intake in children at low and high risk for lead poisoning. ***FASEB J.* 10,** A481.

Hu, H., *et al.* (1996). The relationship of bone and blood lead to hypertension: The normative aging study. ***J. Am. Med. Assoc.* 275,** 1171–1176.

Sun, J.-B., and Wang, J.-P. (1995). Recommended diagnostic criteria for occupational chronic lead poisoning. ***Biomed. Environ. Sci.* 8,** 318–329.

Verberk, M. M., *et al.* (1996). Environmental lead and renal effects in children. ***Arch. Environ. Health* 51,** 83–87.

Zidenberg-Cherr, S., *et al.* (1996). Trace element status in children at low and high risk for lead poisoning. ***FASEB J.* 10,** 785–792.

Mercury

Anonymous (1991). Safe handling of mercury: A guideline for the construction industry, NTIS/MIC-96-02631.

Gilbert, S. G., and Grant-Webster, K. S. (1994). Methylmercury: A risk assessment based on human and animal data. ***Neurotoxicology* 15,** 964–965.

Goering, P. L., *et al.* (1992). Toxicity assessment of mercury vapor from dental amalgams. ***Fundam. Appl. Toxicol.* 19,** 319–329.

Gray, D. G. (1995). A physiologically based pharmacokinetic model for methyl mercury in the pregnant rat and fetus. ***Toxicol. Appl. Pharmacol.* 132,** 91–102.

Harada, M. (1995). Minamata disease: Methylmercury poisoning in Japan caused by environmental pollution. ***Crit. Rev. Toxicol.* 25,** 1–24.

Martin, M. D., *et al.* (1995). Factors contributing to mercury exposure in dentists. ***J. Am. Dental Assoc.* 126,** 1502–1511.

Smith, J. C., and Farris, F. F. (1996). Methyl mercury pharmacokinetics in man: A reevaluation. ***Toxicol. Appl. Pharmacol.* 137,** 245–252.

Stein, E., Cohen, Y., and Winer, A. M. (1996). Environmental distribution and transformation of mercury compounds. ***Crit. Rev. Environ. Sci. Technol.* 26,** 1–44.

Valentino, L., *et al.* (1995). Health effects of mercury ingested through consumption of seafood. ***Water Sci. Technol.* 32,** 41–47.

Nickel

Benson, J. M., *et al.* (1995). Pulmonary toxicity of nickel subsulfide in F344/N rats exposed for 1–22 days. ***Toxicology* 103,** 9–22.

Savolainen, H. (1996). Biochemical and clinical aspects of nickel toxicity. ***Rev. Environ. Health* 11**(4), 167–173.

Von Burg, R. (1997). Nickel and some nickel compounds. ***J. Appl. Toxicol.* 17**(6), 425–431.

Tin

Dunnick, J. K. *et al.* (1995). Comparative carcinogenic effects of nickel subsulfide, nickel oxide, or nickel sulfate hexahydrate chronic exposures in the lung. ***Cancer Res.* 55,** 5251–5256.

Fent, K. (1996). Ecotoxicology of organotin compounds. ***Crit. Rev. Toxicol.* 26,** 1–117.

Sosroseno, W. (1995). The immunology of nickel-induced allergic contact dermatitis. ***Asian Pacific J. Allergy Immunol.* 13,** 173–181.

Tsai, P. J., *et al.* (1995). Occupational exposure to inhalable and total aerosol in the primary nickel production industry. ***Occup. Environ. Med.* 52,** 793–799.

CHEMICALS—PESTICIDES

Ballantyne, B., and Marrs, T. C. (Eds.) (1992)
Clinical and Experimental Toxicology of Organophosphates and Carbamates
Butterworth, Boston.

Provides a thorough overview of organophosphates and carbamates. Covers basic science, neurotoxicity, organ and long-term toxicology of these chemicals. Reviews exposure patterns, protecton and monitoring of workers, and clinical and therapeutic aspects.

Bandal, S. K. (1981)
The Pesticide Chemist and Modern Toxicology
American Chemical Society, Washington, DC

A useful reference interfacing the chemistry and biology of pesticides. This book presents chapters from a workshop in which both pesticide chemists and toxicologists discussed advances in toxicology, metabolism and analytical studies necessary to support safety evaluation of pesticides, and regulatory aspects of these activities. Many of the major concepts being used in this field today are presented in a clear, easily understandable fashion.

Bismuth, C., and Hall, A. H. (Eds.) (1995)
Paraquat Poisoning
Dekker, New York

Covers the clinical and basic research into specific therapies for paraquat poisoning. The book lays the groundwork, presents the experimental evidence from animals and man, examines factors leading to or involved in the response, and discussed treatment options.

Briggs, S. A. (1992)
Basic Guide to Pesticides: Their Characteristics and Hazards
Hemisphere, Washington, DC

Attempts to give the key information regarding the safe use of pesticides to the layperson. The six chapters include a description of intent, instructions for using the guide, index of names, pesticide characteristics, chemical classes, and references. This book is useful to those desiring a simple guide to the why, what, and how of safe pesticide use.

British Crop Protection Council (1997)
The Pesticide Manual, 11th ed.
British Crop Protection Council, Farnham, UK

Contains 759 detailed main entries as well as abbreviated details covering 593 superseded products. Covers herbicides, fungicides, insecticides, acaricides, nematicides, plant growth regulators, herbicide safeners, repellents, pheromones, biological control agents, rodenticides, and animal ectoparasites. Also available on a searchable CD from the Council (*http://www.bcpc.org*), as is the 1999 edition of the *U.K. Pesticide Guide.*

Carozzi, N. B., and Koziel, M. G. (Eds.) (1997)
Advances in Insect Control: The Role of Transgenic Plants
Taylor & Francis, Washington, DC

Describes a field which has risen in importance in the past decade. With contributions from leaders in both academia and industry, this book serves as an update of current technologies for engineering insect tolerant crops as well as an overview of new technologies that are being pursued for the development of new genetically engineered crops.

Chambers, J. E., and Levi, P. E. (Eds.) (1992)
Organophosphates: Chemistry, Fate, and Effects
Academic Press, New York

Reviews the current research on organophosphorus anticholinesterases, with primary focus on the insecticidal organophosphorus compounds. The book includes acetylcholinesterase inhibition, teratogenicity, delayed neuropathy, and immunotoxicity effects.

Chavasse, D. C., and Yap, H. H. (Eds.) (1997).
Chemical Methods for the Control of Vectors and Pests of Public Health Importance, 5th ed.
World Health Organization, Geneva.

Provides and updates recommendations for the safe and effective use of pesticides to control insect vectors and pests. The core of the book is 12 chapters focusing on the major disease vectors and pests. Each chapter has an introduction, discusses the role of chemicals in control strategies, and provides appropriate use and handling information.

Cheremisinoff, N. P., and King, J. A. (1994).
Toxic Properties of Pesticides
Dekker, New York.

Provides a comprehensive reference on the toxicological properties and safe handling practices for pesticides. It is intended to assist the practitioner in proper usage and registration of pesticide ingredients. The toxicology of the various pesticides by chemical class are presented along with detailed information on the specific agents.

Crop Protection Reference, 15th ed. (1999)
Chemical and Pharmaceutical Press, New York

Can be used to research uses and effects of products and to look up scientific crops and pests, target organisms, rates and means of application, and safety and toxicity. It contains the following indexes: manufacturers, common and chemical name, product category, brand name, crop and noncrop use, and pest use. Included are first aid and safety rules, lists of poison control centers and solid and hazardous waste agencies by state, and general information on handling and storage of pesticides. Chemical and Pharmaceutical Press' *Electronic Pesticide Reference* (master version) brings together, on CD-ROM, The *Crop Protection Reference, MSDS Reference for Crop Protection Products,* and *Turf and Ornamental Reference for Plant Protection Products.*

Curry, P. B., Iyengar, S., Maloney, P. A., and Maroni, M. (Eds.) (1995)
Methods of Pesticide Exposure Assessment
Plenum, Washington, DC

Proceeding of an international symposium held in 1993 The past, present, and future of the topic is presented in the introductory chapters, followed by the methodologies and strategies employed to assess current exposures in the field. Case studies/histories are the main feature of this collection. The closing section deals with the use of biomarkers as indicators of exposure.

Ecobichon, D. J. (Ed.) (1998)
Occupational Hazards of Pesticide Exposures: Sampling, Monitoring, Measuring
Taylor & Francis, Washington, DC

Examines techniques used to monitor pesticide deposition following its application and to assess human exposure. Principles and applications of techniques for sampling, monitoring, and measuring pesticide exposure are presented in the text.

Ecobichon, D. J., and Joy, R. M. (1994)
Pesticides and Neurological Diseases, 2nd ed.
CRC Press, Boca Raton, FL

Discusses the toxicology of various chemical classes of pesticides in terms of the morphological, physiological, and biochemical mechanisms related to the ability to cause subtle or overt damage to the central and/or peripheral nervous systems following either acute or chronic administration.

Farm Chemicals Handbook (annual)
Meister, Willoughby, OH

Published annually, this handbook contains a plant food dictionary, a pesticide dictionary, a buyer's guide, and addresses of farm chemicals manufacturers. Data include compositions and toxicities of chemicals.

Fong, G. W., *et al.* (1999)
Pesticide Residues in Foods: Methods, Techniques, and Regulations
Wiley, New York

Provides guidelines to analytical techniques, demonstrating how to analyze minute traces of pesticides quickly and accurately. Explores safety issues, regulatory aspects of pesticide registration, residue analysis, exposure monitoring, risk assessment, and tolerance enforcement.

Foy, C. L., and Pritchard, D. W. (Eds.) (1996)
Pesticide Formulation and Adjuvant Technology
CRC Press, Boca Raton, FL

Based on a 1994 symposium and covers topics such as regulation of inert ingredients and adjuvants, targeting and efficacy enhancement technologies, packaging technology and trends, water dispersible granules, emulsifiable concentrates and gels, and adjuvants. The book is targeted to agricultural and pharmaceutical formulators but there are many areas of interest to the toxicologist in this book.

Gilliom, R. J. (Series Editor-in-Chief) (1995–1997).
Pesticides in the Hydrologic System
Ann Arbor Press, Chelsea, MI

A four-volume series of reference books reviewing and interpreting the occurrence, causes, and significance of pesticides in water resources. Summarizes physical/chemical processes governing the source, transport, and fate of pesticides in each component of the hydro-

logic systems. The four volumes are *Pesticides in the Atmosphere, Pesticides in Ground Water, Pesticides in Surface Waters,* and *Pesticides in Bed Sediments and Aquatic Biota in Streams.*

Hall, F. R., and Barry, J. W. (Eds.) (1995)
Biorational Pest Control Agents
American Chemical Society, Washington, DC

Identifies the critical needs of formulation and novel delivery systems for biologicals being advocated for agricultural pest management. Registration needs, formulation choices, and efficacy and safety data are carefully discussed and presented.

Hayes, W. J., Jr., and Laws, E. P., Jr., (Eds.) (1991)
Handbook of Pesticide Toxicology, 3 vols.
Academic Press, San Diego

The three volumes of this handbook offer a comprehensive look at pesticide toxicology. The first volume provides an overview of the general principles of toxicology and it contains chapters summarizing what is known about human exposure to pesticides, the effects of pesticides on human populations, diagnosis and treatment of poisoning, prevention of injury, and effects of pesticides on domestic animals and wildlife. Volumes 2 and 3 provide overviews of different classes of pesticies, with a separate section devoted to each of 256 compounds that have been studied in humans.

Hornsby, A. G. (1996)
Pesticide Properties in the Environment
Springer, New York

Presents data on hundreds of pesticides, including their common, commercial, and scientifc names, chemical formulas, environmental properties including water solubility, field half-life, sorption coefficient, and vaport pressure. The book is packaged with the data in electronic form on a 3 1/2-in. diskette.

Hutson, D. H., and Paulson, G. D., (Eds.) (1995)
The Mammalian Metabolism of Agrochemicals
Wiley, Chichester, UK

Brings together the various aspects of agrochemical metabolism studies in mammals. The models used to assess the toxicity of a compound to man are reviewed as well as how the metabolic picture can influence this process. The nine chapters cover background learnings, metabolism of insecticides, factors affecting pesticide metabolism, and examples from the natural environment.

Kamrin, M. A. (1997)
Pesticide Profiles: Toxicity, Environmental Impact and Fate
CRC Press, Boca Raton, FL

Profiles for each of 137 pesticides include regulatory information, toxicity assessments, environmental fate data, physical properties, and acceptable exposure limit values. The book includes a major section dealing with the practical aspects of carcinogenicity. It offers readers of various backgrounds and interests an appreciation of the toxicity and environmental issues.

Klaine, S. (Ed.) (1998)
Disposition of Pesticides in Tropical Marine Environments
Taylor & Francis, Washington, DC

Practical guide detailing the current status of efforts in more than 15 tropical countries to understand the distribution and effects of pesticides on marine tropical ecosystems. Case studies are included throughout, and future research needs are identified.

Laird, M., Lacey, L. A., and Davidson, E. W. (1990)
Safety of Microbial Insecticides
CRC Press, Boca Raton, FL

From the honeybee and silkworm to other organisms which affect nontarget organisms, this book covers the history, present, and applications of microbial insecticides in practice. The four main sections include registration requirement and safety considerations, ecological overview, safety of these to vertebrates, and safety to nontarget invertebrates.

Leng, M. L., Leovey, E. M. K., and Zubkoff, P. L. (Eds.) (1995)
Agrochemical Environmental Fate
Lewis, Boca Raton, FL

Collects the vast amount of information available on the environmental fate of agrochemicals and presents it in a single volume containing 37 chapters. Data integration and environmental assessment, considerations of modeling in environmental assessment, the ramifications of this information, and guidelines for obtaining further information are topics of discussion.

Matsumura, F. (Ed.) (1985)
Toxicology of Insecticides, 2nd ed.
Plenum, New York

Discusses general principles of insecticide toxicology. Chapters review modes of action of insecticides, their metabolism by animals and plants, toxicological studies in insects, dynamics of insect movement in the animal body, movement of insecticides in the environment, effects of pesticides in wildlife, and hazards to humans and domestic animals.

McDuffie, H. H. (Ed.) (1995)
Agricultural Health and Safety: Workplace, Environment, Sustainability
Lewis, Boca Raton, FL

Focuses on current research priorities and prevention technologies of agricultural health and safety. Topics include disorders of the respiratory system, health effects of agricultural chemicals, and accidents, death, and disability in agriculture. Other chapters discuss migrant workers, seasonal laborers, and health in rural populations.

Meyer, M. T., and Thurman, E. M. (Eds.) (1996).
Herbicide Metabolites in Surface Water and Groundwater
American Chemical Society, Washington, DC

Overview of the environmental chemistry of herbicide metabolites to inform researchers and registration personnel. The major subsections include those covering analytical methods, fate and transport, and water quality studies. A total of 21 chapters devoted to current research makes this a valuable text.

Milne, G. W. A. (Ed.) (1994)
CRC Handbook of Pesticides
CRC Press, Boca Raton, FL

Compilation focuses on 386 of the most commonly used pesticides recently registered by the EPA. Each entry includes the physical chemical characteristics and data pertaining to the compound's acute toxicity in various species. Intended as a quick reference to those dealing directly with pesticides either in use or in health maintenance.

Montgomery, J. H. (Ed.) (1997)
Agrochemicals Desk Reference, 2nd ed.
CRC Press, Boca Raton, FL

Features environmental and physical/chemical data on more than 200 compounds, including pesticides, herbicides, and fungicides. This revised edition includes an expanded Environmental Fate section, subdivided into categories including Biological, Soil, Plant, Surface Water, Groundwater, Photolytic, and Chemical/Physical.

Morgan, D. P. (1989)
Recognition and Management of Pesticide Poisonings, 4th ed.
U.S. EPA, Washington, DC

Deals almost exclusively with acute harmful effects of pesticides. The goal is to supply the attending medical team the appropriate information on which to base treatment following acute overexposures. The information is presented by chemical types (organophosphates, carbamates, organochlorine, etc.). Included in this edition are measures to be taken for solvents, adjuvants, and formulations. EPA-540/9-80-005. Available from Superintendent of Documents, U.S. Government Printing Office, Washington, DC.

National Research Council (1993)
Pesticides in the Diet of Infants and Children
National Academy Press, Washington, DC

Covers what is known about exposures to pesticide residues in the diets of infants and children. The adequacy of current risk assessment methods and policies is also examined, followed by identification of toxicologic issues of greatest concern. Presents a critical assessment by two expert panels following 5 years of deliberation on the previously mentioned topics.

National Research Council (1996)
Veterans and Agent Orange: Update 1996
National Academy Press, Washington, DC

Updates and evaluates the available scientific evidence regarding statistical associations between diseases and exposure to dioxin and other chemical compounds in herbicides used in Vietnam, focusing on new scientific studies and literature published since the release of *Veterans and Agent Orange* (1994), also by the National Research Council. Special attention is paid to the relationship between exposure to herbicides and the development of birth defects and transient peripheral neuropathy, as well as the relationship between exposure to herbicides and the subsequent development of prostrate, hepatobiliary, nasopharyngeal, and other cancers.

Prakash, A., and Rao, J. (1997)
Botanical Pesticides in Agriculture
Lewis, Boca Raton, FL

Reviews the research on botanical pesticides used to combat losses due to pests of agricultural importance. Discusses such botanicals as neem, bael, begonia, pyrethrum, tobacco, karanj, and mahuwa.

Progress in Pesticide Biochemistry and Toxicology
Wiley, Chichester, UK

A monographic series covering important issues related to pesticides. Recent volumes include 5-*Insecticides* (1986), 6-*Herbicides* (1987), 7-*Environmental Fate of Pesticides* (1990), 8-*Mammalian Metabolism of Agrochemicals* (1995), and 9-*Environmental Behaviour of Agrochemicals* (1995).

Saleh, M. A., Blancato, J. N., and Naumann, C. H. (Eds.) (1994)
Biomarkers of Human Exposure to Pesticides
American Chemical Society, Washington, DC

Focuses on the range of activities needed to bring an exposure biomarker to a useful end point. The molecu-

lar basis is characterized, methods currently being used are discussed, and application of these findings to risk assessment are presented.

Sundlof, S. F., Riviere, J. E., and Craigmill, A. L. (1996).
Handbook of Comparative Pharmacokinetics and Residues of Pesticides and Environmental Contaminants
CRC Press, Boca Raton, FL

Convenient and concise compilation of information on the application of pharmacokinetic principles to chemical residue avoidance. The information is categorized into three classes—physicochemical constants and chemical structure, legal tissue tolerances, and pharmacokinetic parameters derived from the open literature.

Tardiff, R. G. (Ed.) (1992)
Methods to Assess Adverse Effects of Pesticides on Nontarget Organisms
Wiley, New York

Topics include the assessment and control of exposure of human and nonhuman organisms to pesticides, acute toxicity in humans (mostly neurotoxicity and dermal effects), chronic toxicity in humans (mostly reproductive and developmental), and damage to ecosystems. Recommendations are made not only to research needs but also on ways to mitigate problems associated with pest control.

Waxman, M. (1998)
The Agrochemicals and Pesticides Handbook
CRC Press, Boca Raton, FL

Serves as a field resource on the hazard of agricultural pesticides and chemicals. Featuring over 200 chemicals with Chemical Abstracts Service Registry numbers, Department of Transportation designations, and molecular formulas and weights.

White-Stevens, R. (1971)
Pesticides in the Environment
Dekker, New York

Provides the properties, functions, utilities, and contributions of pesticidal chemicals. It covers both theoretical aspects of pesticides and the practical business of handling pesticides in the environment.

World Health Organization (WHO) (1990)
Principles for the Toxicological Assessment of Pesticide Residues in Food, Environmental Health Criteria No. 104
WHO, Geneva

Explains the principles, concepts, and definitions used by the Joint FAO/WHO Meeting on Pesticide Residues (JMPR) when assessing toxicological data on pesticide residues in food and establishing acceptable daily intakes. It is intended to guide the design and interpretation of relevant toxicological studies. The book alerts readers to the multiplicity of factors, from the endocrinology of the animal species to the pharmacokinetic and pharmacodynamic properties of the pesticide, that can influence the validity of a study and determine its relevance to safety assessment.

World Health Organization (WHO) (1991–1993)
Environmental Health Criteria
WHO, Geneva

A monographic series. Each chemical volume reviews and summarize the information regarding the chemical's potential health effects, as determined by an expert committee. Sections covered specifically include the physical–chemical properties and analytical methods, sources of environmental exposure, effects on the environment, kinetics and metabolism, effects in animals, and effects in man. Each volume concludes with a summary and evaluation of the data along with conclusions and recommendations for further research. Volumes related to pesticides include the following:

WHO No. 97: Deltamethrin, 1991
WHO No. 99: Cyhalothrin, 1990
WHO No. 120: Hexacyclopentadiene, 1991
WHO No. 121: Aldicarb, 1991
WHO No. 123: alpha- and beta-Hexachlorocyclohexanes, 1992
WHO No. 124: Lindane, 1991
WHO No. 130: Endrin, 1992
WHO No. 133: Febitrothion, 1992
WHO No. 142: α-Cypermethrin, 1992
WHO No. 148: Benomyl, 1993
WHO No. 149: Carbendazim, 1993
WHO No. 177: 1,2-Dibromoethane, 1996
WHO No. 183: Chlorothalonil, 1996
WHO No. 184: Diflubenzuron, 1996

World Health Organization (WHO) (1995)
Anticoagulant Rodenticides, Environmental Health Criteria No. 175
WHO, Geneva

Evaluates the risks to human health and the environment posed by the use of anticoagulants for rodent control in urban and agricultural settings. Warfarin is considered with the more potent second-generation anticoagulants, including the single-dose ''superwarfarins.'' Because warfarin is widely used in the clinical management of thromboembolic disease, its effects on human health are well documented. Abundant information is also provided on the mechanisms by which these anticoagulants act as vitamin K antagonists.

See Also:

Blancato: *Biomarkers for Agrochemicals and Toxic Substances* (Biomonitoring)

Donham: *Agricultural Health and Safety: Recent Advances* (Occupational)

Fisher: *Toxic Substances and Pesticides Regulation Deskbook* (Regulatory Requirements)

Murty: *Toxicity of Pesticides to Fish* (Environmental—Aquatic)

Repetto: *Pesticides and the Immune System* (Target Sites—Immune)

United Nations Food and Agricultural Organization: *Pesticide Residues in Food* (Food and Nutrition)

Journals

Archives of Environmental Contamination and Toxicology

Bulletin of Environmental Contamination and Toxicology

Ecotoxicology

Ecotoxicology and Environmental Safety

Environmental Pollution

Environmental Toxicology and Chemistry

Journal of Environmental Science and Health. Part B: Pesticides, Food Contaminants, and Agricultural Wastes

Journal of Soil Contamination

Pesticide Biochemistry and Physiology

Pesticide Science

Journal Articles

Abou-Donia, M., and Lapadula, D. M. (1990). Mechanisms of organophosphorus ester-induced delayed neurotoxicity. ***Annu. Rev. Pharmacol. Toxicol.*** **30,** 405–440.

Aldridge, W. N. (1991). An assessment of the toxicological properties of pyrethroids and their neurotoxicity. ***Crit. Rev. Toxicol.*** **21,** 89–105.

Arbuckle, T. E., and Sever, L. E. (1998). Pesticide exposures and fetal death: A review of the epidemiologic literature. ***Crit. Rev. Toxicol.*** **28,** 229–270.

Banerjee, B. D., *et al.* (1996). Immunotoxicity of pesticides: Perspectives and trends. ***Indian J. Exp. Biol.*** **34**(8), 723–733.

Brown, P., *et al.* (1996). Identification of pesticide poisoning in wildlife. ***J. Chromatogr. A*** **754**(1/2), 463–478.

Brown, I., Classen, W., Ivens, I. A., Krinke, G. J., Rieth, J., Rozenboom, W., and Skripsky, T. (1997). A critical review of hazard identification of organophosphorus pesticides: Sixth meeting of the International Neurotoxicology Association, Szeged, Hungary, June 29–July 4, 1997. ***Neurotoxicology*** **18**(3), 876.

Caux, P.-Y., *et al.* (1996). Environmental fate and effects of chlorothalonil: A Canadian perspective. ***Crit. Rev. Environ. Sci. Technol.*** **26,** 45–94.

Chung, K., Starrett, S., Chung, Y., and Ro, K. S. (1998). Pesticides and Herbicides. ***Water Environ. Res.*** **70**(4), 693–697.

Costa, L. G. (1997). Basic toxicology of pesticides. ***Occup. Med.*** **12**(2), 251–268.

Cummings, A. M. (1997). Methoxychlor as a model for environmental estrogens. ***Crit. Rev. Toxicol.*** **27,** 367–379.

De Bertoldi, M. (1996). Genotoxic effects of pesticides. ***Eur. J. Cancer Prevention*** **5**(5), 397–399.

De Raat, W. K., *et al.* (1997). Toxicological risk assessment of worker exposure to pesticides: Some general principles. ***Regul. Toxicol. Pharmacol.*** **25**(2), 204–210.

Dich, J., Zahm, S. H., Hanberg, A., and Adami, H. O. (1997). Pesticides and cancer. ***Cancer Causes Control*** **8**(3), 420–443.

Ferrer, A., and Cabral, R. (1995). Recent epidemics of poisoning by pesticides. ***Toxicol. Lett.*** **82/83,** 55–63.

Fischer, S. A., and Hall, L. W., Jr. (1992). Environmental concentrations and aquatic toxicity data on diflubenzuron (Dimilin). ***Crit. Rev. Toxicol.*** **22,** 45–80.

Hodgson, E., and Levi, P. E. (1996, March). Pesticides: An important but underused model for the environmental health sciences. ***Environ. Health Perspect.*** **104**(Suppl. 1), 97–106.

Katoh, K. (1995). A review of studies of the delayed neurotoxicity induced by organophosphorus esters. ***Sangyo Eiseigaku Zasshi*** **37,** 309–319.

Keifer, M. C., and Arne, K. H. (1997). Toxicity testing of pesticides sold in the United States. ***Occup. Med.*** **12**(2), 365–370.

Koh, D., and Jeyaratnam, J. (1996). Pesticides hazards in developing countries. ***Sci. Total Environ.*** **188**(Suppl. 1), PS78–PS85.

Lotti, M. (1991). The pathogenesis of organophosphate polyneuropathy. ***Crit. Rev. Toxicol.* 21,** 465–588.

Lu, F. C. (1995). A review of the acceptable daily intakes of pesticides assessed by WHO. ***Regul. Toxicol. Pharmacol.* 21**(3), 352–364.

Lusk, S. L., and Connon, C. (1996). Monitoring for pesticides exposures. ***AAOHN J.* 44**(12), 599–603.

Mileson, B. E., Chambers, J. E., Chen, W. L., Dettbarn, W., Ehrich, M., Eldefrawi, A. T., Gaylor, D. W., Hamernik, K., Hodgson, E., Karczmar, A. G., Padilla, S., Pope, C. N., Richardson, R. J., Saunders, D. R., Sheets, L. P., Sultatos, L. G., and Wallace, K. B. (1998). Common mechanism of toxicity: A case study of organophosphorus pesticides. ***Toxicol. Sci.* 41,** 8–20.

Moretto, A. (1998). Experimental and clinical toxicology of anticholinesterase agents. ***Toxicology Lett.* 102–103,** 509–513.

Notario del Pino, J., and Diaz, R. (1998). Pesticide distribution and movement. ***Biotherapy* 11**(2/3), 69–76.

O'Malley, M. (1997). Clinical evaluation of pesticide exposure and poisonings. ***Lancet* 349**(9059), 1161–1166.

Pimentel, D. (1996). Green revolution agriculture and chemical hazards. ***Sci. Total Environ.* 188**(Suppl. 1), PS86–PS98.

Reigart, J. R. (1995). Pesticides and children. ***Pediatr. Ann.* 24**(12), 663–668.

Sathiakumar, N., and Delzell, E. (1997). A review of epidemiologic studies of triazine herbicides and cancer. ***Crit. Rev. Toxicol.* 27,** 599–612.

Vijverberg, H. P. M., and van den Bercken, J. (1991). Neurotoxicological effects and the mode of action of pyrethroid insecticides. ***Crit. Rev. Toxicol.* 21,** 105–126.

Zahm, S. H., and Ward, M. H. (1998). Pesticides and childhood cancer. ***Environmental Health Perspectives* 106**(Suppl. 3), 893–908.

CHEMICALS—SOLVENTS

Collings, A. J., and Luxon, S. G. (Eds.) (1982)
Safe Use of Solvents
Academic Press, London

Reviews the problems with specific solvents, solvent abuse, and the training of personnel controlling the safe use of solvents.

DeRenzo, D. J. (Ed.) (1986)
Solvents Safety Handbook
Noyes, Park Ridge, NJ

Compilation of data on 335 frequently used solvents, providing information on health hazards and toxicity, fire, exposure, and water pollution, and protective equipment.

European Chemical Industry Ecology and Toxicology Centre (ECETOC) (1990)
Technical Report No. 37: Tetrachloroethylene: Assessment of Human Carcinogenic Hazard
ECETOC, Brussels

Reviews and appraises the evidence for the carcinogenicity of tetrachloroethylene from animal toxicity, mutagenicity, pharmacokinetic, metabolism, and epidemiological studies; includes a bibliography.

European Centre for Ectoxicology and Toxicology of Chemicals (ECETOC) (1992)
Technical Report No. 52: Styrene Toxicology. Investigations on the Potential for Carcinogenicity
ECETOC, Brussels

Addresses the concern that putative carcinogenic potential exists from styrene 7,8-oxide, an intermediate metabolite of styrene. New toxicokinetic data on styrene and the metabolic occurrence of styrene oxide have been generated and are presented in this report.

European Centre for Ecotoxicology and Toxicology of Chemicals (ECETOC) (1994)
Technical Report No. 60: Trichloroethylene: Assessment of Human Carcinogenic Hazard
ECETOC, Brussels

Reviews TCE studies with respect to cancer epidemiology, animal carcinogenicity, metabolism and kinetics, mutagenicity, and mechanisms of tumor formation. An assessment of the extent to which it represents a carcinogenic hazard for man is presented.

European Centre for Ecotoxicology and Toxicology of Chemicals (ECETOC) (1995)
Technical Report No. 64: The Toxicology of Glycol Ethers and Its Relevance to Man
ECETOC, Brussels

Presents relevant toxicological information in animals and man and reviews the knowledge of mechanisms underlying the observed toxicology in 35 glycol ethers. The key toxicological data for each of the glycol ethers has been summarized in individual substance profiles.

International Agency for Research on Cancer (IARC) (1995)
Dry Cleaning, Some Chlorinated Solvents, and Other Industrial Chemicals, IARC Monographs on the Evaluation of Carcinogenic Risks to Humans, Vol. 63
IARC, Geneva

Data and conclusions concerning the carcinogenic potential of many dry cleaning solvents (including tri- and tetrachloroethylene) and other industrial chemicals (acrolein, crotonaldehyde, furan, furfural, benzofuran, vinyl acetate, and vinyl fluoride) are presented. As with other volumes in this series, a thorough review of the cancer and chronic toxicity data along with biologies (such as genetic) that supply meaningful information relative to the long-term hazards are carefully presented.

Laskin, S., and Goldstein, B. D. (1977)
A Critical Evaluation of Benzene Toxicity
New York University Medical Center, Institute of Environmental Medicine, New York

Reviews analysis, metabolism, experimental intoxication, cytologic effects, and hematotoxicity of benzene. Contains an extensive list of references.

Mehlman, M. A. (Ed.) (1989)
Benzene: Occupational and Environmental Hazards: Scientific Update
Princeton Scientific, Princeton, NJ

Includes estimates of exposed populations, consequences of exposure related to hematological toxicity, mechanistic studies on the mode of action, and mathematical models for assessing the relationship between exposure and health risks.

Snyder, R. (Ed.) (1987–1992)
Ethel Browning's Toxicity and Metabolism of Industrial Solvents, 2nd. ed.
Elsevier, Amsterdam

First published in 1965, this book by Ethel Browning was the first to cite the properties and describe the toxicology of individual solvents and also to discuss their metabolism and mechanisms of toxicity. Volume 2 focuses on nitrogen and phosphorus solvents, whereas Vol. 3 examines alcohols and esters.

World Health Organization (WHO)
Environmental Health Criteria
WHO, Geneva

Review of the existing literature regarding the potential health effects of the solvent under review by an expert panel. The key information on each section is summarized and an overview of the impact on human health is presented along with recommendations for further research. The topic areas covered include physical properties and analytical methods, sources of exposure, environmental occurrence and effects on the environment, metabolism and kinetics, effects on animals, and effects on man:

WHO No. 100: Vinylidene Chloride, 1990
WHO No. 114: Dimethyl Formamide, 1991
WHO No. 115: 2-Methoxyethanol, 2-Ethoxyethanol and Their Acetates, 1990
WHO No. 122: n-Hexane, 1991
WHO No. 128: Chlorobenzenes Other Than Hexachlorobenzene, 1991
WHO No. 129: Isobenzane, 1991
WHO No. 143: Methyl Ethyl Ketone, 1993
WHO No. 146: 1,3- and 1,2-Dichloropropane and Mixtures, 1993

See Also:
Arlien-Soborg: *Solvent Neurotoxicity* (Target Sites—Nervous System)

Journal Articles

Baker, E. L. (1994). A review of recent research on health effects of human occupational exposure to organic solvents. A critical review. ***J. Occup. Med.*** **36**(10), 1079–1092.

Bird, M. G., *et al.* (1996). Evaluation of butadiene and isoprene health risk. ***Toxicology*** **113,** 2–360.

Bogen, K. T., and Gold, L. S. (1997). Trichloroethylene cancer risk: Simplified calculation of PBPK-based MCLs for cytotoxic end points. ***Regul. Toxicol. Pharmacol.*** **25,** 26–42.

Bolt, H. M., and Gansewendt, B. (1995). Mechanisms of carcinogenicity of methyl halides. ***Crit. Rev. Toxicol.*** **25,** 91–112.

Calabrese, E. J., *et al.* (1993). Subpopulation in rat liver induced into mitosis by low-level exposure to carbon tetrachloride: An adaptive response. ***Toxicol. Appl. Pharmacol.*** **121,** 1–7.

Campagna, D., *et al.* (1995). Monitoring neurotoxic effects among laboratory personnel working with organic solvents. ***Rev. Epidemiol. Sante Publique*** **43,** 519–532.

Caux, P.-Y., *et al.* (1995). Environmental fate and effects of MCPA: A Canadian perspective. ***Crit. Rev. Environ. Sci. Technol.*** **25,** 313–376.

Cornet, M., and Rogiers, V. (1997). Metabolism and toxicity of 2-methylpropene (isobutene). A review. ***Crit. Rev. Toxicol.*** **27,** 223–232.

Das, M., and Khanna, S. K. (1997). Clinicoepidemiological, toxicological, and safety evaluation studies on argemone oil. ***Crit. Rev. Toxicol.* 27,** 261–272.

Graham, D. G., *et al.* (1995). Pathogenetic studies of hexane and carbon disulfide. ***Crit. Rev. Toxicol.* 25,** 91–112.

Green, T. (1990). Chloroethylenes: A mechanistic approach to human risk evaluation. ***Annu. Rev. Pharmacol. Toxicol.* 30,** 73–89.

Iregren, A. (1996). Behavioral methods and organic solvents: Questions and consequences. ***Environ. Health Perspect.* 104**(Suppl. 2), 361–366.

Johnson, A. C., and Nylen, P. R. (1995). Effects of industrial solvents on hearing. ***Occup. Med.* 10,** 623–640.

Kavet, R., and Nauss, K. M. (1991). The toxicity of inhaled methanol vapors. ***Crit. Rev. Toxicol.* 21,** 21–50.

Labreche, F. P., and Goldberg, M. S. (1997). Exposure to organic solvents and breast cancer in women: A hypothesis. ***Am. J. Ind. Med.* 32,** 1–14.

Lof, A., and Johanson, G. (1998). Toxicokinetics of organic solvents: A review of modifying factors. ***Crit. Rev. Toxicol.* 28**(6), 571–650.

Lundberg, I., *et al.* (1995). Neuropsychiatric function of housepainters with previous long-term heavy exposure to organic solvents. ***Scand. J. Work Environ. Health* 21,** 1–44.

McClellan, R. O. (Ed.) (1994). Styrene toxicology and epidemiology. ***Crit. Rev. Toxicol.* 24,** 51–5125.

Medeiros, A. M., *et al.* (1997). Potential biomarkers of benzene exposure. ***J. Toxicol. Environ. Health* 51**(6), 519–539.

Medinsky, M. A., *et al.* (1995). Benzene: A case study in parent chemical and metabolite interactions. ***Toxicology* 105,** 225–233.

Moen, B. E., and Kyvik, K. R. (1998). Organic solvents and the nervous system. ***Tidsskrift Norske Laegeforening* 118**(5), 721–726.

Schenker, M. B., and Jacobs, J. A. (1996). Respiratory effects of organic solvent exposure. ***Tubercle Lung Dis.* 77,** 4–18.

Seegal, R. F. (1996). Epidemiological and laboratory evidence of PCB-induced neurotoxicity. ***Crit. Rev. Toxicol.* 26,** 709–738.

Snyder, R., and Kalf, G. F. (1994). A perspective on benzene leukemogenesis. ***Crit. Rev. Toxicol.* 24,** 177–209.

Tahti, H., *et al.* (1997). Mechanisms and models of neurotoxicity of n-hexane and related solvents. ***Arch. Toxicol. Suppl.* 19,** 337–345.

Thomas, K. A. (1996). MR imaging in solvent-induced chronic toxic encephalopathy. ***Acta Radiol.* 37,** 177–179.

Troulakis, G., *et al.* (1997). Acute intoxication and recovery following massive turpentine ingestion: Clinical and toxicological data. ***Vet. Hum. Toxicol.* 39**(3), 155–157.

Wallace, L. A. (1997). Human exposure and body burden for chloroform and other trihalomethanes. ***Crit. Rev. Toxicol.* 27,** 113–194.

White, R. F., and Proctor, S. P. (1997). Solvents and neurotoxicity. ***Lancet* 349**(9060), 1239–1243.

CHEMICALS—SELECTED CHEMICALS

Abel, E. L. (Ed.) (1996)
Fetal Alcohol Syndrome
CRC Press, Boca Raton, FL

Provides straightforward facts regarding the impact of alcohol consumption as it affects the development of the embryo and fetus. Current research addressing the immediate and delayed effects is covered. A chapter is devoted to assessing the behavior of children who were prenatally exposed to alcohol.

Benowitz, N. L. (Ed.) (1998)
Nicotine Safety and Toxicity
Oxford University Press, New York

Looks at nicotine in relation to cardiovascular disease, cancer, reproduction, and behavioral toxicity.

Cheremisinoff, N. P. (1995)
Hazardous Chemicals in the Polymer Industry
Dekker, New York

Written as a practical reference for engineers, technicians, and compounders. The handbook gives information on toxic and hazardous properties, symptoms of overexposure, safe handling and shipping, fire hazards, and spill responses for both generic and specific polymer chemicals.

Chin, S. B., and Pisoni, D. B. (1997)
Alcohol and Speech
Academic Press, New York

Serves as a reference source for those interested in speech motor effects evident in the acoustic record, reaction times, speech communication strategies, and

perceptual judgments accompanying ingestion of ethanol. It is a comprehensive review of the effects of alcohol on speech and compares the various theoretical concerns which form this research. An interesting example from the Exxon Valdez oil spill is reviewed.

Chollat-Traquet, C. (1992)
Women and Tobacco
World Health Organization, Geneva

Intended to inform all those concerned with the effects of tobacco use and the health of women. The six chapters include the issues at stake, women and usage patterns, tobacco and health (organs and systems affected), factors influencing use of tobacco, prevention and cessation aids, and a strategy for long-term control. Each chapter includes selected references for detailed follow-up.

Clary, J. J., Gibson, J. E., and Waritz, R. S. (Eds.) (1983)
Formaldehyde: Toxicology, Epidemiology, and Mechanisms
Dekker, New York

Presents topics covered in two symposia which were convened following the determination of formaldehyde as an animal carcinogen. Because of its ubiquitous nature, it is important to thoroughly understand its biology and be aware of the implications of animal findings to human health. This book allows the reader to review the experimental facts and examine the human data on which the risk assessment is based. The topics covered in this book include occupational exposure, mathematical modeling of cancer risks, human data from epidemiology studies, skin cancer studies, genetic studies, interaction with target tissue studies, and a review of the mechanism of action in risk evaluation.

Committee on Toxicological Aspects of Oxygenated Motor Vehicle Fuels (1996)
Toxicological and Performance Aspects of Oxygenated Motor Vehicle Fuels
National Academy Press, Washington, DC

Assesses the effects of oxygenated gasoline on public health, air quality, fuel economy, engine performance, and water quality. The basic chemical discussed throughout is methyl *t*-butyl ether. In addition to evaluating the scientific basis of the government report covering this topic, research attempting to better understand the overall impact of oxygenated fuels is presented.

Coulston, F., and Pocchiari, F. (Eds.) (1983)
Accidental Exposure to Dioxins: Human Health Aspects
Academic Press, New York

Focuses on accidental exposure of plants, animals, and humans to dioxins. It covers environmental cleanup concerns.

Deitrich, R. A., and Erwin, V. G., (Eds.) (1995)
Pharmacological Effects of Ethanol on the Nervous System
CRC Press, Boca Raton, FL

Reviews current data on the action of ethanol in the central nervous system and the resulting behavioral effects. Old theories of effect are updated. Particularly helpful are chapters covering the fetal alcohol syndrome and the effects of long-term ethanol exposure. The mechanisms for effect at the neurotransmitter level is well presented.

D'Itri, F. M., and Kamrin, M. A. (Eds.) (1983)
PCBs: Human and Environmental Hazards
Butterworth, Boston

Presents background, scientific, and social information important to understanding PCB contamination; describes the current state of the art with respect to chemical analyses and monitoring; and summarizes information on the metabolism, biotransformation, toxicology, and persistence of PCBs.

Environment Canada (1993)
Polychlorinated Dibenzodioxins and Polychlorinated Dibenzofurans
Government of Canada, Ottawa

Discusses two classes of agents identified by Canada as priority substances for their health effects in man or animals and on the environment. This is an example of their series of documents, each of which presents the following information on the specific chemical or chemical class: chemical identity and properties, sources to the environment, environmental fate and levels, kinetics and metabolism, toxicology, effects on the ecosystem, effects on humans, and control strategies and regulations in Canada.

Erickson, M. D. (1997)
Analytical Chemistry of PCBs, 2nd ed.
CRC Press, Boca Raton, FL

A comprehensive review of the analytical chemistry of PCBs. Includes gas chromatographic determination, mass spectrometry, sampling approaches, separations, interlaboratory studies, and PCB toxicology.

European Centre for Ectoxicology and Toxicology of Chemicals (ECETOC) (1992)
Technical Report No. 49: Exposure of Man to Dioxins: A Perspective on Industrial Waste Incineration
ECETOC, Brussels

Reviews the current knowledge of the occurrence, mechanism of formation, and environmental fate of polychlorinated dibenzodioxins and polychlorinated dibenzofurans. Emissions of these materials originating from industrial waste incinerators are placed into perspective relative to their global emissions. Exposure levels, toxicological properties, and human health impact are also addressed.

European Centre for Ectoxicology and Toxicology of Chemicals (ECETOC) (1995)
Technical Report No. 63: Reproductive and General Toxicology of Some Inorganic Borates and Risks Assessment for Human Beings
ECETOC, Brussels

Reviews the toxicology of some inorganic borates and focuses on the reproductive toxicity. A risk assessment is presented based on estimated human exposure and extrapolation of animal data. A suitable safe level of borate in drinking water is recommended.

European Centre for Ectoxicology and Toxicology of Chemicals (ECETOC) (1995)
Technical Report No. 65: Formaldehyde and Human Cancer Risk
ECETOC, Brussels.

Examines the cytologic and cytogenetic studies of workers exposed to formaldehyde and examines the epidemologic studies on cancer risk as they relate to formaldehyde exposure. All studies reviewed were nonexperimental in design and, as such, concerns of bias, confounding, and chance must be evaluated thoroughly before any etiologic conclusion can be drawn.

International Agency for Research on Cancer (1994).
Some Industrial Chemicals
World Health Organization, Lyon

Volume 27 of the *IARC Monographs on the Evaluation of Carcinogenic Risks to Humans*. Reviews 14 industrial chemicals by an expert committee for their potential to be carcinogenic to humans. This book presents a relatively complete bibliography of the pertinent information along with the evaluation by the committee. The following chemicals were considered not classifiable regarding their carcinogenicity to man: ethylene, vinyl toluene, *N*-methylolacrylamide, methyl methacrylate, and 2-ethylhexyl acrylate; the following were classified as possibly carcinogenic to humans: propylene oxide, isoprene, styrene, 4-vinylcyclohexene, and 4-vinylcyclohexene diepoxide; the following were classified as probably carcinogenic to humans: styrene-7,8-oxide and acrylamide; and the following was classified as carcinogenic to humans: ethylene oxide.

Kahn, M. A. Q., and Stanton, R. H. (Eds.) (1981)
Toxicology of Halogenated Hydrocarbons: Health and Ecological Effects
Pergamon, New York

Covers human exposure and health effects, hepatotoxicity and carcinogenicity, cytotoxicity, teratogenicity, mutagenicity, and neurotoxicity, metabolism and toxicodynamics, and environmental fate.

Kanal, E., and Shellock, F. G. (1996).
Safety Reference Manual on Magnetic Resonance Imaging Contrast Agents
Lippincott–Raven Press, Cedar Knolls, NJ

Contrast agents have found wide usage in the diagnosis and treatment of disease and the field is rapidly expanding. This text introduces the topic and points out the recent successes in abdominal, breast, and musculoskeletal conditions. Specific topics covered in the book include mechanism of action, pharmacokinetics, routes of administration, toxicity, special patient populations, and future issues.

Kuratsune, M., Yoshimura, H., Hori, Y., Okumura, M., and Masuda, Y. (Eds.) (1996).
Yusho: A Human Disaster Caused by PCBs and Related Compounds
Kyushu Univ. Press, Hazozaki, Japan

Brings together information from medical, epidemiological, and biochemical investigations of the contaminated rice oil episode. The book offers an excellent example of how a toxicological disaster exists and must be investigated and of the critical interface between biochemistry, toxicology, and pathology. The careful reader will be impressed by the approach taken to detect and ultimately control the problem.

MacFarland, H. N., Holdsworth, C. E., MacGregor, J. A., Call, R. W., and Kane, M. L. (1982).
The Toxicology of Petroleum Hydrocarbons
American Petroleum Institute, New York

Presents reference papers on general toxicology, absorption and metabolism, genetic toxicology/mutagenesis, carcinogenesis, teratology, neurotoxicity, and neurobehavioral effects of petroleum hydrocarbons.

Marrs, T. C., Maynard, R. L., and Sidell, F. R. (1996)
Chemical Warfare Agents: Toxicology and Treatment
Wiley, New York.

Guide to the practical medical management of victims of chemical warfare. Offers an explanation of the underlying pharmacology and toxicology of the various agents. Discusses all major classical agents, including nerve agents, vesicants, lung-damaging agents, respi-

ratory poisons, irritants, and psychoactive agents. Also featured is a section on field management of chemical agent exposures.

Ojima, I., McCarthy, J. R., and Welch, J. T. (Eds.) (1996)
Biomedical Frontiers of Fluorine Chemistry
American Chemical Society, Washington, DC

Reviews recent research on fluorine-containing, biologically relevant molecules in biology and medicinal chemistry. The text covers applications of organofluorine compounds as enzyme inhibitors, antithrombotics, anticancer agents, central nervous system agents, and antifungal and antiviral agents.

Pollak, J. K. (1993)
The Toxicity of Chemical Mixtures
Center for Human Aspects of Science, Sydney

Explains the pressing need for understanding the complexity of interactions between foreign compounds which contribute to effects in man. Additional ways of demonstrating and dealing with these toxic actions are described. The four chapters include an overview of the issue, the toxicology of mixtures, the cellular basis for the reactions, and social aspects of decision making.

Ramamoorthy, S., and Ramamoorthy, S. (1997).
Chlorinated Organic Compounds in the Environment: Regulatory and Monitoring Assessment
CRC Press, Boca Raton, FL.

Toxicity profiles provided for each chemical allow for evaluation of the short- and long-term effects on the environment. Discussions of environmental residues and pertinent worldwide regulations help readers compare chloroorganic contamination in different areas and analyze the associated regulatory approaches.

Schecter, A. (Ed.) (1994).
Dioxins and Health
Plenum, New York

Presents the latest information relating to potential human health risks of dioxin. The main areas include cancer, immune system compromise, reproductive and developmental disorders, neurological damage, and endocrine system alterations. Most of the 20 chapters include specific new data relating to the particular endpoint toxicity, and the difficulty of applying both the human and the animal data to an appropriate quantitative risk assessment is considered throughout.

Sheftel, V. O. (1995)
Toxic Properties of Monomers and Additives
Lewis, Boca Raton, FL

Provides comprehensive information on the toxic effects of plastics ingredients that enter the body, mainly by the oral route. The chapters include sections covering background information and format, monomers, plasticizers, stabilizers, catalysts, initiators, and other agents, and rubber ingredients, solvents, and other additives.

Spiller, G. (Ed.) (1997)
Caffeine
CRC Press, Boca Raton, FL

Botany, cultivation, processing, composition, and consumption patterns of natural products such as tea, coffee, mate, and cocoa and chocolate products are described. Consumption of caffeine is examined in detail. An overview of basic physiology and biochemistry of caffeine is provided. Ergogenic, cognitive, and emotional effects of caffeine are discussed, as are specific health effects—serum cholesterol, cancer and fibrocystic breast disease, calcium and bone health, and human reproduction.

Wimer, W. W., Russel, J. A., and Kaplan, H. L. (1983)
Alcohols Toxicology
Noyes, Park Ridge, NJ

Covers toxicology of methanol, ethanol, propanol, isopropanol, and butanols. Includes comparison of properties, a brief history of industrial hygiene, exposure limits, and processing.

World Health Organization (WHO) (1997)
Flame Retardants: A General Introduction, Environmental Health Criteria No. 192
WHO, Geneva

Provides a general overview of the properties, mechanisms of action, production, use, and performance of chemicals added to polymeric materials, both natural and synthetic, to enhance flame-retardant properties. Flame-retardant chemical are most often used with low-to-moderate cost commodity polymers to either lower ignition susceptibility or lower flame spread once ignition has occurred. The volume also indicates some of the known health and environmental hazards for certain flame retardants.

Yang, R. S. H. (Ed.) (1994)
Toxicology of Chemical Mixtures
Academic Press, San Diego

Chapters presented attempt to answer the question of whether exposure to mixtures of chemicals results in interactions that alter the potential toxicologic response to the individual chemicals involved. Major sections include introduction and principles, real-life case studies or special problem-related situations, target organ toxicity or special toxicologic responses related to chemical mixture exposures, and contemporary issues.

See Also:
Section on Chemical Compendia

Section on Miscellaneous

Calabrese: *Multiple Chemical Interactions* (Testing Methods)

Esfandabad: *Odor and Irritation Detection of Formaldehyde by Human Observers* (Target Sites—Sensory)

Sittig: *Handbook of Toxic and Hazardous Chemicals and Carcinogens* (Cancer)

Journal Articles

General

Beasley, D. M., and Glass, W. I. (1998). Cyanide poisoning: Pathophysiology and treatment recommendations. ***Occup. Med.*** **48**(7), 427–431.

Busker, R. W., and van Helden, H. P. (1998). Toxicologic evaluation of pepper spray as a possible weapon for the Dutch police force: Risk assessment and efficacy. ***Am. J. Forensic Med. Pathol.*** **19**(4), 309–316.

Schins, R. P., and Borm, P. J. (1999). Mechanisms and mediators in coal dust induced toxicity: A review. ***Ann. Occup. Hyg.*** **43**(1), 7–33.

Alcohols

Ahmed, F. E. (1995). Toxicological effects of ethanol on human health. ***Crit. Rev. Toxicol.*** **25,** 347–368.

Becker, U., *et al.* (1996) Prediction of risk of liver disease by alcohol intake, sex, and age: A prospective population study. ***Hepatology*** **23,** 1025–1029.

Castaneda, R., *et al.* (1996). A review of the effects of moderate alcohol intake on the treatment of anxiety and mood disorders. ***J. Clin. Psychiatr.*** **57,** 207–212.

De Waal, E. J., Schuurman, H. J., Van Loveren, H., and Vos, J. G. (1997). Differential effects of 2,3,7,8-tetrachlorodibenzo-*p*-dioxin, bis(tri-*N*-butyltin)oxide and cyclosporine on thymus histophysiology. ***Crit. Rev. Toxicol.*** **27,** 381–430.

Hanspeter, W., Joad, J. P., and Pinkerton, K. E. (1997). The toxicology of environmental tobacco smoke. ***Annu. Rev. Pharmacol. Toxicol.*** **37,** 29–52.

Hoffman, D. (1996). Tobacco-specific N-nitrosamines: Recent advances. ***Crit. Rev. Toxicol.*** **26,** 121–138.

Huber, W. W., Grasl-Kraupp, B., and Schulte-Hermann, R. (1996). Hepatocarcinogenic potential of di(2-ethylhexyl) phthalate in rodents and its implications on human risk. ***Crit. Rev. Toxicol.*** **26,** 365–481.

Käfferlein, H. U., Göen, T., and Angerer, G. (1998). Musk xylene: Analysis, occurrence, kinetics, and toxicology. ***Crit. Rev. Toxicol.*** **28,** 431–476.

Kaneko, M., *et al.* (1996). The effect of work-related stress with change of working conditions for workers with alcohol drinking habit and liver disorder. ***Jpn J. Alcohol Stud. Drug Dependence*** **31,** 81–94.

Nimrod, A. C., and Benson, W. H. (1996). Environmental estrogenic effects of alkylphenol ethoxylates. ***Crit. Rev. Toxicol.*** **26,** 335–364.

Ragland, D. R., *et al.* (1995) Occupational and nonoccupational correlates of alcohol consumption in urban transit operators. ***Preventive Med.*** **24,** 634–645.

Schuckit, M. A., and Smith, T. L. (1996). An 8-year follow-up of 450 sons of alcoholic and control subjects. ***Arch. Gen. Psychiatr.*** **53,** 202–210.

Seegal, R. F. (1996) Epidemiological and laboratory evidence of PCB-induced neurotoxicity. ***Crit. Rev. Toxicol*** **26,** 709–737.

Victorin, K., *et al.* (1998). Methods for health risk assessment of chemicals: Are they relevant for alcohol. ***Alcohol. Clin. Exp. Res.*** **22**(Suppl. 7), 270S–276S.

Wood, M. D., *et al.* (1996). Alcohol outcome expectancies and alcohol use and problems. ***J. Stud. Alcohol*** **57,** 283–288.

Arsenic

Anonymous (1995). *Arsenic and Inorganic Compounds of Arsenic (Except Arsine) in Air.* HSE Books.

Golub, M. S. (1994). Maternal toxicity and the identification of inorganic arsenic as a developmental toxicant. ***Reprod. Toxicol.*** **8,** 283–295.

Hering, J. G. (1996). Risk assessment for arsenic in drinking water: Limits to achievable risk levels. ***J. Hazardous Materials*** **45,** 175–184.

Maloney, M. E. (1996). Arsenic in dermatology. ***Dermatol. Surg.*** **22,** 301–304.

Mann, S., *et al.* (1996). A physiologically based pharmacokinetic model for arsenic exposure. I. Development in hamsters and rabbits. ***Toxicol. Appl. Pharmacol.*** **137,** 8–22.

Slejkovec, Z., *et al.* (1996). Preliminary studies on arsenic species in some environmental samples. ***Fresenius' J. Anal. Chem.*** **354,** 592–595.

Caffeine

Aarbakke, J. (1995). Caffeine—The gentle addictive stimulant. ***Tidsskrift Norske Laegeforening*** **115,** 1714–1724.

Azcona, O., *et al.* (1995). Evaluation of the central effects of alcohol and caffeine interaction. ***Br. J. Clin. Pharmacol.* 40,** 393–400.

Benowitz, N. L. (1995). Effects of caffeine deprivation on complex human functioning. ***Psychopharmacology* 118,** 377–384.

Miller, R. C. *et al.* (1994). Acute maternal and fetal cardiovascular effects of caffeine ingestion. ***Am. J. Perinatol.* 11,** 132–136.

Spriet, L. L. (1995). Caffeine and performance. ***Int. J. Sport Nutr.* 5,** 84–99.

Dioxin

Birnbaum, L. S. (1994). The mechanism of dioxin toxicity: Relationship to risk assessment. ***Environ. Health Perspect.* 102,** 157–167.

Birnbaum, L. S. (1995). Developmental effects of dioxins. ***Environ. Health Perspect.* 103,** 89–94.

Birnbaum, L. S., and DeVito, M. J. (1995). Use of toxic equivalency factors for risk assessment for dioxins and related compounds. ***Toxicology* 105,** 391–401.

Bock, K. W. (1994). Aryl hydrocarbon or dioxin receptor: Biologic and toxic responses. ***Physiol. Biochem. Pharmacol.* 125,** 1–42.

DeRosa, C. T., *et al.* (1996). Health evaluation of 1,4-dioxane. ***Toxicol. Ind. Health* 12,** 1–44.

Flesch-Janys, D., *et al.* (1996). Elimination of polychlorinated dibenzo-p-dioxins and dibenzofurans in occupationally exposed persons. ***J. Toxicol. Environ. Health* 47,** 363–378.

Giesy, J. P., and Kannan, K. (1998). Dioxin-like and non-dioxin-like toxic effects of polychlorinated biphenyls (PCBs): Implications for risk assessment. ***Crit. Rev. Toxicol.* 28**(6), 511–569.

Johnson, E. S. (1991). Human exposure to 2,3,7,8-TCDD and risk of cancer. ***Crit. Rev. Toxicol.* 21,** 451–464.

Kerkvliet, N. I. (1995). Immunological effects of chlorinated dibenzo-p-dioxins. ***Environ. Health Perspect.* 103,** 47–53.

Lindstrom, G., *et al.* (1995). Workshop on perinatal exposure to dioxin-like compounds. I. Summary. ***Environ. Health Perspect.* 103,** 135–142.

Michalek, J. E., *et al.* (1996). Pharmacokinetics of TCDD in veterans of Operation Ranch Hand: 10-year follow-up. ***J. Toxicol. Environ. Health* 47,** 209–220.

Peterson, R. E., *et al.* (1993). Development and reproductive toxicity of dioxins and related compounds: Cross-species comparisons. ***Crit. Rev. Toxicol.* 23,** 282–336.

Van den Berg, M., *et al.* (1994). The toxicokinetics and metabolism of polychlorinated dibenzo-*p*-dioxins (PCDDs) and dibenzofurans (PCDFs) and their relevance for toxicity. ***Crit. Rev. Toxicol.* 24,** 1–74.

Whitlock, J. P., Jr. (1990). Genetic and molecular aspects of 2,3,7,8-tetrachlorodibenzo-*p*-dioxin action. ***Annu. Rev. Pharmacol. Toxicol.* 30,** 251–177.

Formaldehyde

Anonymous (1996). **Formaldehyde: Industrial health hazards,** NTIS/PB96-865597.

Barker, J. R., *et al.* (1996). Formaldehyde: Environmental partitioning and vegetation exposed. ***Water Air Soil Pollution* 86,** 71–91.

Cassee, F. R., *et al.* (1996). Sensory irritation to mixtures of formaldehyde, acrolein, and acetaldehyde in rats. ***Arch. Toxicol.* 70,** 329–337.

Cheney, J. E., and Collins, C. H. (1995). Formaldehyde disinfection in laboratories: Limitations and hazards. ***Br. J. Biomed. Sci.* 52,** 195–201.

Fernandez-Caldas, E., *et al.* (1994). Environmental control of indoor biologic agents. ***J. Allergy Clin. Immunol.* 94,** 404–412.

Heck, H.d'A., *et al.* (1990). Formaldehyde toxicity—New understanding. ***Crit. Rev. Toxicol.* 20,** 397–426.

Korczynski, R. E. (1994). Formaldehyde exposure in the funeral industry. ***Appl. Occup. Environ. Hygiene* 9,** 575–579.

Restani, P., and Corrado, L. G. (1991). Oral toxicity of formaldehyde and its derivatives. ***Crit. Rev. Toxicol.* 21,** 315–328.

Vasudeva, N., and Anand, C. (1996). Cytogenetic evaluation of medical students exposed to formaldehyde vapor in the gross anatomy dissection laboratory. ***J. Am. Coll. Toxicol.* 44,** 177–179.

PCBs

Arnold, D. L., *et al.* (1995). Toxicological consequences of aroclor 1254 ingestion by female rhesus (*Macac mulatta*) monkeys. Part 2. Reproduction and infant findings. ***Food Chem. Toxicol.* 33,** 457–474.

Barron, M. G., *et al.* (1995). Comparative reproductive and developmental toxicology of PCBs in birds. ***Comp. Biochem. Physiol. C Pharmacol. Toxicol. Endocrinol.* 112,** 1–14.

Battershill, J. M. (1994). Review of the safety assessment of polychlorinated biphenyls (PCBs) with particular reference to reproductive toxicity. ***Hum. Exp. Toxicol.* 13,** 581–597.

Carpenter, D. O. (1998). Polychlorinated biphenyls and human health. ***Int. J. Occup. Med. Environ. Health* 11**(4), 291–303.

Kimbrough, R. D. (1995). Polychlorinated biphenyls (PCBs) and human health: An update. ***Crit. Rev. Toxicol.* 25,** 133–164.

Rogan, W. J. (1995). Human PCB toxicity studies overview. ***Neurotoxicology* 16,** 751–752.

Safe, S. H. (1994). Polychlorinated biphenyls (PCBs): Environmental impact, biochemical and toxic responses, and implications for risk assessment. ***Crit. Rev. Toxicol.* 24,** 87–150.

Sauer, P. J., *et al.* (1994). Effects of polychlorinated biphenyl (PCBs) and dioxins on growth and development. ***Hum. Exp. Toxicol.* 13,** 900–906.

Silberhorn, E. M., *et al.* (1990). Carcinogenicity of polyhalogenated biphenyls: PCBs and PBBs. ***Crit. Rev. Toxicol.* 20,** 439–496.

Tryphonas, H. (1995). Immunotoxicity of PCBs (Aroclors) in relation to Great Lakes. ***Environ. Health Perspect.* 103,** 36–46.

Valberg, P. A., *et al.* (1996). Evaluating the health impacts of incinerator emissions. ***J. Hazardous Materials* 47,** 205–227.

Van den Berg, *et al.* (1998). Toxic equivalency factors (TEFs) for PCBs, PCDDs, PCDFs for humans and wildlife. ***Environ. Health Perspec.* 106**(12), 775–792.

Rubber

Altman, L. C. (1995). Occupational exposure to latex. ***Western J. Med.* 163,** 369–370.

Hunt, L. W. *et al.* (1995). An epidemic of occupational allergy to latex involving health care workers. ***J. Occup. Environ. Med.* 37,** 1204–1209.

Vandenplas, O. (1995). Occupational asthma caused by natural rubber latex. ***Eur. Respir. J.* 8,** 1957–1965.

Vaneckova, J., and Ettler, K. (1994). Hypersensitivity to rubber surgical gloves in healthcare personnel. ***Contact Dermatitis* 31,** 266–268.

CLINICAL TOXICOLOGY

(U.S.) Agency for Toxic Substances and Disease Registry (ATSDR) (1992)
Managing Hazardous Materials Incidents: Medical Management Guidelines for Acute Chemical Exposures
ATSDR, Atlanta

Designed to assist emergency department physicians. Guidelines contain 27 chemical-specific protocols that provide recommendations for on-scene medical management of patients exposed during a hazardous materials incident.

American Pharmaceutical Association (1998)
Poisoning and Toxicology Compendium
Lexi-Comp, Cleveland, OH

A quick reference compiled for use by physicians, toxicologists, poison information specialists, and others. Six cross-referenced sections—medicinal agents, nonmedicinal agents, biological agents, herbal agents, diagnostic tests/procedures, and antidotes and drugs used in toxicology. Provides information such as mechanism of toxic action, adverse reactions, warnings, signs and symptoms of acute overdose, toxicodynamics/kinetics, overdosage treatment, and additional information, including references.

Arena, J., and Drew, R. H. (Eds.) (1986)
Poisoning: Toxicology-Symptoms-Treatments, 5th ed.
Thomas, Springfield, IL

A classic compilation of practical information on clinical toxicology. An introductory chapter on the general considerations of poisoning is followed by chapters on insecticides, other pesticides, industrial hazards, occupational diseases and hazards, environmental hazards, drugs, soaps and detergents, cosmetics and toiletries, poisonous plants and animals, etc.

Bates, N., *et al.* (1997)
Paediatric Toxicology: Handbook of Poisoining in Children
Stockton, New York

A practical guide to the diagnosis, risk assessment, and management of acute poisoning in children. Covers more than 1000 potentially poisonous agents, including drugs, household and garden products, plants, and animals.

Berman, E. (1996)
The Laboratory Practice of Clinical Toxicology
Thomas, Springfield, IL

Overview of the analytical techniques and methodologies developed and applied to meet the laboratory practice of clinical toxicology. It covers the various aspects of drug abuse, therapeutic drug monitoring, sequelae of exposures to trace metals, and miscellaneous toxins present in industrial and nonindustrial environments.

Bronstein, A. C., *et al.* (1994)
Emergency Care for Hazardous Materials Exposure, 2nd ed.
Mosby Lifeline, St. Louis, MO

Provides field recognition and management guidelines for hazardous materials and associated emergencies, including emergency care of exposed and contaminated patients.

Bryson, P. D. (1996)
Comprehensive Review in Toxicology for Emergency Clinicians, 3rd ed.
Taylor & Francis, Washington, DC

Provides an excellent reference in areas such as venomous creatures, drug interactions, cardiac medications, drugs of abuse, inhalation agents, pharmacokinetics for the pediatric and geriatric populations, autonomic nervous system drugs, and burn management with reference to end organ toxicity.

Curry, A. S. (1988)
Poison Detection in Human Organs, 4th ed.
Thomas, Springfield, IL

Part 1 concerns emergency toxicology in the living patient, Part 2 involves investigations on the dead, and Part 3 provides an alphabetical list of chemicals along with methods for their detection.

Dart, R. C. (1998)
5 Minute Consult in Medical Toxicology
Lippincott/Williams & Wilkins, Philadelphia

Based on the subject matter of the most commonly received calls at the Rocky Mountain Poison and Drug Center.

Descotes, J. (1996)
Human Toxicology
Elsevier, Amsterdam

A comprehensive volume containing information on management of acute poisonings, laboratory diagnosis, risk analysis, acute poisonings during pregnancy, analgesics, metals, pesticides, solvents, toxic gases, household products, poisonous plants and animals, and more.

Ellenhorn, M. J., and Barceloux, D. G. (1997)
Medical Toxicology and Treatment of Human Poisoning, 2nd ed.
Williams & Wilkins, Baltimore

An extensive and well-respected textbook presentation of data necessary to evaluate and treat the clinical effects of toxic substances. Major sections include general approach to the poisoned patient, therapeutic drugs, drugs of abuse, chemical products, and natural toxins. Covers topics such as pharmacokinetics, pathophysiology, clinical presentation, laboratory analysis, and treatment.

Foden, C. R., and Weddel, J. (1992)
Household Chemicals and Emergency First Aid
Lewis, Boca Raton, FL

Written for people who respond to emergency incidents involving hazardous materials. It will assist in making the initial evaluation about the possible potential of the hazard and in initiating actions to protect the emergency personnel handling the incident.

Goldfrank, L. R., *et al.* (Eds.) (1998)
Goldfrank's Toxicologic Emergencies, 6th ed.
Appleton & Lange, Stamford, CT

This highly regarded clinical toxicology text offers readers a case-study approach/problem-solving approach with an emphasis on patient management. [117 chapters]

Gossel, T. A., and Bricker, J. D. (1994)
Principles of Clinical Toxicology, 3rd ed.
Raven Press, New York

Introduction to basic principles, chemicals and environmental toxins, and drug toxicity. This book is meant for students of pharmacy and the health science.

Gosselin, R. E., Smith, R. P., and Hodge, H. C. (1984)
Clinical Toxicology of Commercial Products, 5th ed.
Williams & Wilkins, Baltimore

Assists physicians in quickly and effectively handling acute chemical poisonings arising through misuse of consumer products and provides a list of trade name products together with their ingredients; addresses and telephone numbers of companies for use when descriptions of products are not available; sample formulas of many types of products with an estimate of the toxicity of each formula; toxicological information, including an appraisal of toxicity of individual ingredients; and recommendations for treatment and supportive care. Also contains detailed documentation of published case reports and clinical and experimental research papers. This book is out of print and hard to find. Available as an online database under same title (see Chapter 6).

Hachet, J. C. (1992)
Dictionary of Clinical Toxicology—Chemical and Industrial Products and Environmental Pollutant,
Saint-Germain, Paris

Provides an alphabetical listing of commonly used toxic substances and groups of substances, with an outline of information on their acute and chronic toxic-

ity, antidotes or treatment, and on exposure limits, routes of entry, and metabolism. More detailed information is provided on classes of substances which are fungicides, pesticides, and carcinogens.

Haddad, L. M., Shannon M. W., and Winchester, J. F. (Eds.) (1998)
Clinical Management of Poisoning and Drug Overdose, 3rd ed.
Saunders, Philadelphia

Demonstrates the widening scope of and the increasing knowledge base underlying the treatment of poisoning and overdose. By emphasizing clinical management, this text provides a great deal of indepth information within a focused framework. Chapters are formatted by background, pharmacology, pathophysiology, diagnosis, and clinical management for each toxin.

Karch, S. B. (1998)
Drug Abuse Handbook
CRC Press, Boca Raton, FL

Covers drug-related issues in criminalistics, pathology, and toxicology, including pharmacokinetics, workplace drug testing, and treatment of drug-related medical emergencies.

Kaye, S. (1988)
Handbook of Emergency Toxicology, 5th ed.
Thomas, Springfield, IL

Recommended for use by medical practitioners and laboratory investigators who need to take prompt action in handling poisoning cases. The first section contains information on lethal doses, symptoms and signs, analysis, and antidotes and treatments. The second includes the specifics on individual poisons presented alphabetically.

Kent, D. A., Willis, G. A., and Lepik, K. J. (Eds.) (1997)
Poison Management Manual, 4th ed.
Drug and Poison Information Center, Vancouver, BC

Designed to serve as a reference to be used in conjunction with other information sources by professionals treating poisoned patients. The book consists of many monographs of frequently encountered poisons. The manual is cross-indexed and easy to use but contains few references.

Meier, J. and White, J. (Eds.) (1995)
Handbook of Clinical Toxicology of Animal Venoms and Poisons
CRC Press, Boca Raton, FL

Text includes information on the biology and taxonomy of poisonous animals, their venom or poison, diagnosis, and general treatment principles and specific treatment. This book covers shellfish, stingrays, venous fish, sea snakes, scorpions, spiders, insects, and glia lizards.

Mitchell, F. L. (Ed.) (1992)
Multiple Chemical Sensitivity: A Scientific Overview
National Academy Press, Washington, DC

Covers both a workshop and a conference on the topic presented by the Agency for Toxic Substances and Disease Registry. The issue is concerns the development in some persons of sensitivity to a wide variety of substances which presents difficult and complex medical and scientific issues.

Olson, K. R. (1994)
Poisoning and Drug Overdose, 2nd ed.
Appleton & Lange, Norwalk, CT

Provides practical advice for the management of poisoning and drug overdose and essential information about industrial chemicals and occupational illness. Outlines a comprehensive approach to management, including essential advice on how to diagnose and treat poisoning and how to recognize and treat common complications.

Proudfoot, A. T. (1993)
Acute Poisoning: Diagnosis and Management of Acute Poisoning, 2nd ed.
Butterworth-Heinemann, Oxford

A practical guide directed primarily to junior doctors in emergency departments and medical units. Following introductory chapters on definition and classification of acute poisoning, diagnosis, and general plans for management of cases, the features and management of specific poisons are presented alphabetically.

Rea, W.J. (1992–1997)
Chemical Sensitivity
CRC Press, Boca Raton, FL

Volume I—Principles and Mechanisms, Volume II—Sources of Total Body Load, Volume III—Clinical Manifestations of Pollutant Overload, Volume IV—Tools for Diagnosis and Methods of Treatment.

Rodgers, G. C., and Matyunas, N. J. (Eds.) (1994)
Handbook of Common Poisonings in Children, 3rd ed.
American Academy of Pediatrics, Elk Grove Village, IL

Groups together drugs, chemical abuse agents, chemicals, and biological poisons in a series of instructive chapters. The book is intended to provide the practitioner with the essential information needed to assess poisoning exposures and initiate a course of action.

Sommers, D. K. (1992)
The Treatment of Acute Poisoning
Butterworth, Boston

Enables doctors to determine the correct method of treating a poison victim within a few minutes. It offers a broad approach with guidelines for effective treatment.

Stilp, R. H., and Bevelacqua, A. S. (1997)
Emergency Medical Response to Hazardous Materials Incidents
Delmar, Albany, NY

A guide to applying emergency medical response to hazardous material incidents for hazmat team members. Explores the medical response from the initial response to the effects on body systems, injury, and treatment and also provides information on chemicals and toxicology.

Sullivan, J. B., and Kreiger, G. R. (1999)
Clinical Environmental Health and Toxic Exposures, 2nd ed.
Lippincott/Williams & Wilkins, Philadelphia

This is a new edition of the book previously titled *Hazardous Material Toxicology* by the same authors. It covers many basic principles, with an emphasis on clinical toxicology of hazardous materials, health and safety aspects, and emergency medical response.

Turkington, C. (1994)
Poisons and Antidotes
Facts on File Press, New York

Designed to give insight into the many potentially toxic substances found in nature and made by man. The target of this text is the layperson who might need to deal with accidental poisoning; for example, the first section deals with how to call a poison control center.

Viccellio, P., *et al.* (Eds.) (1998)
Emergency Toxicology, 2nd ed.
Lippincott-Raven, Philadelphia

Offers complete coverage of the field, addressing all types of poisoning and overdose, with extensive information on preparations available, pharmacology and properties, clinical manifestations, lab evaluation, management, and disposition. Includes references and a substantial concluding chapter on the differential diagnosis of poisoning.

See Also:
Section on Chemicals—Drugs

Section on Forensic Toxicology

Section on Occupational Health

Ansell: *Imaging Drug Reactions and Toxic Hazards* (Chemicals—Drugs)

Brooks: *Environmental Medicine* (Occupational Health)

DeGroot: *Unwanted Effects of Cosmetics and Drugs Used in Dermatology* (Target Sites—Skin)

Frankel: *Clinical Applications of Immunotoxins* (Target Sites—Immune)

Hartman: *Neuropsychological Toxicology* (Target Sites—Nervous System)

Marks: *Contact and Occupational Dermatology* (Target Sites—Skin)

Newcombe: *Clinical Immunotoxicology* (Target Sites—Immune)

Pfleger: *Mass Spectral and GC Data* (Analytical Toxicology)

Rosenstock: *Textbook of Clinical Occupational and Environmental Medicine* (Occupational Health)

Ryan: *Toxicology Desk Reference* (Chemical Compendia)

Stockley: *Drug Interactions* (Chemicals—Drugs)

Journals

Adverse Drug Reactions and Toxicological Reviews

American Journal of Emergency Medicine

Drug Safety

Human and Experimental Toxicology

Journal of Environmental Medicine

Journal of Toxicology: Clinical Toxicology

Journal of Toxicology: Cutaneous and Ocular Toxicology

Veterinary and Human Toxicology

Journal Articles

Banner, W., Jr., and Penterl, P. R. (1994). Medical toxicology. ***J. Am. Med. Assoc.*** **271**(21) 1681–1682.

Caravati, E. M., and McElwee, N. E. (1991). Use of clinical toxicology resources by emergency physicians and its impact on poision control centers. ***Ann. Emergency Med.*** **20,** 147–150.

Chan, T. Y. (1998). Childhood poisoning: The scope for prevention. ***Vet. Hum. Toxicol.*** **40**(6), 361–363.

Felberg, L. *et al.* (1996). State of the nation's poison centers: 1995 American Association of Poison Con-

trol Centers Survey of US poison centers. ***Vet. Hum. Toxicol.*** **38**(6), 445–453.

Flanagan, R. J. (1995). The poisoned patient: The role of the laboratory. ***Br. J. Biomed. Sci.*** **52**(3), 202–213.

Fournier, E. (1990). Development of the concept of antidotes: The contribution of clinical toxicology. ***Bull. Acad. Natl. Med.*** **174,** 703–707.

Goldfrank, L. R. (1992). Medical toxicology. ***J. Am. Med. Assoc.*** **268**(3), 375–376.

Haselberger, M. B., and Kroner, B. A. (1995). Drug poisoning in older patients. Preventative and management strategies. ***Drugs Aging*** **7**(4), 292–297.

Henretig, F. M. (1994). Special considerations in the poisoned pediatric patient. ***Emergency Med. Clin. North Am.*** **12**(2), 549–567.

Jacobsen, D. (1992). Research aspects in clinical toxicology. ***Arch. Toxicol. Suppl.*** **15,** 20–25.

Jaeger, A., *et al.* (1992). Diagnosis in clinical toxicology. ***Arch. Toxicol. Suppl.*** **15,** 29–39.

Krenzelok, E. P., and Leikin, J. B. (1996). Approach to the poisoned patient. ***Dis. Mon.*** **42**(9), 509–607.

Krenzelok, E., and Vale, A. (1997). Position statements: Gut decontamination. American Academy of Clinical Toxicology; European Association of Poisons Centers and Clincal Toxicologists. ***J. Toxicol. Clin. Toxicol.*** **35**(7), 695–786.

Levy, M., and Koren, G. (1992). Clinical toxicology of the neonate. ***Sem. Perinatol.*** **16,** 63–75.

Liang, H. K. (1996). Clinical evaluation of the poisoned patient and toxic syndromes. ***Clin. Chem.*** **42**(8, Pt. 2), 1350–1355.

Litovitz, T. L., *et al.* (1997). 1996 annual report of the American Association of Poison Control Centers Toxic Exposure Surveillance System. ***Am. J. Emergency Med.*** **15**(5), 447–500.

Lopez, G. P. (1990). Clinical toxicology: A review for the clinical pharmacist. ***ASHP Annu. Meeting*** **47,** 1–40.

Lovejoy, F. H., Jr., *et al.* (1992). Recent advances in clinical toxicology. ***Curr. Problems Pediatri.*** **22,** 119–129.

McGuigan, M. A. (1997). Quality management for poison centers. ***J. Toxicol. Clin. Toxicol.*** **35**(3), 283–293.

Norris, L. H., and Papageorge, M. B. (1995). The poisoned patient. Toxicologic emergencies. ***Dent. Clin. North Am.*** **39**(3), 595–619.

Pfaff, B. L. (1998). Emergency department management of nerve agent exposure. ***Int. J. Trauma Nurs.*** **4**(3), 71–78.

Proudfoot, A. (1998). Practical management of the poisoned patient. ***Ther. Drug Monit.*** **20**(5), 498–501.

Vale, J. A. (1993). Clinical toxicology. ***Postgrad Med. J.*** **69,** 19–32.

Vale, J. A., and Meredith, T. J. (1993). Clinical toxicology in the 1990s: The development of clinical toxicology centers—A personal view. ***J. Toxicol. Clin. Toxicol.*** **31**(2), 223–227.

Watson, I. D. (1998). Laboratory support for the poisoned patient. ***Ther. Drug Monit.*** **20**(5), 490–497.

Woolf, A. D., and Shannon, M. W. (1995). Clinical toxicology for the pediatrician. ***Pediatr. Clin. North Am.*** **42**(2), 317–333.

DEVELOPMENTAL AND REPRODUCTIVE TOXICOLOGY

Barker, D. J. P. (1996)
Mothers, Babies, and Diseases in Later Life
BMJ, London

Covers agents acting on the mother throughout the reproductive cycle and the impact on the embryo/fetus/child. Written for the health professional to gain an appreciation of the overall impact of those chemical and physical agents in the environment which have a lifetime effect on the next generation.

Barlow, S. M., and Sullivan, F. M. (1982)
Reproductive Hazards of Industrial Chemicals
Academic Press, London

Remains a key reference source regarding the reproductive effects of specific industrial chemicals in animals and man. The value and limitations of the data in predicting human health impact are assessed. Each chemical is reviewed in a standard format so that potency and activity comparisons can easily be made. An introductory section covering the background of testing and the recognition of reproductive hazards is followed by a detailed review covering approximately 50 industrial chemicals.

Bennett, P. N. (Ed.) (1996)
Drugs and Human Lactation
Elsevier, Amsterdam

Provides an overview of the excretion and effects of drugs transferred to the infant through human milk.

Briggs, G. G., *et al.* (1998)
Drugs in Pregnancy and Lactation: A Reference Guide to Fetal and Neonatal Risk, 5th ed.
Williams & Wilkins, Baltimore

Features information on more than 800 drugs (100 new to this edition). The reviews are from human cases. Animal experimental information is included only where human data are unavailable. *Briggs Update: Drugs in Pregnancy and Lactation,* a quarterly update, is also available, as is a CD-ROM version of the book.

Burger, E. J., Tardiff, R. G., Scialli, A. R., and Zenick, H. (Eds.) (1989)
Sperm Measures and Reproductive Success
A. R. Liss, New York

Examines sperm and the changes in quality and quantity affected by environmental agents. In doing this, four major sections are developed: U.S. regulatory framework around assessing risk of toxic injury, source of data on sperm and male reproductive performance, toxicologic and pharmacologic data, and statistical considerations.

Buyse, M. L. (Ed.) (1990)
Birth Defects Encyclopedia
Blackwell Sci., Cambridge, MA

A comprehensive, systematic, illustrated reference source for the diagnosis, delineation, etiology, biodynamics, occurrence, prevention, and treatment of human anomalies of clinical relevance. This work is a product of the Center for Birth Defects Information Services and brings together contributions from over 1000 researchers in a single, relatively easy to use format.

Chapin, R. E., and Heindel, J. J. (Eds.) (1993)
Male Reproductive Toxicology
Academic Press, New York

Details methods for assessing reproductive processes from gametogenesis up to the mature sperm and sexual process. The book contains 23 chapters which present the methodologies and applications of these methodologies in detail.

Danish Environmental Protection Agency (written by J. Toppari *et al.*) (1995)
Male Reproductive Health and Environmental Chemicals with Estrogenic Effects
Ministry of Environment and Energy, Cophenhagen

The report addresses the possible effects of environmental chemicals know to possess estrogenic activity on male reproductive health. It presents data and summaries on several estrogenic compounds, discusses methods for evaluation, and suggests strategies for further investigations.

Daston, G. P. (Ed.) (1996)
Molecular and Cellular Methods in Developmental Toxicology
CRC Press, Boca Raton, FL

Provides a convenient source of experimental procedures including the most current molecular and cellular techniques. Intended as a working guide for the laboratorian.

Dixon, R. L. (Ed.) (1985)
Reproductive Toxicology
Raven Press, New York

Deals with effects on development, female reproduction, male reproduction, fertilization, implantation, heritable germline toxicity, and effects of ionizing radiation.

European Chemical Industry Ecology and Toxicology Centre (ECETOC) (1983)
Monograph No. 5: Identification and Assessment of the Effects of Chemicals on Reproduction and Development (Reproductive Toxicology)
ECETOC, Brussels

Reports on the potential effects of chemicals, natural and man-made, on reproduction in humans. Chapters describe structure–activity relationships, modes of action, and dose–response relationships. The current state of testing is presented. Critically examines the significance of experimental animal data and the relevance to humans.

European Chemical Industry Ecology and Toxicology Centre (ECETOC) (1989)
Monograph No. 12: Alternative Approaches for the Assessment of Reproductive Toxicity (with Emphasis on Embryotoxicity/Teratogenicity)
ECETOC, Brussels

Assesses the current status of the alternative *in vivo* and *in vitro* tests which were developed for evaluating the effects of chemicals on reproduction in relation to a possible substitution of the classical *in vivo* assays, to their relevance to man, and to the more humane use of experimental animals.

European Chemical Industry Ecology and Toxicology Centre (ECETOC) (1992)
Technical Report No. 47: EC 7th Amendment: Toxic to Reproduction. Guidance on Classification
ECETOC, Brussels

Reviews the system of classification that has been proposed by the EC experts for those substances which

may be considered ''toxic to reproduction.'' Fertility and toxicity to the developing fetus have been separated. The proposed risk phrases for use with each of the categories are listed.

Forman, R., Gilmour-White, S., and Forman, N. (1996)
Drug-Induced Infertility and Sexual Dysfunction
Cambridge Univ. Press, New York

Presents the available evidence so that, when confronted with a clinical situation which could implicate a particular drug, an informed clinical judgment can be made quickly, easily, and accurately. Following a review of sexual and reproductive function, antihypertensive therapy, CNS and psychotropic drugs, cancer chemotherapeutic agents, hormonal therapy, antibiotics, recreational drugs, and miscellaneous drugs are discussed. The last chapter covers the broad effects of the environment on fertility.

Frazier, L., and Hage, M. (1998)
Reproductive Hazards of the Workplace
Van Nostrand–Reinhold, New York

Focus is on the practical strategies for assessing and managing occupational reproductive risk. Highlights numerous case studies. Covers the basics of reproductive and developmental biology, risk assessment, and workplace risk reduction. Also included is a detailed examination of the chemical, physical, ergonomic, biologic, travel, and psychosocial considerations affecting reproductive health.

Friedman, J. H., and Polifka, J. E. (1998)
The Effects of Neurologic and Psychiatric Drugs on the Fetus and Nursing Infant: A Handbook for Health Care Professionals
Johns Hopkins Unviersity Press, Baltimore

A concise guide to the potential teratogenic risks of some 225 drugs that are prescribed for neurologic and psychiatric disorders. Rates the risk of teratogenic effects ''none, likely, minimal, small, moderate, high, or undetermined.''

Friedman, J. M., and Polifka, J. E. (1994)
Teratogenic Effects of Drugs: A Resource for Clinicians
Johns Hopkins Univ. Press, Baltimore

Summarizes the teratogenic risks associated with the large number of drugs covered in this text. Presented alphabetically, each section covers details of the developmental toxicity of the agent. A complete list of references for each drug is presented. This book is directed to health professionals needing a quick look at the risks of each agent and also serves as a starting point for the interested researcher.

Friedman, J. M., and Polifka, J. E. (1996)
The Effects of Drugs on the Fetus and Nursing Infant
Johns Hopkins Univ. Press, Baltimore

Provides an assessment of information available regarding fetal and neonatal risks associated with maternal use of common medications during pregnancy or lactation. The book is arranged alphabetically by trade names of drugs, and entries provide an assessment of potential for teratogenicity, an assessment of the quality and quantity of data available, effects reported, the risk from breast-feeding, and key references.

Gagnon, C. (Ed.) (1990)
Controls of Sperm Motility: Biological and Clinical Aspects
CRC Press, Boca Raton, FL

Details the activities regarding sperm motility. Both the biological aspects and the clinical aspects are covered from both an experimental and a practical point of view. A total of 22 chapters are included that examine this aspect of male fertility in-depth.

Gilstrap, L. C., and Little, B. B. (Eds.) (1998)
Drugs and Pregnancy, 2nd ed.
Chapman and Hall, New York

Intended for obstetricians, maternal–fetal medicine specialists, and others providing care to pregnant women. Part I: General Principles of Human Teratology, Clinical Evaluation, Patient Counseling; Part II: Medication Use during Pregnancy; Part III: Substance Abuse during Pregnancy.

Heindel, J. J., and Chapin, R. E. (Eds.) (1993)
Female Reproductive Toxicology (*Methods in Toxicology,* Vol. 3B)
Academic Press, New York

Details methods for assessing reproductive processes from gamete to genesis up to the implantation of the new embryo in the uterus. It provides methods for evaluating many effects in the nonpregnant and pregnant female and in the male.

Hood, R. D. (Ed.) (1996)
Developmental Toxicology: Risk Assessment and the Future
Van Nostrand–Reinhold, New York

Reviews current knowledge and focuses on the areas needing research as outlined by EPA guidelines. Analyses of the research achievements and needs in paternally mediated effects, nonbehavioral functional effects, pharmacokinetic and physiologically based models, structure–activity relationships, and mathematical modeling are presented.

Hood, R. D. (Ed.) (1997)
Handbook of Developmental Toxicology
CRC Press, Boca Raton, FL

Provides a practical guide for a wide variety of developmental toxicologists by containing in a single place information that is otherwise scattered throughout the literature. It contains both mechanistic studies of known developmental toxicants and the toxicological assessment of pharmaceutical agents, food additives, pesticides, industrial chemicals, and environmental pollutants to which pregnant women may be exposed.

Johnson, E. M., and Kochhar, D. M. (Eds.) (1983)
Teratogenesis and Reproductive Toxicology
Springer-Verlag, New York

Provides information on detection and analysis of potential hazards to the conceptus in the workplace and pharmacokinetic aspects of the maternal/placental/fetal complex and its relationship to human birth defects. Probable mechanisms of teratogenesis are discussed. Summaries of recent investigations on the emerging field of postnatal functional evaluations are included.

Juchau, M. R. (Ed.) (1981)
The Biochemical Basis of Chemical Teratogenesis
Elsevier, New York

Focuses on the biochemical means by which chemicals produce dysmorphogenic effects. Special topics include accessibility of teratogens to the developing embryo, enzymatic bioactivation/inactivation of chemical teratogens, alkylating agents, folate antagonists, thalidomide, glucocorticoids, trace elements, and selected therapeutic agents.

Kacew, S., and Lambert, G. H. (Eds.) (1997)
Environmental Toxicology and Pharmacology of Human Development
Taylor & Francis, London

Recent advances and extensive developments in the field are detailed. The book provides a review of the pharmacokinetic characteristics, metabolism, and renal handling of chemicals and drugs in the fetus, lactating infant, and developing newborn. It also discusses topics such as maternal–fetal exposure, heavy metals, pesticides, solvents, contaminants and breast milk, caffeine, genetic predisposition to toxicity, and retinoids.

Kavlock, R. J., and Daston, G. P. (Eds.) (1997)
Drug Toxicity in Embryonic Development
Springer-Verlag, Berlin

Volume 124 of the *Handbook of Experimental Pharmacology.* Considers advances in understanding mechanisms of birth defects. Includes critical reviews of the biology involved. Also deals with the molecular control of normal morphogenesis for several organ systems to aid experimentalists in revealing significant mechanisms for drug-induced alterations.

Kenen, R. (1993)
Reproductive Hazards in the Workplace: Mending Jobs, Managing Pregnancies
Haworth, New York

Written to achieve a pregnancy-friendly workplace. To this end, the author reviews the history of pregnancy and the working woman to put the concerns in perspective. Other major sections include evaluation of workplace safety and strategies for the future. The book is directed at the lay audience and objectively examines an emotional issue.

Kimmel, C. A., and Buelke-Sam, J. (Eds.) (1994)
Developmental Toxicity, 2nd ed.
Raven Press, New York

Viewed as a companion to and not a replacement for the first edition. The book presents an integrated approach for characterizing outcome in developmental toxicology. This volume focuses primarily on the causes, mechanisms, and prevention of developmental toxicity in humans. The section headings include Basic Biology, Abnormal Development Outcomes, Pharmacokinetics, Human Studies, Modeling Approaches, and Regulatory Aspects.

Kimmel, G. L., and Kochhar, D. M. (1990)
In Vitro Methods in Developmental Toxicology
CRC Press, Boca Raton, FL

Brings together work of several investigators who have used *in vitro* techniques in probing the nature of embryonic cells' response to a diverse group of chemical agents. The emphasis is on the approaches, their usefulness and limitations, and their applicability in defining mechanisms underlying dysmorphogenesis.

Knobil, E., and Neill, J. D. (Eds.) (1994)
The Physiology of Reproduction, Vols. 1 and 2
Raven Press, New York

Presents a critical assessment of the state of the art in every aspect of research on the physiology of reproduction in 61 chapters and 2 volumes. Each section provides both an overview and details of topics, including gametes and fertilization, the reproductive system, endocrine control functions, reproductive behavior and its control, and the reproductive process and its control.

Knobil, E., and Neill, J. D. (Eds.) (1998)
Encyclopedia of Reproduction
Academic Press, New York

Covers in four volumes expanded information on all aspects of animal reproduction. The systems covered range from invertebrates to humans. Over 500 articles are included.

Kolb, V. M. (Ed.) (1993)
Teratogens: Chemicals Which Cause Birth Defects, 2nd ed.
Elsevier, Amsterdam

Deals with practical issues such as how to obtain information about the teratogenic potential of chemicals. Principles and mechanisms are reviewed, the relationships between effects and exposures are discussed, and legal and ethical aspects of fetal protection policies are covered.

Konkol, R. J., and Olsen, G. D. (1996)
Prenatal Cocaine Exposure
CRC Press, Boca Raton, FL

Discusses the problem of maternal cocaine abuse and its effects on exposed infants, including growth retardation, learning, cardiovascular effects, and seizures. The volume reviews both animal and clinical studies to explain implications for treatment and long-term outcomes of early exposure.

Korach, K. S. (Ed.) (1998)
Reproductive and Developmental Toxicology
Dekker, New York

Offers extensive discussions on the pharmacological, environmental, endocrinological, and natural factors that alter reproduction or developmental processes. The text elucidates the effects on mechanisms of reproduction. Included in the book is an overview of the basic biology and physiology of organ systems affected by toxicants, detailed examples of altered developmental toxicity, analysis of germ cell toxicity and infertility, and discussion of how gonadal processes may be susceptible to toxicants.

Koren, G. (1994)
Maternal–Fetal Toxicology: A Clinician's Guide, 2nd ed.
Dekker, New York

Presents accurate, up-to-date estimates of the teratogenic risks of exposure to drugs, chemicals, viruses, and radiation during pregnancy. It also covers the maternal–fetal toxicology of medicinal plants, developmental risk assessment, and biological markers of intrauterine exposure to drugs of abuse. It includes clinical cases in most chapters.

Lewis, R. J. (1991)
Reproductively Active Chemicals: A Reference Guide
Van Nostrand–Reinhold, New York

Identifies, compiles, and documents the effects of more than 3300 chemical substances known or suspected to produce adverse effects on human health. The book is well cross-referenced, draws from authoritative sources, and presents the information as an easily understood format. The chemicals covered include drugs, food additives, preservatives, ores, pesticides, and dyes.

Meyers, V. K. (Ed.) (1988)
Teratogens: Chemicals Which Cause Birth Defects
Elsevier, Amsterdam

Makes chemists and those working with chemicals aware of the practical aspects of chemical teratogenesis. This book is written in nontechnical terms and gives the reader an appreciation of the issues, indicates where to find key information, and provides commonsense practices to avoid chemical contact, especially for women of child-bearing age.

National Research Council (1989)
Biologic Markers in Reproductive Toxicology
National Academy Press, Washington, DC

Sets forth in general terms the broad concepts and definitions of biologic markers and, in the introduction, discusses the use of markers in environmental health research. This volume includes chapters on biologic markers in male reproductive and gametic genetic toxicology and in female reproductive toxicology, toxicity during pregnancy, and neurodevelopmental toxicity. This is part of a series of reports in a new field on exposure assessment based on individual analytes.

Naz, R. K. (1999)
Endocrine Disruptors: Effects on Male and Female Reproductive Systems
CRC Press, Boca Raton, FL

Examines the epidemiology and etiology of environmental toxicants/hormone imposters, many of which act as reproductive toxicants that cause fertility problems and carcinogenic hazards.

Needleman, H. L., and Bellinger, D. (Eds.) (1994)
Prenatal Exposure to Toxicants: Developmental Consequences
Johns Hopkins Univ. Press, Baltimore

Summary of work in some of the key areas to provide the clinician, researcher, and public health specialist insight into the current status of this area and a look at future needs. The four major sections are neurode-

velopmental toxicology, toxicants well studied in humans, toxicants studied mainly in animals, and regulatory issues.

Nisbet, I. C., and Karch, N. J. (1983)
Chemical Hazards to Human Reproduction
Noyes, Park Ridge, IL

A critical evaluation and documentation of the current evidence and governmental policy implications of the reproductive hazards of drugs and chemicals. The chapters include an overview of the human reproductive system and its sensitivity, sources of data in man, agents affecting this system, ways of demonstrating this experimentally, and concordance between findings in animals and man.

Olshan, A. F., and Mattison, D. R. (Eds.) (1994)
Male-Mediated Developmental Toxicity
Plenum, New York

Presents material based on an international conference on male-mediated developmental toxicity in September 1992 The book follows the meeting sessions, which included concepts and mechanisms, laboratory evidence, epidemiological findings, risk assessment and policy issues, current methods, new molecular approaches, laboratory research on specific agents and end points, novel pathways, and mechanisms.

O'Rahilly, R., and Muller, F. (1992)
Human Embryology and Teratology
Wiley–Liss, New York

Provides an up-to-date, reasonably brief, reliable text specifically on the human embryo and fetus. Focused on the developmental stages during which various morphological features normally appear in the embryonic period proper. The book is divided into two major sections—the first deals with general embryology and teratology and the second with systemic embryology and teratology.

Paul, M. (Ed.) (1993)
Occupational and Environmental Reproductive Hazards: A Guide for Clinicians
Williams & Wilkins, Baltimore.

Intended as a resource for obstetricians–gynecologists and health care professionals involved in the promotion of reproductive health. The book has four main sections: important background findings, an overview of the epidemiological and toxicological methods used to identify agents, clinical evaluation and management of patients, and information on specific reproductive and developmental hazards.

Persuad, T. V. N. (1990)
Environmental Causes of Human Birth Defects
Thomas, Springfield, IL

Provides an up-to-date and overall view of environmental teratogens as causes of human birth defects. Specific chapters deal with infections, *in utero* exposure to radiation, maternal prescribed drugs and illicit drugs, industrial chemicals, the pregnant woman in the workplace, and the consumption of alcohol, nicotine, and caffeine.

Richardson, M. (Ed.) (1993)
Reproductive Toxicology
Weinheim, New York

Addresses the problem of the effects of industrial development on future generations. The major sections include introduction and overview, male and female reproductive toxicology, and human health aspects. The 17 chapters present a balanced view of the area.

Rolland, R. M., Gilbertson, M., and Peterson, R. E. (1997)
Chemically Induced Alterations in Functional Development and Reproduction of Fishes
SETAC, Pensacola, FL

Examines the scientific evidence on the link between exposure to chemicals and reproductive and developmental effects in fishes. Particular emphasis is placed on effects at early developmental stages. The bulk of the book is concerned with research into the effects of endocrine modulating chemicals on these potential targets.

Sadler, T. W. (1995)
Langman's Medical Embryology, 7th ed.
Williams & Wilkins, Baltimore

A concise, well-illustrated presentation of essential facts of human development, including summary tables and charts. This is directed at the medical student and researcher in the field of developmental biology.

Sastry, B. V. R. (Ed.) (1995)
Placental Toxicology
CRC Press, Boca Raton, FL

Examines placental transfer and toxicology of drugs and environmental agents to placenta as well as to the fetus. Placental and fetal consequences of exposure of pregnant women to drugs, environmental agents, and infections such as HIV are discussed. Featured chemical classes include drugs of addiction, pesticides, and hormonally active materials.

Sastry, B. V. R. (Ed.) (1996)
Placental Pharmacology
CRC Press, Boca Raton, FL

Describes the use of modern biophysical methods to study placental function. The hemodynamics of the placenta, use of placental tissue in research, and placental transfer of drugs during pregnancy are well covered. Directed at scientists interested in the placenta and its uses in drug development and testing.

Schardein, J. L. (1993)
Chemically Induced Birth Defects, 2nd ed.
Dekker, New York

Catalogs the available data on drugs and chemicals for their potential teratogenicity in animals and humans. The basic divisions are drugs and chemicals and they are sorted in a way which makes access to the desired specific information easy. The data are presented on a chemical by chemical basis and not by the various end points determined.

Scialli, A. R. (1992)
A Clinical Guide to Reproductive and Developmental Toxicology
CRC Press, Boca Raton, FL

Written for clinicians desiring a fundamental understanding of the basic science behind the observational data. Chapters include principles of teratology, toxicology and pharmacology, study types, fetoplacental unit, female and male reproduction, breast milk, the workplace, risk assessment and counseling, and legal implications.

Scialli, A. R., and Clegg, E. D. (Eds.) (1992)
Reversibility in Testicular Toxicity Assessment
CRC Press, Boca Raton, FL

Examines the potential for reversibility of effects of toxicants on important cell types in the testis. Included are Leydig cells, Sertoli cells, the germinal cells, and the testicular circulatory system. The intent is to provide background information to facilitate consideration of reversibility in risk assessments.

Scialli, A. R., and Zinaman, M. J. (1993)
Reproductive Toxicology and Infertility
McGraw-Hill, New York

Directed at clinicians needing an understanding of ways in which drugs and other potential toxicants may alter male and female reproductive competence. The first section provides background, the second discusses ways in which the system can be deranged, and the final section describes methods by which fertility can be monitored and by which reproductive toxicity might be identified.

Scialli, A. R., Lione, A., and Padgett, G. K. B. (1995)
Reproductive Effects of Chemical, Physical, and Biological Agents
Johns Hopkins Univ. Press, Baltimore

Presents the effects of chemicals and physical agents on fertility, pregnancy, and lactation. The primary audience consists of health care providers who are addressing patient concerns. Over 3800 specific chemical and agents are included in this text.

Sever, J. L., and Brent, R. L. (Eds.) (1986)
Teratogen Update: Environmentally Induced Birth Defect Risks
A. R. Liss, New York

Continues the compilation of information on human teratogens started in 1975. The articles are intended to summarize the clinical manifestations, etiology, pathogenesis, treatment, and prevention of the phenomena. Also included are related articles dealing with the complexities of solving the problem, methods for evaluating teratogenicity, and medicolegal issues.

Shepard, T. H. (1998).
Catalog of Teratogenic Agents, 9th ed.
Johns Hopkins Univ. Press, Baltimore

An important compilation of teratogenic agents. Helps link the information on experimental teratogenic agents with congenital defects in human beings. Agents listed include chemicals, drugs, physical factors, and viruses. This edition contains 1500 additions, of which 270 are newly listed agents. A special effort was made to obtain agents to which pregnant women may be exposed.

Snell, K. (Ed.) (1982)
Developmental Toxicology
Prager, New York

Covers essential information regarding the basics of developmental toxicology. The reader will find the following chapters to be well presented and useful today: Model Systems, *In Vitro* Testing, Cell Cultures, Biochemical Mechanisms, Distribution of Agent in the Fetus, Differentiation in Relation to Toxicity, Role of the Placenta, Developmental Carcinogenicity, Behavioral Teratogenicity, and Developmental Enzyme Pathology.

Szabo, K. T. (1989)
Congenital Malformations in Laboratory and Farm Animals
Academic Press, San Diego

Presents information of the type and frequency of congenital malformations, much of which is derived from

the author's own experimental experience. The data on more than 50,000 mouse, rat, and rabbit fetuses are presented by organ system involved. Introductory and application chapters are also valuable.

Wilson, J. G. (1973)
Environment and Birth Defects
Academic Press, New York

Remains a valuable reference to those working in the field of developmental toxicity. The aim is to provide information needed to evaluate environmental factors that may represent risks to unborn generations. Two areas of special concern handled by this book are mutagenesis and teratogenesis.

Wilson, J. G., and Fraser, F. C. (1977)
Handbook of Teratology, 4 vols.
Plenum, New York

A comprehensive text covering general principles and etiology; mechanisms and pathogenesis; comparative, maternal, and epidemiologic aspects; and research procedures and data analysis.

Wilson, J. G., and Warkany, J. (Eds.) (1965)
Teratology, Principles and Techniques
Univ. of Chicago Press, Chicago

The sentinel reference in the field. The book resulted from a symposium to examine the safety of drugs with particular emphasis on the unborn. The 10 chapters cover both the theory and the practice of experimental teratology. Particularly useful are some of the hands-on chapters which present the details of procedures that are still in use.

Witorsch, R. J. (Ed.) (1995)
Reproductive Toxicology, 2nd ed.
Raven Press, New York

Offers a broad look at physiological mechanisms of action of toxic agents on the reproductive system. It encompasses discussions of the physiology of male and female reproduction, including pregnancy and lactation, and includes clinical and epidemiological studies pertaining to the reproductive system.

Working, P. K. (Ed.) (1989)
Toxicology of the Male and Female Reproductive Systems
Hemisphere, New York

Provides a firm grounding in basic male and female reproductive physiology, including aspects of gametogenesis, postgonadal gamete maturation and transport, and fertilization. This is then related to the practice of reproductive toxicology.

Yen, S. S. C., and Vale, W. W. (Eds.) (1990)
Neuroendocrine Regulation of Reproduction
Serono Symposia, Norwell, MA

An important collection concerning the interplay of the nervous and endocrine systems in maintaining the functional integrity of the immensely complex male and female reproductive systems. The book examines areas such as central regulation of reproduction, gonadal regulators, and neuroendocrine regulation of gonadotrophs.

Zielhuis, R. L., Stijkel, A., Verberk, M. M., and von de Poel-Bot, M. (Eds.) (1984)
Health Risks to Female Workers in Occupational Exposure to Chemical Agents
Springer-Verlag, Berlin

Contains chapters on the following exposures and professions/industries: organic solvents, carbon disulfide, pesticides, PCBs and PBBs, plastic monomers, carbon monoxide, lead, cadmium, mercury, operating room personnel, health care personnel, pharmaceutical industry, chemical industry, rubber industry, beauticians, and hairdressers.

See Also:

Abel: *Fetal Alcohol Syndrome* (Chemicals—Selected Chemicals)

Clarkson: *Reproductive and Developmental Toxicity of Metals* (Chemicals—Metals)

ECETOC: *Technical Report No. 47: EC 7th Amendment: Toxic to Reproduction. Guidance on Classification* (Regulatory Toxicology)

ECETOC: *Technical Report No. 38: A Guide to the Classification of Preparations Containing Carcinogens, Mutagens, and Teratogens* (Testing Methods and Toxicity Assessment)

ECETOC: *Technical Report No. 63: Reproductive and General Toxicology of Some Inorganic Borates and Risk Assessment for Human Beings* (Target Sites—Reproductive)

Harry: *Developmental Neurotoxicology* (Target Sites—Nervous System)

Hodges and Rowlatt: *Developing Biology and Cancer* (Cancer)

Hodges: *Developmental Biology and Cancer* (Cancer)

Jones: *Monographs on Pathology of Laboratory Animals Series* (Pathology)

Neubert *et al.*: *Risk Assessment of Prenatally-Induced Adverse Health Effects* (Risk Assessment)

Slikker: *Handbook of Developmental Neurotoxicology* (Target Sites—Nervous System)

Wilkens: *Genetic Analysis of Animal Development*, 2nd ed. (Genetic)

Journals

Development

Molecular Reproduction and Development

Neurotoxicology and Teratology

Reproductive Toxicology

Teratogenesis, Carcinogenesis and Mutagenesis

Teratology

Journal Articles

Agency for Toxic Substance and Disease Registry, (1998). Reproductive and developmental hazards. An overview for occupational and environmental health nurses. ***AAOHN J.*** **46**(2), 57–65.

Bechter, R. (1995). The validation and use of *in vitro* teratogenicity tests. ***Arch. Toxicol. Suppl.*** **17,** 170–191.

Bernstein, J. H. (1994). Assessment of developmental toxicity: Neuropsychological batteries. ***Environ. Health Perspect.*** **102,** 141–144.

Bieler, G. S., and Williams, R. L. (1995). Cluster sampling techniques in quantal response teratology and developmental toxicity studies. ***Biometrics*** **51,** 764–776.

Brandt, I., Berg, C., Halldin, K., and Brunstrom, B. (1998). Developmental and reproductive toxicity of persistent environmental pollutants. ***Arch. Toxicol. Suppl.*** **20,** 111–119.

Chahoud, I. *et al.* (1999). Classification terms in developmental toxicology: Need for harmonisation. Report of the Second Workshop on the Terminology in Developmental Toxicology, Berlin, 27–28 August 1998. ***Reprod. Toxicol.*** **13,** 77–82.

Clegg, J. A. (1994). Male reproductive toxicity testing. ***Adverse Drug Reactions Toxicol. Rev.*** **13**(4), 235–247.

Colie, C. F. (1993). Male mediated teratogenesis. ***Reprod. Toxicol.*** **7,** 3–9.

Cooke, B. A. (1998). *In vitro* models for the investigation of reproductive toxicology in the testis. ***Adv. Exp. Med. Biol.*** **444,** 95–102.

Cooper, R. I., and Kavlock, R.J. (1997). Endocrine disruptors and reproductive development: A weight-of-evidence overview. ***J. Endocrinol.*** **152**(2), 159–166.

Danzo, B. J. (1998). The effects of environmental hormones on reproduction. ***Cell. Mol. Life Sci.*** **54,** 1249–1264.

Domingo, J. L. (1998). Developmental toxicity of metal chelating agents. ***Reprod. Toxicol.*** **12,** 499–510.

Farrar, H. C. (1991). Fetal effects of maternal drug exposure. ***Annu. Rev. Pharmacol. Toxicol.*** **31,** 525–547.

Giwercman, A., and Bonde, J. P. (1998). Declining male fertility and environmental factors. ***Endocrin. Met. Clinics N. Am.*** **27,** 807–830.

Gombar, V. K., *et al.* (1995). Assessment of developmental toxicity potential of chemicals by quantitative structure–toxicity relationship models. ***Chemosphere*** **31,** 2499–2510.

Hoyer, P. B., and Sipes, I. G. (1996). Assessment of follicle destruction in chemical-induced ovarian toxicity. ***Annu. Rev. Pharmacol. Toxicol.*** **36,** 307–332.

Juchau, M. R. (1993). Chemical teratogenesis. ***Prog. Drug. Res.*** **41,** 9–50.

Kamrin, M. A., *et al.* (1994). Female reproductive and developmental toxicology: Overview and current approaches. ***Toxicol. Lett.*** **74,** 99–119.

Kimmel, C. A., *et al.* (1993). A new frontier in understanding the mechanisms of developmental abnormalities. ***Toxicol. Appl. Pharmacol.*** **119,** 159–165.

Krewski, D., and Zhu, Y. (1995). A simple data transformation for estimating benchmark doses in developmental toxicity experiments. ***Risk Anal.*** **15,** 29–39.

Levine, B. S. (1995). **Preclinical toxicology studies for new drugs and vaccines,** NTIS/ADA303 781/9.

Maranghi, F., *et al.* (1998). Evaluation of the placenta: Suggestions for a greater role in developmental toxicology. ***Adv. Exp. Med. Biol.*** **444,** 129–136.

Meistrich, M. L. (1992). A method for quantitative assessment of reproductive risks to the human male. ***Fundam. Appl. Pharmacol.*** **18,** 479–490.

Miller, M. S., *et al.* (1996). Drug metabolic enzymes in developmental toxicology. ***Fundam. Appl. Toxicol.*** **34,** 165–175.

Moore, J. A., Daston, G. P., Faustman, E., Golub, M. S., Hart, W. L., Hughes, C., Jr., Kimmel, C. A., Lamb, J. C., 4th, Schwetz, B. A., and Scialli, A. R. (1995, January/February). An evaluative process for

assessing human reproductive and developmental toxicity of agents. ***Reprod. Toxicol.* 9,** 61–95.

Narotsky, M. G., and Kavlock, R. J. (1995). A multidisciplinary approach to toxicological screening: II. Developmental toxicity. ***J. Toxicol. Environ. Health* 45,** 145–171.

Nelson, B. K. (1994). Interactions in developmental toxicology: A literature review and terminology proposal. ***Teratology* 49,** 33–71.

Nunziata, A. (1998). An overview of current *in vivo* test procedures to reproductive toxicology. ***Adv. Exp. Med. Biol.* 444,** 171–183.

O'Flaherty, E. J. (1994). Physiologically based pharmacokinetic models in developmental toxicology. ***Risk Anal.* 14,** 605–611.

Peters, P. W. (1998). Developmental toxicology: Adequacy of current methods. ***Food Additive Contam.* 15**(Suppl.), 55–62.

Scharfstein, D. O., and Williams, P. L. (1994). Design of developmental toxicity studies for assessing joint effects of dose and duration. ***Risk Anal.* 14,** 1057–1071.

Schwetz, B. A. (1996). Noncancer risk assessment: Reproductive toxicology. ***Drug Metab. Rev.* 28**(1/2), 77–84.

Shepard, T. H. (1995). Agents that cause birth defects. ***Yonsei Med. J.* 36,** 393–396.

Toppari, J., and Skakkebaek, N. E. (1998). Sexual differentiation and environmental endocrine disrupters. ***Baillieres Clin. Endocrin. Metab.* 12,** 143–156.

Welsch, F. (1992, July). In vitro approaches to the elucidation of mechanisms of chemical teratogenesis. ***Teratology* 46,** 3–14.

ENVIRONMENTAL TOXICOLOGY—GENERAL

Advances in Environmental Science and Technology (1969–)
Wiley–Interscience, New York

A monographic series. Recent titles include *Environmental Oxidants, Arsenic in the Environment, Nickel and Human Health, Gaseous Pollutants,* and *Food Contamination from Environmental Sources.*

Advances in Modern Environmental Toxicology (1980–)
Stockton Press, NY

A monographic series. Recent topics include the oil refining industry, asbestos and cancers, chemically induced alterations in sexual and functional development, predicting ecosystem risk, complex mixtures, pesticides, endocrine disrupting chemicals (Vol. 24, 1998), and hazardous waste (Vol. 25, 1998).

Alexander, M. (1994)
Biodegradation and Bioremediation
Academic Press, New York

Considers microbiological, chemical, environmental, engineering, and technological aspects of biodegradation and bioremediation. The key general principles are presented in a way designed for professionals and students who may be familiar with only one of the several different disciplines involved.

American Society for Testing and Materials (ASTM)
Environmental Toxicology and Risk Assessment
ASTM Press, Philadelphia

A monographic series. Recent volumes include Vol. 5, *Biomarkers and Risk Assessment* (1996), and Vol. 6, *Modeling and Risk Assessment* (1997).

Cairns, J., Jr., and Niederlehner, B. R. (1995)
Ecological Toxicity Testing: Scale, Complexity, and Relevance
Lewis, Boca Raton, FL

Provides a critical comparison of toxicity tests at different levels of biological organization from cells to landscapes. Includes evaluations of toxicity test systems at various scales and complexities by expert practitioners. Also offers broader analyses of the effects of scale on end-point selection, test design and analyses, and chemical sensitivity.

Chakrabarty, A. M. (Ed.) (1982)
Biodegradation and Detoxification of Environmental Pollutants
CRC Press, Boca Raton, FL

Chapters on selected pesticides, PCBs, aromatic hydrocarbons, mercury, chlorinated compounds, and metabolic evolution. The chemistry as it applies to environmental discharges in the focus of most chapters.

Chapman and Hall Ecotoxicology Series (1992–)
Chapman & Hall, London

A monographic series bringing together expert opinions on a wide range of subjects. Previous volumes include *Animal Biomarkers as Pollution Indicators, Ecotoxicology in Theory and Practice, Interconnections between Human and Ecosystem Health,* and *Ecotoxicology: Ecological Dimensions.*

Cockerham, L. G., and Shane, B. S. (Eds.) (1994)
Basic Environmental Toxicology
CRC Press, Boca Raton, FL

A comprehensive introduction to environmental toxicology. The first section introduces toxicology and ecotoxicology. The second section presents the effects of different types of toxicants. The third section discusses the effects of toxicants in air, soil, and water, and the final section addresses environmental health, detection of pollutants, and risk assessment.

Connell, D. W. (1997)
Basic Concepts of Environmental Chemistry
Lewis, Boca Raton, FL

Describes the behavior and effects of both natural and man-made organic substances in the environment. It explains environmental properties in terms of bonds and molecules, including toxicity and biological effects as the important properties of organic chemicals.

Crosby, D. G. (1998)
Environmental Toxicology and Chemistry
Oxford Univ. Press, New York

Includes discussion of subjects such as environmental chemicals, environmental chemodynamics, environmental transport, abiotic transformation, biotransformations, intoxication, quantitative toxicology, and exposure and risk.

DeSerres, F. J., and Bloom, A. D. (Eds.) (1996)
Ecotoxicity and Human Health: A Biological Approach to Environmental Remediation
Lewis, Boca Raton, FL

Assesses the impact of chemical toxins on human health and also considers other organisms comprising the ecosystem of land, sea, and air. The chapters provide a biological approach to environmental remediation and characterize overall problem areas. Chapters discussing specific approaches to bioremediation are included.

DiGiulio, R. T., and Monosson, E. (Eds.) (1996)
Interconnections between Human and Ecosystem Health
Chapman & Hall, New York

Provides insights into the needs, opportunities, and advantages inherent in activities aimed at preventing the degradation of the environment and the adverse health effects associated with chemical exposure. The book contains 17 chapters and presents a balanced, interdisciplinary approach to the topics.

Duursma, E. K., and Carroll-Butts, J. (1996)
Environmental Compartments
Springer, New York

Examines the transfer process from one environmental compartment (air, water, sediment, and biota) to another. This transfer is regulated by the chemical properties of both the substances and the compartments. The factors driving this to equilibrium are discussed.

Environmental Science Research (1972–)
Plenum, New York

A monographic series with titles such as *Evaluating Climate Change, Chemistry for the Protection of the Environment,* and *Biomonitors and Biomarkers.*

Fava, J., Consoli, F., Denison, R., Dickson, K., Mohin, T., and Vigon, B. (Eds.) (1993)
A Conceptual Framework for Life-Cycle Impact Assessment
SETAC, Pensacola, FL

Analyzes holistically the cradle-to-grave environmental impact of products, packages, processes, and activities from raw material acquisition to final disposition. This text examines the impact assessment component of the inventory model for life-cycle analysis. The three-phase approach covers classification, characterization, and valuation to allow a credible model.

Fawell, J. K., and Hunt, S. (1988)
Environmental Toxicology: Organic Pollutants
Horwood, Chichester, UK

Contains critical reviews of the toxicology of individual and classes of compounds that have been identified in drinking water. The reviews were prepared between 1983 and 1987. A greater emphasis was placed on chronic toxicity and carcinogenicity data than on acute data, depending on the amount of data available.

Forbes, V. (Ed.) (1998)
Genetics and Ecotoxicology
Taylor & Francis, Philadelphia

The first volume in the series *Current Topics in Ecotoxicology and Environmental Chemistry*. Compiles and synthesizes current knowledge of the relationship between genetics and ecotoxicology. The book gives examples of the extent to which biological variability has a genetic basis. Exposure to chemicals may influence the genetics of natural populations.

Francis, B. M. (1994)
Toxic Substances in the Environment
Wiley, New York

Discusses several disciplines that cover the study of toxic substances in the environment. It focuses on environmental chemistry—the presence and fate of chemicals in the environment and their transport between air, water, and soil; environmental toxicology—the ef-

fects of chemicals in the environment on organisms; and ecology—interactions between organisms.

Hoffman, D. J., Rattner, B. A., Burton, G. A., and Cairns, J. (1995)
Handbook of Ecotoxicology
Lewis, Boca Raton, FL

Integrates concepts and data from aquatic and terrestrial toxicology. Main sections include quantifying and measuring ecosystem effects, contaminant sources and effects, case histories and ecosystem surveys, and methods for making estimates and predictability in ecotoxicology.

Howard, P. H. (Ed.) (1989–1997)
Handbook of Environmental Fate and Exposure Data for Organic Chemicals
Lewis, Boca Raton, FL

Volume I: Large Production and Priority Pollutants, Volume II: Solvents, Volume III: Pesticides, Volume IV: Solvents 2, Volume V: Solvents. Outlines in detail how individual chemicals are released, transported, and degraded in the environment and how they are exposed to humans and environmental organisms. The series reviews and evaluates the information on physical and chemical properties, commercial uses, and possible sources of environmental contamination.

Hughes, W. W. (1996)
Essentials of Environmental Toxicology: Environmentally Hazardous Substances and Human Health
Taylor & Francis, London

Introductory textbook addresses the principles and mechanisms of toxicology as applied to environmentally encountered toxic agents. This book is intended to provide the novice with the characteristics and effects of exposure to toxicants of current public health importance and their pathologic effect on representative tissues and organs. Topics include dose response, hazards and risk assessment, determination of toxicity, pesticides, plastics, organic solvents, environmental carcinogens, teratogens, and mutagens.

Jorgensen, S. E. (Ed.) (1990)
Modelling in Ecotoxicology
Elsevier, New York

Presents the state of the art of modeling the fate and effects of toxic substances in the environment. It includes a comprehensive review of available parameter estimation methods. Model examples and case studies are provided.

Jorgensen, S. E., *et al.* (1998)
Handbook of Estimation Methods in Ecotoxicology and Environmental Chemistry
Lewis, Boca Raton, FL

Presents estimation methods for determining many physicochemical, biological, and toxicological parameters for chemicals. This handbook presents information on more than 100,000 chemicals that are produced in amounts potentially threatening to the environment. Includes WinTox software.

Kaiser, K. L. E., and Devillers, J. (1994)
Ecotoxicity of Chemicals to Photobacterium Phosphoreum
Gordon & Breach, Buffalo, NY

Presents toxicity results for more the 1000 chemicals derived from the Microtox test. Cross-indexed presentation makes this a useful handbook.

Keith, L. (Ed.) (1996)
Principles of Environmental Sampling, 2nd ed.
American Chemical Society, Washington, DC

Considers the many variables and special techniques that are needed to plan and execute sampling analyses. The 40 chapters include planning and sample design, quality assurance, sampling the water, air, biota, and solids, and hazardous wastes.

Koren, H. (1996)
Illustrated Dictionary of Environmental Health and Occupational Safety
CRC Press, Boca Raton, FL

Presents an alphabetical listing of more than 7000 entries covering subjects including environmental health and occupational safety, epidemiology, toxicology, risk assessment, statistics, instrumentation, medical terminology, and basic sciences.

Landis, W. G., and Yu, M. H. (1995)
Introduction to Environmental Toxicology: Impacts of Chemicals upon Ecological Systems
Lewis, Boca Raton, FL

Focuses on the impacts of chemicals on ecological systems ranging from the events at the molecular level to the dynamics of ecosystems. Emphasis is placed on the use of toxicity tests and field studies in the context of ecological risk. Included are discussions of biodegradation, structure–activity relationships, atmospheric pollutants and their effects, and the difficulties of assessing impacts within ecosystems and the potential use of biomarkers.

Landis, W. G., and Yu, M. (1998)
Introduction to Environmental Toxicology, 2nd ed.
Lewis, Boca Raton, FL

A major text in environmental toxicology. This new edition contains new chapters on metal toxicity, multi-

species toxicity tests, estrogen-like environmental toxins, and endocrine disrupters.

Landis, W. G., Hughes, J. S., and Lewis, M. A. (Eds.) (1993)
Environmental Toxicology and Risk Assessment
ASTM, Philadelphia

Contains the proceedings of the First Symposium on Environmental Toxicology and Risk Assessment held in 1991. The chapters discuss ecological risk assessment under TSCA, evaluation of ecological impact at the population and community level, biomarkers, marine toxicity and test methods, and methods development.

Lippmann, M. (Ed.) (1992)
Environmental Toxicants: Human Exposures and Their Health Effects
Van Nostrand–Reinhold, New York

Identifies and critically reviews current knowledge on human exposure to selected chemical agents and physical factors. There are 19 reviews which include the extent of human exposure and toxic responses. The final chapters discuss the uses of the data for risk assessment, clinical applications, and industrial operations.

Mackay, D., Shiu, W. Y., and Ma, K.-C. (Eds.) (1992–1997)
Illustrated Handbook of Physical–Chemical Properties and Environmental Fate for Organic Chemicals, 5 vols.
CRC Press, Boca Raton, FL

Series presents environmental fate calculations and QSAR plots. Environmental partitioning and persistence are calculated in a generic form using standard fugacity models. This shows where a chemical will go, relative concentrations, persistence, and important intermedia transport processes which allow a behavior profile to be accomplished.

Manahan, S. E. (1992)
Environmental Chemistry
Willard Grant, Boston

Designed as a textbook for teaching environmental chemistry. Included in this basic text are the nature and scope of environmental chemistry, specific chemical interactions and reactions in the air and water, monitoring and measuring both aquatic and atmospheric contamination, and specific methodologies for the more routine analyses.

Manahan, S. E. (1992)
Toxicological Chemistry, 2nd ed.
CRC Press, Boca Raton, FL

Easy to understand general discussion of biological processes operating on environmental chemical species. The chapters include the basic chemistry of life processes, environmental chemistry, and microbial processes and their impact on the intact organism.

Meyers, R. A. (Ed.) (1998)
The Wiley Encyclopedia of Environmental Analysis and Remediation
Wiley, New York

Provides an in-depth examination of the environmental analysis and remediation fields in an eight-volume reference source. A two-volume set (based upon this text) titled *The Wiley Encyclopedia of Environmental Pollution and Cleanup* was published in 1999.

Moltmann, J. F., and Rombke (1996)
Applied Ecotoxicology
CRC Press, Boca Raton, FL

Focuses on assessment and monitoring of the amounts of pollutants in the environment and the subsequent damage.

Moriarty, F. (1999)
***Ecotoxicology: The Study of Pollutants in Ecosystems,* 3rd ed.**
Academic Press, San Diego.

Discusses the ecological effects of pollutants, the way in which ecosystems can be affected, and current attempts to predict and monitor such effects. Addresses the interface of ecology and toxicology.

National Research Council (1975)
Principles for Evaluating Chemicals in the Environment
National Academy of Sciences, Washington, DC

Topics on basic issues of safety assessment include testing, risk–benefit analysis, estimation of exposure levels, human health effects, acute through chronic toxicities, along with carcinogenesis, mutagenesis, teratogenesis, and behavioral effects. Chapters also cover nonhuman biological effects, inanimate systems, analysis, and monitoring.

Newman, M. C. (1998)
Fundamentals of Ecotoxicology
Ann Arbor Press, Chelsea, MI

Contents include contaminant accumulation detailed from biomolecular to foodweb level, material on risk assessment, and effects presented at the levels of molecule, cell, tissue, organ, and individual.

Newman, M. C., and Jagoe, C. H. (1996)
Ecotoxicology: A Hierarchical Treatment
Lewis, Boca Raton, FL

Second volume of the Savannah River Symposia on Environmental Sciences. Topics include ecotoxicology as a scientific discipline, metals, molecular markers, organic contaminant exposure in aquatic organisms, cell membrane barrier, quantitative methods in histopathology, population and community dynamics, and effects of environmental stressors on interactions of aquatic animals.

Ney, R. E. (1995)
Fate and Transport of Organic Chemicals in the Environment: A Practical Guide, 2nd ed.
Government Institutes, Rockville, MD

A tool to help in the prediction of the fate and transport of chemicals in air, water, soil, flora, and fauna. The equations and background information needed for prediction are included.

Paasivirta, J. (1991)
Chemical Ecotoxicology
Lewis, Chelsea, MI

Concerned with the adverse effects of the activities of mankind on the environment. Topics include cycles of chemicals in the environment, structure and toxicity, analysis for chemicals, interpretation of environmental analysis results, mercury in the environment, organohalogens, and emissions from the forest and oil industries.

Patnaik, P. (1997)
Handbook of Environmental Analysis: Chemical Pollutants in Air, Water, Soil, and Solid Wastes
CRC Press, Boca Raton, FL

Areas addressed include ambient air, groundwater, surface water, industrial wastewater, and soils and sediments.

Philip, R. B. (1995)
Environmental Hazards and Human Health
Lewis, Boca Raton, FL

Designed to bridge the fields of environmental science and toxicology by acquainting the student with the major environmental hazards, both man-made and natural, and with the risks to human health that they pose. Included at the end are 24 interesting case study reviews that illustrate the principles and practices discussed in the early chapters of this book.

Richardson, M. L. (Ed.) (1988)
Risk Assessment of Chemicals in the Environment
Royal Society of Chemistry, London

Reviews the current status of risk assessment procedures as they relate to the environment. It does not deal with the risks of specific chemicals but rather with the multidisciplinary approach required to assess hazard, risk, safety, and environmental impact.

Richardson, M. (Ed.) (1995)
Environmental Toxicology Assessment
Taylor & Francis, London

Collection of papers from international experts covering the field of environmental toxicology. The role of pesticide application in developing countries appears to be the most common theme because it is stressed in several chapters. Also included is information on many new techniques being applied to ecotoxicology.

Richardson, M. (1996)
Environmental Xenobiotics
Taylor & Francis, Washington, DC

Examines ways to understand the significance of emissions to the environment and how to reduce them. It also helps in understanding the effects of man-made substances on the environment.

Rose, J. (Ed.) (1998)
Environmental Toxicology: Current Developments
Gordon & Breach, Berkshire, UK

Collection of essays highlighting current developments in the field of environmental toxicology. Topics covered include carcinogens and mutagens, toxicity of volcanic gasses, chlorinated fatty acids, arsenic, urban air pollution, and natural plant toxins.

Sabatini, D. A., Knox, R. C., and Harwell, J. H. (Eds.) (1995)
Surfactant-Enhanced Subsurface Remediation—Emerging Technologies
American Chemical Society, Washington, DC

Review of the current understanding of surfactant-based remediation technologies. The chapters range from fundamental discussions of physicochemical and biological processes affecting these technologies to implementation and optimization issues affecting their widespread use. Future emerging issues in this area are covered in the closing section.

Schnoor, J. L. (1996)
Fate and Transport of Pollutants in Water, Air, and Soil
Wiley, New York

Provides an accessible introduction to the underlying science and physical processes that determine how chemicals react with their environment and shows how to develop models that can help predict their effects. The book offers a broad and timely perspective to environmental modeling, covering groundwater, atmosphere, soil, and global change.

Schuurmann, G., and Markert, B. A. (Eds.) (1997)
Ecotoxicology: Ecological Fundamentals, Chemical Exposure, and Biological Effects
Wiley, New York

Provides a comprehensive single-source coverage of the field from the ecological basis to the effects of chemicals on the environment to the latest test strategies. Areas covered include ecosystem sensitivity, principles for analysis, fate and distribution of chemicals, bioaccumulation, ecotoxicological test systems, and concepts for ecological risk assessment.

Shaw, I. C., and Chadwick, J. (1998)
Principles of Environmental Toxicology
Taylor & Francis, Philadelphia

Provides a general introduction to all major areas of environmental toxicology, including the fate of chemicals in the environment, toxicity testing, risk assessment, radioactivity in the environment, legislation, modeling, and the future impact of industrial development.

Shineldecker, C. L. (1992)
Handbook of Environmental Contaminants: A Guide for Site Assessment
Lewis, Boca Raton, FL

Reference book for anyone involved in environmental liability issues. The information presented includes ways to identify such situations, standards for the performance of site assessments, and specific cases.

Shukla, S. K., and Srivastava, P. R. (1992)
Characterization of Health Hazards in Man's Environment
Commonwealth, New Delhi

Examines the balance of outside stresses including chemical exposures to health. A total of 15 chapters develop this theme with stressor influences, including noise, solid waste, heat, and air pollution.

Sittig, M. (1994)
World-Wide Limits for Toxic and Hazardous Chemicals in Air, Water, and Soil
Noyes, Park Ridge, NJ

Summarizes allowable limits for over 1100 chemicals in workplace air, ambient air, water of various types, and soils. It includes data from states and 25 foreign countries and organizations.

Smith, R. P. (1997)
A Primer of Environmental Toxicology
Lea & Febiger, Philadelphia

A basic text which evolved from lectures given at Dartmouth Medical School and Vermont Law School. Chapters include acute toxicity and limitations of the ED_{50} and LD_{50}; subchronic and chronic toxicity testing; absorption, distribution, and excretion of chemicals; biotransformation; pesticides and setting food tolerances; and chapters on specific compounds including DDT, heavy metals, sulfur pollutants, nitrogen pollutants, and detergents.

Society of Environmental Toxicology and Chemistry (SETAC)
SETAC publications
SETAC, Pensacola, FL

SETAC publishes a wide variety of books, many based on their workshops, in environmental toxicology including ecotoxicology, risk assessment, and life-cycle assessment.

Somani, S. M., and Cavender, F. L. (Eds.) (1981)
Environmental Toxicology: Principles and Policies
Thomas, Springfield, IL

Topics include metabolism and disposition, target organ toxicity, heavy metal toxicity, pulmonary responses, mutagens/carcinogens, regulatory programs, air pollution, and epidemiological evaluation. The use of normal marine animals such as bivalves as exposure and effect monitors for persistent pollutants in aquatic environments is suggested.

Streit, B. (Ed.) (1998)
Encyclopedic Dictionary of Ecotoxicology and Environmental Chemistry, 2nd ed.
Taylor & Francis, Washington, DC

Supplies information on ecotoxicological data collections for chemical elements as well as environmentally significant compounds. The book also addresses the basics and concepts of theoretical and applied ecotoxicology, important terms, product groupings, techniques, and available data banks.

Theodore, L., Reynolds, J., and Morris, K. (1997)
Concise Dictionary of Environmental Terms
Gordon & Breach, Berkshire, UK

Supplies one-sentence definitions for approximately 6000 words or terms in nontechnical jargon. The words and terms derive from air, water, solid waste, meteorology, regulations, toxicology, engineering, and health, safety, and accident management areas.

van Agteren, M. H., Keuning, S., and Janssen, D. B. (1998)
Handbook on Biodegradation and Biological Treatment of Hazardous Organic Compounds
Kluwer, Dordrecht

Presents an overview of the biodegradation processes and pathways that yield detoxification and mineralization.

Walker, C. H., Hopkin, S. P., Sibly, R. M., and Peakall, D. B. (1997)
Principles of Ecotoxicology
Taylor & Francis, London

A basic text presented in three parts. Part I includes chapters on pollutants and their fate in ecosystems. Part II includes chapters on effects of pollutants on individual organisms. Part III contains chapters on effects of pollutants on populations and communities.

Watters, D., Lavin, M., Maguire, D., and Pearn, J. (1992)
Toxins and Targets
Harwood, Philadelphia

Develops the field of ecotoxicology and is written from the viewpoint of establishing and preserving a safe environment. The major sections presented include aquatic ecosystems, damage to animal cells, and pollution, people, and prevention. This book is aimed at both the lay population and the scientist.

Zakrzewski, S. F. (1997)
Principles of Environmental Toxicology, 2nd ed.
American Chemical Society, Washington, DC

Intended for use as a teaching aide for graduate students who wish to learn how chemicals interact with living organisms and how deterioration of the environment affects our lives. The beginning chapters provide a background for toxicologic principles. One chapter is devoted to chemical carcinogenesis. The remainder of the text deals with specific examples.

See Also:
Brooks: *Environmental Medicine* (Occupational Health).

Chen: *Quantitative Structure–Activity Relationships in Environmental Sciences* (Testing Methods and Toxicity Assessment)

Craighead: *Pathology of Environmental and Occupational Disease* (Pathology)

Crurus: *Environmental Sampling and Analysis: Laboratory Manual* (Analytical Toxicology)

Greenberg: *Occupational, Industrial, and Environmental Toxicology* (Occupational)

Howard: *Handbook of Physical Properties of Organic Chemicals* (Chemical Compendia)

Kopfler: *Environmental Epidemiology* (Epidemiology)

McCunney: *A Practical Approach to Occupational and Environmental Medicine*, 2nd ed. (Occupational Health)

Prager: *Environmental Contaminant Reference Databook* (Environmental Toxicology—General)

Steenland: *Topics in Environmental Epidemiology* (Epidemiology)

Sullivan: *Clinical Environmental Health and Toxic Exposures* (Clinical Toxicology)

Talbott: *Introduction to Environmental Epidemiology* (Epidemiology)

Verschueren: *Handbook of Environmental Data on Organic Chemicals* (Chemical Compendia)

Williams: *The Principles of Toxicology, Environmental and Industrial Applications,* 2nd ed. (Occupational Health)

World Health Organization: *Environmental Health Criteria* (Chemical Compendia)

Journals

Ambio

Archives of Environmental Contamination and Toxicology

Archives of Environmental Health

Biodegradation

Bulletin of Environmental Contamination and Toxicology

Chemosphere

Ecotoxicology

Ecotoxicology and Environmental Safety

Environmental Engineering Science

Environmental Health Perspectives

Environmental Modelling and Software

Environmental Monitoring and Assessment

Environmental and Nutritional Interactions

Environmental Pollution

Environmental Research

Environmental Toxicology

Environmental Toxicology and Chemistry

Green Chemistry

Journal of Environmental Medicine

Journal of Environmental Monitoring

Journal of Environmental Science and Health

Journal of Exposure Analysis and Environmental Epidemiology

Reviews of Environmental Contamination and Toxicology

Science of the Total Environment

Toxicological and Environmental Chemistry

Water, Air and Soil Pollution

Journal Articles

Anderson, S., *et al.* (1994). Genetic and molecular ecotoxicology: A research framework. ***Environ. Health Perspect.*** **102**(Suppl. 12), 3–8.

Bhattacharya, S. (1996). The genesis, status and future of environmental toxicology. ***Indian J. Exp. Biol.*** **34**(6), 491–495.

Cairns, J., Jr., *et al.* (1996). Toxicity testing with communities: Microcosms, mesocosms, and whole-system manipulations. ***Rev. Environ. Contam. Toxicol.*** **147,** 45–69.

Cole, D. C., Eyles, J., and Gibson, B. L. (1998). Indicators of human health in ecosystems: What do we measure? ***Sci. Total Environ.*** **224,** 201–213.

Guttman, S. I. (1994). Population genetic structure and ecotoxicology. ***Environ. Health Perspect.*** **102**(Suppl. 12), 97–100.

Lopez-Barea, J. (1995). Biomarkers in ecotoxicology: An overview. ***Arch. Toxicol. Suppl.*** **17,** 57–79.

Neumann, C. M. (1998). Improving the U.S. EPA Toxic Release Inventory database for environmental health research. ***J. Toxicol. Environ. Health B. Crit. Rev.*** **1,** 259–270.

Mukerjee, D. (1998). Assessment of risk from multimedia exposures of children to environmental chemicals. ***J. Air Waste Manage. Assoc.*** **48,** 483–501.

ENVIRONMENTAL TOXICOLOGY—AQUATIC

Abel, P. D. (1996)
Water Pollution Biology, 2nd ed.
Taylor & Francis, Washington, DC

Provides a thorough examination of the scale of water pollution problems and, through case studies, explores the types of investigations biologists need to undertake in solving them. Focuses on the interaction between scientific and legislative approaches, including the use of monitoring and toxicological data in formulating pollution control strategies.

Abel, P. D., and Axiak, V. (1990)
Ecotoxicology and the Marine Environment
Horwood, New York

Provides an unusual blend of approaches to the application of toxicological data in the monitoring and control of marine pollution. It describes and discusses the most recent developments in the application of ecotoxicological principles and outlines ways in which toxicological techniques can be applied in practice.

American Society for Testing and Materials (ASTM) (1993)
ASTM Standards on Aquatic Toxicology and Hazard Evaluation
ASTM Press, Philadelphia

Features 67 ASTM test methods, practices, and guides on field sampling (phytoplankton, zooplankton, benthic macroinvertebrates, and fishes), toxicity of water, toxicity testing of sediment, fate-related procedures, special procedures, uses of toxicological data, avian test procedures, and genotoxicity tests.

Baker, L. A. (Ed.) (1994)
Environmental Chemistry of Lakes and Reservoirs
American Chemical Society, Washington, DC

Explores a broad range of research dealing with large bodies of water. The main topics include methodological advances, cycling and distribution of major aquatic elements, behavior of trace metals, and organic contaminants. The book contains both background and research material.

Bitton, G., and Dutka, B. J. (Eds.) (1986)
Toxicity Testing Using Microorganisms, Vols. 1 and 2
CRC Press, Boca Raton, FL

Surveys the literature on microbial and enzymatic tests which are used to screen for chemical toxicity in the research laboratory or in an aquatic system and describes the more commonly used microbial toxicity screening procedures.

Brown, L. J. (1994)
Sustainable Long-Range Rational Management of Groundwaters Resources
Dekker, New York

Discusses in detail the steps needed for remediation. The need to prioritize cleanup activities is recognized and the scientific basis for cleanup is also discussed.

Craun, G. F. (1986)
Waterborne Diseases in the United States
CRC Press, Boca Raton, FL

Includes sections on waterborne diseases, outbreak statistics, investigation of outbreaks, prevention of outbreaks, and future research needs.

Crompton, T. R. (1997)
Toxicants in the Aqueous Ecosystem
Wiley, New York

Provides coverage of all aspects of the occurrence, toxicity, and analysis of toxicants in the aqueous ecosystem. Chapters deal with toxicity measurement, control of pollution regulation, and toxicity data on metals, organometals, and organic compounds.

DeZuane, J. (1990)
Handbook of Drinking Water Quality: Standards and Controls
Van Nostrand–Reinhold, New York

Attempts to evaluate and emphasize water quality control, from the source to the treatment plant and from the distribution system to the consumer. Provides an introduction to major problems and solutions, detailed and specific information on how standards are evaluated and issued, and information on sampling, monitoring, and interpretation of laboratory results.

European Centre for Ectoxicology and Toxicology of Chemicals (ECETOC) (1993)
Technical Report No. 51: Environmental Hazard. Assessment of Substances
ECETOC, Brussels

Describes the development of a process for aquatic environmental hazard assessment. It includes principles and practical approaches.

European Centre for Ectoxicology and Toxicology of Chemicals (ECETOC) (1993)
Technical Report No. 54: Assessment of the Biodegradation of Chemicals in the Marine Environment
ECETOC, Brussels

Outlines a strategy for a tiered approach to assess the hazard of a chemical in the marine environment. It includes the differences between marine, estuarine, and limnic environments, assessment of existing test methods, and proposals for test guidelines.

European Centre for Ectoxicology and Toxicology of Chemicals (ECETOC) (1993)
Technical Report No. 56: Aquatic Toxicity Data Evaluation: The Database
ECETOC, Brussels

A compilation of referenced aquatic toxicity data points for approximately 350 chemicals. It is an interim report of the database. Results of statistical evaluations are planned and then the database will be available on a floppy disk.

Evans, M. S. (Ed.) (1988)
Toxic Contaminants and Ecosystem Health: Great Lakes Focus
Wiley, New York

Based on the proceedings of a meeting of the Task Force on the Health of Aquatic Communities. The book is divided into three parts. Part 1 deals with Great Lakes biota and the effect of toxic substances on their well-being. Part 2 deals with approaches for investigating the effects of toxic substances and specific objectives of the discharge and concentration of various pollutants. Part 3 contains the deliberations of a workshop held after the meeting.

Hamelink, J. L., Landrum, P. F., Bergman, H. L., and Benson, W. H. (Eds.) (1994)
Bioavailability, Physical, Chemical, and Biological Interactions
Lewis, Boca Raton, FL

Discusses the relationship between the measured environmental concentrations of chemical contaminants and the true, biologically available exposure concentrations that have adverse effects on aquatic life in that environment. This is intended to provide a synopsis of the major factors which control the bioavailability of chemicals to different kinds and sizes of organisms in aquatic environments.

Heath, A. G. (1995)
Water Pollution and Fish Physiology, 2nd ed.
Lewis, Boca Raton, FL

Provides a reasonably concise synthesis of what is known about how pollutants affect physiological processes in fish. After an introductory chapter, experimental hypoxia, respiratory and cardiovascular responses, hematology, liver, ionic regulation, uptake and kinetics, energetic, enzyme changes, immune system, and behavioral, reproductive, and physiological effects are discussed in relation to chemical exposure.

Hill, I. R., Heimbach, F., Leeuwangh, P., and Matthiessen, P. (Eds.) (1994)
Freshwater Field Tests for Hazard Assessment of Chemicals
Lewis, Boca Raton, FL

Presents a series of papers critically assessing the theory and practice of freshwater field tests in a way so as to move toward future developments. The book

also contains a set of recommendations for key issues involving the conduct of field tests, interpretation of results, and further research.

Howells, G. (1994)
Water Quality for Freshwater Fish
Gordon & Breach, Buffalo, NY

Provides a source of critically evaluated water-quality data concerning the effects of various toxins on freshwater fish. The report covers all stages of life cycle and relative trophic levels, including aquatic invertebrates and plants with potential for bioaccumulation up the food chain.

Huang, C. P., O'Melia, C. R., and Morgan, J. J. (Eds.) (1995)
Aquatic Chemistry: Interfacial and Interspecies Process
American Chemical Society, Washington, DC

Presents principles of aquatic chemistry in 19 chapters from experienced investigators. Presents recent developments in the field to allow a better understanding of the mechanisms regulating the chemical composition of natural waters. The transformation and transport of species in aquatic systems through interphase and interspecies interactions are discussed. The principles covered herein can be applied to the design of air, soil, water, and wastewater treatment systems.

Hunter, P. R. (1997)
Waterborne Disease, Epidemiology and Ecology
Wiley, New York

Explores waterborne diseases and reflects the increasing environmental awareness and understanding of public health matters. Selected chapter topics include schistosomiasis, shigellosis, dysentery, leptospirosis, and cancer and water.

Johnson, W. W., and Finley, M. T. (Eds.) (1980)
Handbook of Acute Toxicity of Chemicals to Fish and Aquatic Invertebrates. Resource Publication 137
U.S. Department of the Interior, Fish and Wildlife Service, Washington, DC

Results of toxicity tests on fish and aquatic invertebrates conducted at the Columbia National Fisheries Research Laboratory are presented, including 1587 acute toxicity tests on 271 chemicals in approximately 30 species of both fish and invertebrates.

Kennish, M. J. (1997)
Pollution Impacts on Marine Biotic Communities
CRC Press, Boca Raton, FL

Features a basic introduction to pollution-related issues in coastal regions, case histories of highly contaminated systems, specific coverage of marine pollutants (from organic and radioactive wastes to heavy metals and polycyclic aromatic hydrocarbons), and use and management of coastal resources.

Kraybill, H. F., Dawe, C. J., Harshbarger, J. C., and Tardiff, R. G. (Eds.) (1977)
Aquatic Pollutants and Biological Effects with Emphasis on Neoplasia
New York Academy of Sciences, New York

Stresses neoplasms in aquatic animals, including mollusks, eels, salamanders, carp, hagfish, and trout. Other topics include implications for humans of biological effects on marine animals and public health aspects.

Malins, D. C., and Ostrander, G. K. (1993)
Aquatic Toxicology: Molecular, Biochemical, and Cellular Perspectives
CRC Press, Boca Raton, FL

Examines findings from recent research on the chronic effects of pollutants on aquatic species. Evaluates modern techniques in molecular biology and biochemistry.

Montgomery, J. H. (1996)
Groundwater Chemicals: Desk Reference, 2nd ed.
CRC Press, Boca Raton, FL

This collection includes more than 1400 references. The data should be useful to the environmental-regulated community and consultants in conducting risk-based contamination assessments. The main body of the book deals with chemical-specific information.

Murty, A. S. (1986–)
Toxicity of Pesticides to Fish
CRC Press, Boca Raton, FL

A detailed treatment of the environmental fate of pesticides and their acute and chronic toxicological effects on fish.

National Research Council, Committee on Drinking Water Contaminants (1999)
Setting Priorities for Drinking Water Contaminants
National Academy of Sciences, Washington, DC

Recommends a new process for the U.S. Environmental Protection Agency to use in deciding which potential drinking water contaminants should be regulated in public water supplies to provide the greatest protection against waterborne illnesses. Covers chemical and microbiological contaminants.

National Research Council, Committee on Risk Assessment of Exposure to Radon in Drinking Water (1999)
Risk Assessment of Exposure to Radon in Drinking Water
National Academy of Sciences, Washington, DC

Presents a synthesis of information about the total inhalation and ingestion risks of radon in public drinking water, including reviews of data on the transfer of radon from water to air and on ambient levels of radon in the U.S. outdoors.

National Research Council, Committee on Safe Drinking Water (1977–)
Drinking Water and Health
National Academy of Sciences, Washington, DC

An informative series covering various aspects of drinking water and health, beginning in 1977 through the most recent volume in 1989. Titles volumes include Vol. 7, *Disinfectants and Disinfectant Eye Products;* Vol. 8, *Pharmacokinetics in Risk Assessment;* and Vol. 9, *Selected Issues in Risk Assessment*.

Neilson, A. H. (1994)
Organic Chemicals in the Aquatic Environment: Distribution, Persistence, and Toxicity
CRC Press, Boca Raton, FL

Discusses basic issues of chemical analysis, distribution, persistence, and ecotoxicology, with an emphasis on microbial reactions.

Newman, M. C. (1994)
Quantitative Methods in Aquatic Ecotoxicology
CRC Press, Boca Raton, FL

A quantitative treatment of the science of ecotoxicology. It focuses on aquatic systems; however, the methods can be applied to terrestrial systems. Chapters discuss fundamental concepts and definitions as well as the fate and effects of toxicants at various levels of ecological organizations.

Nriagu, J. O. (1983)
Aquatic Toxicology
Wiley, New York

Volume 13 in the series *Advances in Environmental Science and Technology*. This volume deals with the toxicity of many inorganic and organic contaminants to the aquatic biota. It assesses the response at community, species, tissue, cellular, and subcellular levels to particular toxicants and covers the mechanisms of uptake, metabolism, and excretion of many pollutants. Methodology used in aquatic toxicology is also discussed.

Olin, S. S. (Ed.) (1999)
Exposure to Contaminants in Drinking Water. Estimating Uptake through the Skin and by Inhalation
CRC Press, Boca Raton, FL

Presents the current state of the science for assessing dermal and inhalation exposures from various uses of residential water. Includes the identification and review of available information resources, models, and approaches, along with several exposure assessment case studies.

Ostrander, G. (1996)
Techniques in Aquatic Toxicology
CRC Press, Boca Raton, FL

Designed to assist research scientists and technicians in testing for everything from DNA damage to bioaccumulation of common toxins to assays of fish embryos and tissues. Includes a blend of established and recently developed techniques. Sections cover assessment of toxicity in whole organisms, toxicity at the cellular and subcellular level, and contaminant identification.

Ramamoorthy, S., and Baddaloo, S. R. (1995)
Handbook of Chemical Toxicity Profiles of Biological Species, Volume 1—Aquatic Species
CRC Press, Boca Raton, FL

Offers toxicity profiles on aquatic species. Data are arranged in decreasing order of toxicity for aquatic species such as amphibians, algae, bacteria, crustaceans, fish, insects, mollusks, and protozoa.

Rand, G. M. (Ed.) (1995)
Fundamentals of Aquatic Toxicology: Effects, Environmental Fate and Risk Assessment, 2nd ed.
Taylor & Francis, Washington, DC

A comprehensive source of information in aquatic toxicology for graduate students and practitioners. Addresses current testing procedures, data evaluation and interpretation, fate, environmental legislation, and risk assessment.

Ross, P., Lanze, G. R., Rathbun, J. E., and Scott, G. I. (1998)
Water Quality and Toxicity Testing: Appropriate Technology for Transfer to Developing Countries
Taylor & Francis, Washington, DC

Evolving from a short course, this resource explores issues, problems, and solutions involved in the transfer of contaminant detection and effect technologies in developing countries. It provides general principles of environmental research and monitoring in developing countries as well as concrete examples of appropriate testing techniques.

Suter, G. W., III (Ed.) (1993)
Ecological Risk Assessment
Lewis, Chelsea, MI

Examines the risks of chemicals and mixtures to aquatic systems. It emphasizes risk assessments that predict the effects of new chemicals and effluents rela-

tive to those that describe the extent, magnitude, and causation of effects that began in the past.

Taylor, E. W. (1996)
Toxicology of Aquatic Pollution: Physiological, Cellular and Molecular Approaches
Cambridge Univ. Press, New York

Discusses the mechanisms of toxicity of aluminium, other metals, and aromatic hydrocarbons at low to sublethal levels. New approaches to pollution monitoring are considered, including large-scale models for the exchange of xenobiotics between fish and their environment and the alternative use of sensitive cellular and molecular markers of pollution.

U.S. EPA Office of Water

The EPA publishes numerous documents related to water, including *Drinking Water Criteria, Drinking Water Health Advisories, Ambient Water Quality Criteria,* and *Water Quality Standards.* These are generally available from the National Technical Information Service (NTIS), 5285 Port Royal Road, Springfield, VA 22161. The publications catalog of EPA's Office of Water is on the Web at *http://www.epa.gov/OST/pctoc.html.* A browsable version of EPA's *Drinking Water Regulations* and *Health Advisories* is also available at *http://www.epa.gov/ostwater/Tools/dwstds0.html.*

U.S. EPA Office of Water (1993)
Health Advisories for Drinking Water Contaminants
Lewis, Boca Raton, FL

EPA health advisories are published for contaminants that have the potential to cause adverse human health effects and are known to occur in drinking water. Each advisory contains information on the nature of the adverse health effects and the concentrations that would be anticipated to cause these effects. Also summarized are the occurrence, environmental fate, available analytical methods, and treatment techniques for each of the contaminants.

Wang, R. G. M. (Ed.) (1994)
Water Contamination and Health
Dekker, New York

Addresses the various concerns and the pros and cons of including all routes of exposure to water contaminants for health risk assessment. The first section covers both the U.S. EPA and the state of California efforts in monitoring and treatment of water contaminants. The second section emphasizes exposure assessment and dose. The third section discusses methodology and techniques for dose estimation, and the last section deals with risk assessment techniques applicable to water contaminants.

Weber, L. J. (Ed.) (1982)
Aquatic Toxicology, Vols. 1 and 2
Raven Press, New York

Presents a concise description of some of the core biology needed to begin to use fish as models for toxicity testing. Proceeding from general to specific, emphasis on routes of administration, and exposure to toxins of concern in the environment are the main themes. Major physiological systems (cardiovascular, hepatic, respiratory, and nervous) are described as well as procedures to monitor well-being following exposure to various agents. A particularly useful chapter describes the potential for identification of carcinogens in fish.

Wells, P. G., *et al.* (1997)
Microscale Testing in Aquatic Toxicology: Advances, Techniques, and Practice
CRC Press, Boca Raton, FL

Contains over 40 chapters on bioassay techniques and applications useful for aquatic hazard assessment and environmental quality monitoring and testing.

Wood, E. M. (1987)
The Toxicity of 3400 Chemicals to Fish
EPA/OTC, Washington, DC

Presents results of an investigation undertaken to locate chemicals which would cause acute toxicity to fish at extremely low concentrations. These findings are intended to allow prioritization of testing/research needs in the area.

See Also:

Bergman: *Reassessment of Metals Criteria for Aquatic Life Protection* (Chemicals—Metals)

Coe: *Marine Debris* (Environmental Toxicology—Hazardous Waste)

Evans: *The Physiology of Fishes* (Animals in Research)

Grothe: *Whole Effluent Toxicity Testing* (Testing Methods and Toxicity Assessment)

Hockachka: *Analytical Techniques: Biochemistry and Molecular Biology of Fishes* (Analytical Toxicology)

International Agency for Research on Cancer: Chlorinated Drinking Water (Food and Nutrition)

Louglin: *Marine Mammals and the Exxon Valdez* (Environmental Toxicology—Wildlife)

Meyer: *Herbicide Metabolites in Surface Water and Groundwater* (Chemicals—Pesticides)

Rolland: *Chemically Induced Alterations in Functional Development and Reproduction of Fishes* (Developmental and Reproductive Toxicology)

Journals

Aquatic Toxicology

Environmental Toxicology and Water Quality

Water, Air, and Soil Pollution

Water Environment Research

Journal Articles

Cantor, K. P. (1997). Drinking water and cancer. ***Cancer Causes Control*** **8**(3), 292–308.

Cohn, P. D., *et al.* (1994, October). Assessing human health effects from chemical contaminants in drinking water. ***New Jersey Med.*** **91**(10), 719–722.

Hall, L. W., Jr., and Anderson, R. D. (1995). The influence of salinity on the toxicity of various classes of chemicals to aquatic biota. ***Crit. Rev. Toxicol.*** **25,** 281–346.

Hao, O. J., *et al.* (1996). Sulfate-reducing bacteria. ***Crit. Rev. Environ. Sci. Technol.*** **26,** 155–188.

Jackson, D. A., and Harvey, H. H. (1995). Gradual reduction and extinction of fish populations in acid lakes. ***Water Air Soil Pollut.*** **85,** 389–394.

Kurelec, B. (1992). The multixenobiotic resistance mechanism in aquatic organisms. ***Crit. Rev. Toxicol.*** **22,** 23–44.

Malins, D. C., and Ostrander, G. K. (1991). Perspectives in aquatic toxicology. ***Annu. Rev. Pharmacol. Toxicol.*** **31,** 371–399.

Morris, R. D. (1995). Drinking water and cancer. ***Environ. Health Perspect.*** **103**(Suppl. 8), 225–231.

Oke, N. J., *et al.* (1997). **Review of the literature on the removal of organic chemicals from drinking water,** NTIS/MIC-96-07232.

Ouyang, Y., *et al.* (1996). Colloid-enhanced transport of chemicals in subsurface environments: A review. ***Crit. Rev. Environ. Sci. Technol.*** **26,** 189–204.

Raucher, P. S. (1996). Public health and regulatory considerations of the Safe Drinking Water Act. ***Annu. Rev. Public Health*** **17,** 179–202.

Rossbach, M., and Kniewald, G. (1997). Concepts of marine specimen banking. ***Chemosphere*** **34**(9/10), 1997–2010.

Sanders, B. M. (1993). Stress proteins in aquatic organisms: An environmental perspective. ***Crit. Rev. Toxicol.*** **23,** 49–76.

Segner, H. (1998). Fish cell lines as a tool in aquatic toxicology. ***EXS*** **86,** 1–38.

Streit, B. (1998). Bioaccumulation of contaminants in fish. ***EXS*** **86,** 353–387.

Sumpter, J. P. (1998). Xenoendocrine disrupters—environmental impacts. ***Toxicol. Lett.*** 102–103, 337–342.

Vaal, M. A., and Hoekstra, J. A. (1994). **Modeling the sensitivity of aquatic organisms to toxicants using simple biological and physico-chemical factors,** NTIS/PB96-167705.

van Wezel, A. P., and Operhuizen, A. (1995). Narcosis due to environmental pollutants in aquatic organisms: Residue-based toxicity, mechanisms, and membrane burdens. ***Crit. Rev. Toxicol.*** **25,** 255–280.

Wigle, D. T. (1998). Safe drinking water: A public health challenge. ***Chronic Diseases Can.*** **19,** 103–107.

ENVIRONMENTAL TOXICOLOGY—ATMOSPHERIC

Bardana, E. J. (Ed.) (1997)
Indoor Air Pollution and Health
Marcel Dekker, New York

Integrates health and building science and presents a variety of viewpoints from diverse disciplines, including allergy, toxicology, oncology, environmental science, building engineering, and law.

Burge, H. (1995)
Bioaerosols
Lewis, Boca Raton, FL

A synthesis of the information available on air pollution research and a valuable resource. Brings together important aspects of the relationship between man and biological contaminants of indoor air. The 13 chapters provide essential information on the effects of air quality on the many organisms coexisting in our indoor and outdoor atmospheres.

Calabrese, E. J., and Kenyon, E. M. (1991)
Air Toxics and Risk Assessment
Lewis, Boca Raton, FL

Presents an easy to follow decision tree method for all major end points of public health concern in the derivation of acceptable levels of ambient air contaminants for use in air toxics programs. Over 100 specific agents covering a wide variety of chemical classes and a spectrum of toxicological issues are covered.

Cox, C. S., and Wather, C. M. (1995)
Bioaerosols Handbook
Lewis, Boca Raton, FL

Provides up-to-date detailed descriptions, comparisons, and calibration methods for bioaerosol samplers with appropriate sampling methodologies and analytical procedures. Physical and biological properties are considered from both practical and theoretical viewpoints. The main parts deal with principles of sampling, calibration techniques, analysis, and examples of experience of current practitioners.

Eisenberg, M. (1998)
Risk Assessment and Indoor Air Quality
Lewis, Boca Raton, FL

Examines the problem of long-term exposure to low-level concentrations of toxins. In addition to commonly found toxins such as chemical fumes from furnishings and carpeting, and indoor use of pesticides, this book discusses risks associated with exposure to indoor allergens and infectious disease pathogens such as Legionnaires' disease.

Environmental Protection Agency (EPA), Health Effects Research Laboratory (1993)
Hazardous Air Pollutants: Profiles of Noncancer Toxicity from Inhalation Exposures, EPA 600/R-93/142
EPA, Washington, DC

Compiles and presents selected information on the noncancer end points of hazardous air pollutants. These profiles provide insights on the types of effects seen in humans and animals from exposure to these agents and suggest end points of most concern. The data presented here deal only with noncancer end points and with effects following inhalation of the specific agents.

European Centre for Ectoxicology and Toxicology of Chemicals (ECETOC) (1994)
Technical Report No. 62: Ammonia Emissions to Air in Western Europe
ECETOC, Brussels

Provides a detailed estimate of ammonia emissions in western Europe. Discusses the fertilizer industry and agricultural and anthropogenic sources. Calculations for 17 countries are included.

Gammage, R. B., and Berven, B. A. (Eds.) (1996)
Indoor Air and Human Health, 2nd ed.
Lewis, Boca Raton, FL

Covers such areas as chemical sensitivity, behavioral effects, upper airway irritants, allergic reactions and infections, bioaerosols, human and animal models, and risk assessment.

Gammage, R. B., and Kaye, S. V. (Eds.) (1985)
Indoor Air and Human Health
Lewis, Chelsea, MI

Focuses on indoor air health hazards such as radon, microorganisms, passive cigarette smoke, combustion products, and organics. This book contains much important exposure assessment information.

Godish, T. (1995)
Sick Buildings: Definition, Diagnosis and Mitigation
Lewis, Boca Raton, FL

Topics include definition of the issues, people-related risk factors, environmental conditions, office materials and furnishings, gas and vapor phase contaminants, and biological contaminants. Measurements of indoor air quality, diagnosis of problem buildings, and correction of the problems are discussed in the concluding chapters.

Godish, T. (1998)
Air Quality, 3rd ed.
Lewis, Boca Raton, FL

Covers the atmosphere, atmospheric pollutants, dispersion, atmospheric effects, health and welfare effects, air quality and emissions assessment, regulations and public policy, motor vehicle emissions control, stationary source control, indoor air pollution, noise pollution, and quantitative aspects.

Gratt, L. B. (1996)
Air: Toxic Risk Assessment and Management
Van Nostrand–Reinhold, New York

Brings together the diverse facets involved in performance of an air toxic risk assessment based on the calculation of a risk measure. Book includes many examples and exercise sets.

Hinds, W. C. (1999)
Aerosol Technology: Properties, Behavior, and Measurement in Airborne Particles
John Wiley, New York

Explores the science behind airborne particles.

Holgate, S. T., Koren, H. S., Samet, J. M., and Maynard, R. L. (Eds.) (1999)
Air Pollution and Health
Academic Press, San Diego

Ranges in scope from meteorology, atmospheric chemistry, and particle physics to the causes and scope of allergic reactions and respiratory, cardiovascular, and related disorders.

Lioy, P. J., and Daisey, J. M. (Eds.) (1986)
Toxic Air Pollution
Lewis, Chelsea, MI

Deals with the characteristics and dynamics of noncriteria pollutants and stems from work on the Airborne Toxic Element and Organic Substances project. The book balances the practical and theoretical aspects of air pollution and presents a reasonable hypothesis for testing.

Lipfert, F. W. (1994)
Air Pollution and Community Health: A Critical Review and Data Sourcebook
Van Nostrand–Reinhold, New York

Series of papers covering methodologies, statistics, and other aspects of air pollution and community health. Also considers mortality and selected morbidity studies on the effects of air pollution. Most of the presentations derive from human experience. The book concludes with a synthesis of the information and a series of conclusions.

Maroni, M., Seifert, B., and Lindvall, T. (1995)
Indoor Air Quality: A Comprehensive Reference Book
Elsevier, New York

Presents fundamentals and advanced reference material on indoor air quality. Part I describes the physicochemical nature, occurrence and sources, typical concentrations, and resulting human exposure to the main pollutants of indoor air. The following parts deal with human health effects, risk assessment, and investigation, diagnosis, and management of illnesses and complaints related to buildings.

Michaelis, W. (1997)
Air Pollution: Dimensions, Trends and Interactions with a Forest Ecosystem
Springer-Verlag, Berlin

Presents the final evaluation of a multidisciplinary study on air pollution on a Norway spruce stand in north Germany and on the interactions of atmospheric constituents with the forest ecosystem.

Ness, S. (1996)
Air Monitoring for Toxic Exposures: An Integrated Approach
Van Nostrand–Reinhold, New York

Aimed at professionals working to control occupational and environmental exposures. Covers the procedures for evaluating potentially harmful exposures to people from hazardous materials. The book discusses in detail sampling methods and evaluation of dermal exposures and gives commonsense information regarding the advantages/disadvantages of specific methodologies.

Nriagu, J. O., and Simmons, M. S. (Eds.) (1994)
Environmental Oxidants
Wiley, New York

Covers the biologic importance of environmental oxidants such as ozone and the oxides of nitrogen, sulfur, and carbon. Provides a broad overview of the environmental chemistry and toxicology of oxidants and their role in pollution control.

Patrick, D. R. (1994)
Toxic Air Pollution Handbook
Van Nostrand–Reinhold, New York

Covers control measures for the 189 listed toxic air pollutants. The book discusses methods for assessing human exposures, technologies to control exposures, sampling methods, and regulatory aspects. Air dispersion and deposition models are presented.

Penney, D. G. (1996)
Carbon Monoxide
CRC Press, Boca Raton, FL

Addresses current issues involving carbon monoxide measurement, physiology, toxicology, behavior, and treatment. Topics discussed include outside and domestic CO levels from a regulatory and health perspective, effects of CO on both developing and adult animals, the neural and behavioral consequences of exposure, and the management of CO poisoning.

Pope, A. M., Patterson, R., and Burge, H. (Eds.) (1993)
Indoor Allergens: Assessing and Controlling Adverse Health Effects
National Academy Press, Washington, DC

Deals with the growing concern regarding the indoor environment and its relationship to human health. The need for interdisciplinary approaches to proper controls is stressed. The topics covered include defining the scale of the problem, agents involved, mechanisms of biologic reactivity, testing methods for diagnosis, assessing exposure and risk, engineering control strategies, and the role of education.

Seinfeld, J. H., and Pandis, S. N. (1997)
Atmospheric Chemistry and Physics from Air Pollution to Climate Change
Wiley, New York

Presents the dynamics of atmospheric chemistry in a manner easily applicable to air pollution and other atmospheric conditions. The text carefully examines the cyclic nature of these events and searches for man-made interference and modes of rectification.

Spengler, J. (Ed.) (1982)
Indoor Air Pollution
Pergamon, New York

Covers sources, concentrations, and exposures to radon, organics, formaldehyde, nitrogen dioxide, carbon monoxide, and aerosols; health and comfort aspects of indoor pollutants; and climates and engineering aspects. Although an older text, it is insightful in its approach to what at that time was a new area for toxicologists.

Tucker, W. G., Leaderer, B. P., Molhave, L., and Cain, W. S. (1992)
Sources of Indoor Air Contaminants: Characterizing Emissions and Health Impacts
New York Academy of Sciences, New York

Covers interdisciplinary research on biological response-based testing of emissions. It also considers emissions characterization techniques and exposure modeling; irritation of the eyes, nose, and airways; neuropsychological and behavioral reactions to inhaled agents; and possible influences of inhaled agents on the functioning of the immune system.

U.S. EPA Office of Air and Radiation

This EPA office publishes numerous documents related to air pollution and air quality. Its Web address is *http://www.epa.gov/oar/oarpubs.html.*

Walsh, P. J., Didney, C. S., and Copenhaver, E. D. (Eds.) (1984)
Indoor Air Quality
CRC Press, Boca Raton, FL

Covers health risk assessment of residential wood combustion, indoor air quality in typical residences, indoor air quality in energy-efficient residences, building-associated epidemics, formaldehyde, radon, ambient tobacco smoke, and allergens.

Watson, A. Y., Bates, R. R., and Kennedy, D. (Eds.) (1988)
Air Pollution, the Automobile, and Public Health
National Academy Press, Washington, DC

Discusses the ideas presented at a conference designed to consider how we can quantify the risks as well as narrow the uncertainty about risk in relation to the automotive industry. The basic sections of the book include an overview, exposure analysis, and biological effects. The papers are top quality and serve well to educate the reader on the many aspects needed to make the appropriate evaluation.

Wilson, R., and Spengler, J. (Eds.) (1999)
Particles in Our Air
Harvard Univ. Press, Cambridge, MA

Gives context to today's concerns about particulate matter, ozone, SOx, Nox, VOCs, etc. The volume discusses in careful detail the potential health effects of minute airborne particles. Written primarily for the graduate student in a clear nontechnical fashion.

World Health Organization (WHO) (1997)
Diesel Fuel and Exhaust Emissions, Environmental Health Criteria No. 171
WHO, Geneva

Draws on findings from over 600 studies to evaluate the risks to human health and the environment posed by exposure to diesel fuel and exhaust emissions. The evaluation of diesel fuel begins with a discussion of the complexity of these mixtures and the many variables that affect their quality and composition. The second and largest part evaluates effects of these emissions.

Yunus, M., and Iqbal, M. (Eds.) (1996)
Plant Response to Air Pollution
Wiley, Chichester, UK

Studies the varied plant growth responses to pollution stress and focuses attention on the plant rather than the pollutant. Provides insight into the pollution-based disturbances at the different levels of plant life.

See Also:
Section on Chemicals—Dust and Fibers

Section on Target Sites—Respiratory System

Landsberger: *Elemental Analysis of Airborne Particles* (Chemicals—Dusts and Fibers)

Nagda: *Design and Protocol for Monitoring Indoor Air Quality* (Occupational)

National Research Council: *Waste Incineration and Public Health* (Environmental Toxicology—Hazardous Wastes)

Tomatis: *Indoor and Outdoor Air Pollution and Human Cancer* (Cancer)

Vincent: *Aerosol Science for Industrial Hygienists* (Occupational Health)

Yocum: *Techniques for Measuring Indoor Air Quality* (Testing Methods and Toxicity Assessment)

Journals

Atmospheric Environment

Journal of the Air and Waste Management Association

Water, Air, and Soil Pollution

Journal Articles

Ambient air pollution exposure and cancer. ***Cancer Causes Control*** **8**(3), 284–291.

Anonymous (1992). **Workbook of screening techniques for assessing impacts of toxic air pollutants (revised),** NTIS/PB93-210367,

Anonymous (1993). **Hazardous air pollutants: Profiles of noncancer toxicity from inhalation exposures,** NTIS/PB95-228912.

Anonymous (1995). **Atmospheric environmental implications of propulsion systems,** NTIS/N95-31747/5.

Anonymous (1996). **Spacecraft maximum allowable concentrations for selected airborne contaminants,** NTIS/PB96-150917.

Armon, R., and Kott, Y. (1996). Bacteriophages as indicators of pollution. ***Crit. Rev. Environ. Sci. Technol.*** **26,** 299–336.

Bates, D. V. (1995). Adverse health impacts of air pollution—Continuing problems. ***Scand. J. Work Environ. Health*** **21**(6), 405–411.

Bates, D. V. (1996). Particulate air pollution. ***Thorax*** **51**(Suppl. 2), PS3–8.

Bromberg, P. A., and Koren, H. S. (1995). Ozone-induced human respiratory dysfunction and disease. ***Toxicol. Lett.*** **82/83,** 307–316.

Brunekreef, B. (1997). Air pollution and life expectancy: Is there a relation? ***Occup. Environ. Med.*** **54,** 781–784.

Chang, C. W., *et al.* (1995). Factors affecting microbiological colony count accuracy for bioaerosol sampling and analysis. ***Am. Ind. Hygiene Assoc. J.*** **56,** 979–986.

Charnley, G., and Goldstein, B. D. (1998). A public health context for residual risk assessment and risk management under the Clean Air Act. ***Environ. Health Perspect.*** **106,** 519–521.

Cheng, K. H., *et al.* (1995). **Application of both a physical theory and statistical procedure in the analyses of an *in vivo* study of aerosol deposition,** NTIS/DE96002919.

Committee of the Environmental and Occupational Health Assembly of the American Thoracic Society (1996, January). Health effects of outdoor air pollution. ***Am. J. Respir. Crit. Care Med.*** **153,** 3–50.

Dietert, R. R., and Hedge, A. (1996) Toxicological considerations in evaluation of indoor air quality and human health: Impact of new carpet emissions. ***Crit. Rev. Toxicol.*** **26,** 633–708.

Finlayson-Pitts, B. J., and Pitts, J. N., Jr. (1997). Tropospheric air pollution: Ozone, airborne toxics, polycyclic aromatic hydrocarbons, and particles. ***Science*** **276**(5315), 1045–1052.

Jones, A. P. (1998). Asthma and domestic air quality. ***Soc. Sci. Med.*** **47**(6), 755–764.

Krzyzanowski, M. (1997). Methods for assessing the extent of exposure and effects of air pollution. ***Occup. Environ. Med.*** **54**(3), 145–151.

Lang, C. (1995). **Indoor deposition and the protective effect of houses against airborne pollution,** NTIS/DE96606077.

Linn, W. S., and Gong, H., Jr. (1996). Health effects of outdoor air pollution. ***Comprehensive Ther.*** **22**(10), 673–679.

Lipfert, F. W. (1997). Air pollution and human health: perspectives for the '90s and beyond. ***Risk Anal.*** **17,** 137–146.

Lipfert, F. W., and Wyzga, R. E. (1995). Air pollution and mortality: Issues and uncertainties. ***J. Air Waste Management Assoc.*** **45**(12), 949–966.

Moolgavkar, S. H., and Luebeck, E. G. (1996). A critical review of the evidence on particulate air pollution and mortality. ***Epidemiology*** **7**(4), 420–428.

Pearson, J., and Stewart, G. R. (1993). The deposition of atmospheric ammonia and its effects on plants. ***New Phytol.*** **125,** 283–305.

Raizenne, M., Dales, R., and Burnett, R. (1998). Air pollution exposures and children's health. ***Can. J. Public Health*** **89**(Suppl. 1), S43–S53.

Salvaggio, J. E., and Terr, A. I. (1996). Multiple chemical sensitivity multiorgan dysesthesia, multiple symptom complex, and multiple confusion: Problems in diagnosing the patient presenting with unexplained multisystemic symptoms. ***Crit. Rev. Toxicol.*** **26,** 617–631.

Sathiakuman, N., *et al.* (1997). Epidemiologic evidence on the relationship between mists containing sulfuric acid and respiratory tract cancer. ***Crit. Rev. Toxicol.*** **27,** 233–252.

Schlesinger, R. B., and Graham, J. A. (1992). Health effects of atmospheric acid aerosols: A model problem in inhalation toxicology and air pollution risk assessment. ***Fundam. Appl. Toxicol.*** **18,** 17–24.

Steerenberg, P. A., *et al.* (1996). Nasal lavage as a tool for health effect assessment of photochemical air pollution. ***Hum. Exp. Toxicol.*** **15,** 111–119.

Steerenberg, P. A., *et al.* (1997). Nasal lavage biomarkers in air pollution epidemiology. ***Arch. Toxicol. Suppl.* 19,** 207–216.

Swenberg, J. A., and Beauchamp, R. O., Jr. (1997). A review of the chronic toxicity, carcinogenicity, and possible mechanisms of action of inorganic acid mists in animals. ***Crit. Rev. Toxicol.* 27,** 261–272.

Tsai, P. J., *et al.* (1995). Occupational exposure to inhalable and total aerosol in the primary nickel production industry. ***Occup. Environ. Med.* 52,** 793–799.

Utell, M. J., and Looney, R. J. (1995). Environmentally induced asthma. ***Toxicol. Lett.* 82/83,** 47–53.

Weinmann, G. G. (1996). An update on air pollution. ***Curr. Opin. Pulmonary Med.* 2,** 121–128.

World Health Organization (1997). Assessment of exposure to indoor air pollutants. ***WHO. Regul. Publ. Eur. Ser.* 78,** iii–xii, 1–139.

Wyzga, R. E., and Folinsbee, L. J. (1995). Health effects of acid aerosols. ***Water Air Soil Pollut.* 85,** 177–188.

ENVIRONMENTAL TOXICOLOGY—HAZARDOUS WASTE

Andrews, J. S., Frumkin, H., Johnson, B. L., Mehlman, M. A., Xinteras, C., and Bucsela, J. A. (Eds.) (1994)
Hazardous Waste and Public Health: International Congress on the Health Effects of Hazardous Waste
Princeton Scientific, Princeton, NJ

Collection of over 100 papers and 90 poster presentations from an international congress. The material is divided into the following main sections: hazardous wastes and public health approaches, policy and ethics, international programs, the role of communities, environmental exposure assessment, biomarkers, hazard assessment and risk estimation, health effects, and information services.

Andrews, L. P. (Ed.) (1990)
Worker Protection during Hazardous Waste Remediation
Van Nostrand–Reinhold, New York

Addresses specific problems and provides solutions for the practices needed to maintain a safe work environment and maintain compliance with SARA and the applicable OSHA standards. Covers employee/employer responsibilities hazard recognition, engineering and personal protective equipment recommendations, and safety plans.

Bilitewski, B., Hardtle, G., and Marek, K. (1996)
Waste Management
Springer, New York

Offers a comprehensive treatment of all aspects of waste disposal and management. The book illustrates these aspects using numerous practical examples. Included is a comparison of international regulations covering the environment with many case studies on applications of these regulations.

British Medical Association, Professional and Scientific Division (1991)
Hazardous Waste and Human Health
Oxford Univ. Press, Oxford

Considers health issues related to hazardous waste as well as prevention and control.

Chalmers, G. (1997)
Literature Review and Discussion of the Toxicological Effects of Oilfield Pollution in Cattle
Alberta Agriculture, Food and Rural Development, Edmonton, Canada

Thorough review on the toxicology of oil and gas pollution in cattle and other species. The text focuses on the diagnostic and clinical aspects to oilfield pollution. The book covers field investigation from the farm ecosystem to the known biochemical effects.

Coe, J. M., and Rogers, D. (1996)
Marine Debris
Springer, New York

Addresses the origin of persistent solid waste in the ocean, from urban and rural discharges to waste from ships and the recreational use of the ocean. This text identifies key issues from biological, technological, economic and legal perspectives and provides a framework for controlling each of the main sources of marine debris.

Crawford, M. C. (1997)
Toxic Waste Sites: An Encyclopedia of Endangered America
ABC–CLIO, Santa Barbara, CA

Provides a general overview of CERCLA and an inventory of more than 1300 toxic waste sites arranged by state. Location, brief history, and inventory of wastes are provided for each site.

Freeman, H. M. (1998)
***Standard Handbook of Hazardous Waste Treatment and Disposal*, 2nd ed.**
McGraw-Hill, New York

Provides information and data relevant for hazardous waste management, site clean-up, and alternative treat-

ment. Topics covered include laws and regulations, hazardous waste characteristics and issues, special categories of hazardous wastes, pollution prevention, and recycling.

Johnson, B. L., Andrews, J. S., Xintaras, C., and Mehlman, M. A. (Eds.) (1997)
Hazardous Waste: Toxicology and Health Effects
Stockton Press, New York

Volume 25 in the series ***Advances in Modern Environmental Toxicology.*** Papers of significant ongoing research and policy development generated under the Superfund statute.

King, R. B., *et al.* (1998)
Practical Environmental Bioremediation: The Field Guide.
CRC Press, Boca Raton, FL

Bioremediation is a means of enhanced microbiological treatment of environments contaminated with various organic and inorganic compounds.

Lewandowski, G. A., and DeFilippi, L. J. (1997)
Biological Treatment of Hazardous Wastes
Wiley, New York

Provides engineers, scientists, and technical personnel with a conceptual framework to develop effective treatments adaptable to any hazardous waste scenario they may encounter.

Lunn, G., and Sansone, E. B. (1994)
Destruction of Hazardous Chemicals in the Laboratory, 2nd ed.
Wiley, New York

Collection of detailed procedures that can be used to degrade and dispose of a wide variety of hazardous chemicals. The procedures are applicable to the amounts generally found in the chemical laboratory. This edition also expands the scope to bulk quantities and is aimed so that laboratory technicians can perform the procedures safely.

Maslansky, S. P., and Maslansky, C. J. (1997)
Health and Safety at Hazardous Waste Sites: An Investigator's and Remediator's Guide to HAZWOPER
Van Nostrand–Reinhold, New York

Covers hazard recognition, toxicology, respiratory protection, air monitoring, personal protective equipment, site control, health and safety programs, contingency planning, and confined space entry. The appendices provide a generic emergency response plan, a generic health and safety plan, and excerpts from applicable federal laws on hazardous waste operations and emergency response, permitting required for confined space entry, and excavations.

Maughan, J. T. (1996)
Ecological Assessment of Hazardous Waste Sites
Van Nostrand–Reinhold, New York

Examines the overall approach to risk assessments as well as techniques for evaluating prominent aspects of ecological assessments. The main areas include terrestrial pathways of contaminants, sediment quality and contamination, and toxicity testing. Case studies involving ecological problems are presented.

National Research Council. Committee on the Health Effects of Waste Incineration (1999)
Waste Incineration and Public Health
National Academy Press, Washington, DC

Provides details on processes involved in incineration and how contaminants are released, environmental dynamics of contaminants and routes of human exposure, and tools and approaches for assessing human health effects.

Payne, S. M. (1998)
Strategies for Accelerating Cleanup at Toxic Waste Sites
Lewis, Boca Raton, FL

Provides practical methods to accelerate cleanup and decision making. Tables list remedial and investigative technologies.

Sellers, K. (1998)
Fundamentals of Hazardous Waste Site Remediation
Lewis, Boca Raton, FL

Discusses the basics of hazardous materials chemistry, hydrogeology, reaction engineering, and cleanup-level development.

Travis, C. C., and Cook, S. C. (1989)
Hazardous Waste Incineration and Human Health
CRC Press, Boca Raton, FL

Examines topics such as composition of hazardous waste, incineration technology, risk assessment methodology, health risk assessment for organics and metals, and food chain analysis.

Turnberg, W. L. (1996)
Biohazardous Waste: Risk Assessment, Policy, and Management
Wiley, New York

Covers all important areas of biohazardous waste management, including regulation, collection, and disposal, with a section on health hazard assessment.

Wagner, T. P. (1998)
The Complete Guide to the Hazardous Waste Regulations, 3rd ed.
Wiley, New York

A new edition of an essential reference containing up-to-date information on changes made to the hazardous waste and hazardous materials program since 1991. Clarifies all RCRA, TSCA, HMTA, OSHA, and Superfund rules. Includes a summary of state-specific hazardous waste requirements.

Waxman, M. F. (Ed.) (1996)
Hazardous Waste Site Operations: A Training Manual for Site Professionals
Wiley, New York

Brings together information from available resources to those individuals involved in hazardous waste remediation or the generation of hazardous waste. The manual can be used either as the prime reference in conducting mandated training or to supplement lectures and training. The book provides a broad overview of the possible hazards encountered with hazardous wastes and how workers can properly protect themselves and conduct their work.

Woodside, G. (1999)
Hazardous Materials and Hazardous Waste Management, **2nd ed.**
John Wiley, New York

Integrates information from industrial hygiene, environmental science, and waste management. Discusses the interrelation of the many OSHA, EPA, and other federal regulations.

See Also:
ECETOC: *Technical Report No. 49: Exposure of Man to Dioxins: A Perspective on Industrial Waste Incineration* (Chemicals—Selected Chemicals)

Meyers: *Encyclopedia of Environmental Analysis* (Environmental Toxicology—General)

Journal

Waste Management

Journal Articles

Baird, N., *et al.* (1996). Evaluating surface contamination at hazardous waste sites. ***Occup. Health Safety*** **65,** 47–50.

Cha, D. K., Sarr D., Chiu, P. C., and Kim, D. W. (1998). Hazardous waste treatment technologies. ***Water Environ. Res.*** **70**(4), 705–720.

Cole, B. L., *et al.* (1994). A cross-sectional survey of workers and their training needs at 29 hazardous waste sites. ***Appl. Occup. Environ. Hygiene*** **9,** 605–611.

Cortinas de Nava, C. (1996). Worldwide overview of hazardous waste. ***Toxicol. Ind. Health*** **12**(2), 127–138.

De Rosa, C. T., *et al.* (1996). Public health implications of hazardous waste sites: Findings, assessment and research. ***Food Chem. Toxicol.*** **34**(11/12), 1131–1138.

Dyer, R. D., *et al.* (1991). Evaluating the human health effects of hazardous wastes: Reproduction and development, neurotoxicity, genetic toxicity and cancer. ***Health Effects Res. Lab.,*** NTIS/PB92-110352.

Faroon, O. M., *et al.* (1994). A review of the carcinogenicity of chemicals most frequently found at National Priorities List sites. ***Toxicol. Ind. Health*** **10**(3), 203–230.

Fay, R. M., and Mumtaz, M. M. (1996). Development of a priority list of chemical mixtures occurring at 1188 hazardous waste sites, using the HazDat database. ***Food Chem. Toxicol.*** **34**(11/12), 1163–1165.

Gochfeld, M. (1995). Incineration: Health and environmental consequences. ***Mount Sinai J. Med.*** **62,** 365–374.

Hjelmar, O. (1996). Disposal strategies for municipal solid waste incineration residues. ***J. Hazardous Materials*** **47,** 345–368.

Indulski, J. A., and Lutz, W. (1995). Biomarkers used for the assessment of health hazards in populations living in the vicinity of communal and industrial waste dump sites. ***Int. J. Occup. Med. Environ. Health*** **8,** 11–16.

Itavaara, M., and Vikman, M. (1996). An overview of methods for biodegradability testing of biopolymers and packaging materials. ***J. Environmental Polymer Degradation*** **4,** 29–36.

Johnson, B. L. (1995). Nature, extent, and impact of Superfund hazardous waste sites. ***Chemosphere*** **31,** 2415–2428.

Johnson, B. L., and DeRosa, C. T. (1995). Chemical mixtures released from hazardous waste sites: Implications for health risk assessment. ***Toxicology*** **105,** 145–156.

Johnson, B. L., and De Rose, C. (1997). The toxicologic hazard of superfund hazardous-waste sites. ***Rev. Environ. Health*** **12,** 235–251.

Johnson, B. L., Xintaras, C., and Andrews, J. S., Jr. (1997). Proceedings of the 2nd International Congress on Hazardous Waste: Impacts on Human and Ecological Health. ***Toxicol. Ind. Health*** **13,** 105–404.

Klopman, G., *et al.* (1995). The structure–toxicity relationship challenge at hazardous waste sites. ***Chemosphere*** **31,** 2511–2519.

Pleus, R. C., and Kelly, K. E. (1996). Health effects from hazardous waste incineration facilities: Five case studies. ***Toxicol. Ind. Health*** **12**(2), 277–287.

Millano, E. F. (1998). Hazardous waste storage disposal remediation and closure. ***Water Environ. Res.*** **70**(4), 721–745.

Wei, M.-S., and Weber, F. (1996). An expert system for waste management. ***J. Environ. Management*** **46,** 345–358.

ENVIRONMENTAL TOXICOLOGY—TERRESTRIAL

Buonicore, A. J. (Ed.) (1996)
Cleanup Criteria for Contaminated Soil and Groundwater, 2nd ed.
ASTM Press, Philadelphia.

Book and diskette summarize cleanup criteria developed by the U.S. EPA under various legislative mandates.

European Chemical Industry Ecology and Toxicology Centre (ECETOC) (1990)
Technical Report No. 40: Hazard Assessment of Chemical Contaminants in Soil
ECETOC, Brussels

Describes the hazard assessment process for soil contaminants. Also evaluates the significance of the presence of contaminants in the environment.

Ingersoll, C. G., Dillon, T., and Biddinger, G. R. (Eds.) (1997)
Ecological Risk Assessments of Contaminated Sediments
SETAC, Pensacola, FL

Presents a critical evaluation of existing approaches to determining the risk of contaminated sediments. The text identifies principles and practices for this task designed to improve the process. The text pinpoints critical applications, such as product assessment, navigational dredging, and site cleanup, and pertinent issues such as ecological relevance and methodological uncertainty.

Lokke, H., and Van Gestel, A. M. (1998)
Handbook of Soil Invertebrate Toxicity Tests
Wiley, New York

A comprehensive user guide to toxicity testing which provides readily accessible information on the results of terrestrial invertebrate testing. Presents guidelines for the application of new test systems for soil ecotoxicity testing.

Sheppard, S., and Bembridge, J. (Eds.) (1998)
Advances in Earthworm Ecotoxicology
SETAC, Pensacola, FL

Subject areas convered include bioavailability and internal load, the use of modeling to estimate long-term implications of impacts of toxic compounds on individuals for population survival, and other developments in earthworm research.

Tarradellas, J., *et al.* (Eds.) (1997)
Soil Ecotoxicology
CRC Lewis, Boca Raton, FL

Discusses the sources, fate, and transport of hazardous chemicals in soils. The fate (biodegradation and modeling) and the potential impacts of pesticides on soil ecosystems are emphasized, and methodologies for performing toxicity assessments are provided.

van Straalen, N. M., and Krivolutsky, D. A. (Eds.) (1996)
Bioindicator Systems for Soil Pollution
Kluwer, Dordrecht

Presents new approaches to the development of bioindication systems for the soil environment. The emphasis is on the use of inetebrates, as part of the soil life-support system. Discusses general ecotoxicological approaches, community and systems approaches, and various case studies in Eastern and Western Europe and the United States.

Yaron, B., *et al.* (1996)
Soil Pollution: Processes and Dynamics
Springer, Berlin

Investigates the properties of the interacting materials, pollutant partitioning between the soil phases, pollutant behavior in soils affected by environmental factors, and the principles to be considered in defining pollutant behavior.

See Also:
Dragun: *Chromium in Soil* (Chemicals—Metals)

Proctor: *Chromium in Soil* (Chemicals—Metals)

Journals

Journal of Soil Contamination

Water, Air, and Soil Pollution

Journal Articles

Barnthouse, L. W. (1995). **Effects of ionizing radiation on terrestrial plants and animals: A workshop report,** NTIS/DE96003937.

Bierkens, J. Comparative sensitivity of 20 bioassays for soil quality. ***Chemosphere* 37,** 2935–2947.

Farrell, E. P. (1995). Atmospheric deposition in maritime environments and its impact on terrestrial ecosystems. ***Water Air Soil Pollut.* 85,** 123–130.

Grandjean, P., *et al.* (1995). Biomarkers in environmental toxicology state of the art. ***Clin. Chem.* 41,** 1902–1904.

Kuylenstierna, J. C. I., *et al.* (1995). Terrestrial ecosystem sensitivity to acidic deposition in developing countries. ***Water Air Soil Pollut.* 85,** 2319–2324.

Lebourg, A., *et al.* (1996). Suitability of chemical extraction to assess risks of toxicity induced by soil trace metal bioavailability. ***Agronomie*** (*Paris*) **16**(4), 201–215.

Liebl, B., *et al.* (1995). Toxicological evaluation of pollutants in soil—Concept of the AGU* and assessment of tolerable concentrations for metals. ***Arch. Toxicol.*** *Suppl.* **17,** 446–452.

Oliver, M. A. (1997). Soil and human health: A review. ***Eur. J. Soil Sci.* 48**(4), 573–592.

Overcash, M. (1996). European soil remediation research: 1992–1994. ***Crit. Rev. Environ. Sci. Technol.*** **26,** 337–368.

Samsoe-Petersen, L., and Pedersen, F. (1995). Development of guidance for terrestrial effects assessment. ***Arch. Toxicol. Suppl.* 17,** 406–419.

Suedel, B. C., *et al.* (1996). Formulated sediment as a reference and dilution sediment in definitive toxicity tests. ***Arch. Environ. Contami. Toxicol.* 30,** 47–52.

Van Beelen, P., and Doelman, P. (1997). Significance and application of microbial toxicity tests in assessing ecotoxicological risks of contaminants in soil and sediment. ***Chemosphere* 34**(3), 455–499.

Will, M. E., and Suter, G. W. (1996). (Department of Energy) **Toxicological benchmarks for potential contaminants of concern for effects on soil and litter invertebrates and heterotrophic process,** NTIS/DE96007745.

ENVIRONMENTAL TOXICOLOGY—WILDLIFE

Beyer, W. N., Heinz, G. H., and Redmon-Norwood, A. W. (1996)
Environmental Contaminants in Wildlife: Interpreting Tissue Concentrations
Lewis, Boca Raton, FL

Deals exclusively with the question, How much of a chemical in the tissues of an animal is harmful? This book contains not only discussions of different chemicals but also information for those doing the task of evaluating the harm of environmental contaminants to wildlife. Chemicals discussed in this book include organochlorine pesticides, PCBs, dioxins, PAHs, metals, selenium, and fluoride.

Brewer, L., and Fagerstone, K. (Eds.) (1998)
Radiotelemetry Applications for Wildlife Toxicology Field Studies
SETAC, Pensacola, FL

Represents the proceedings from a SETAC workshop on radiotelemetry in support of pesticide field studies. Includes the description and results of several radiotracking and radiotelemetry studies designed around U.S. EPA guidelines mandating registrants of pesticides to determine the ''unreasonable and adverse effects'' of these pesticides on wildlife.

Devillers, J., and Exbrayat, J. M. (1992)
Ecotoxicity of Chemicals to Amphibians
Gordon & Breach, Buffalo, NY

Contains a detailed review of toxicological results for a large collection of chemicals, taken from both laboratory and field experiments. It also provides a taxonomical guide to species and information on their ecology.

Fairbrother, A., Locke, L. N., and Hoff, G. L. (Eds.) (1996)
Noninfectious Diseases of Wildlife, 2nd ed.
Iowa State Univ. Press, Ames

Provides updated information of noninfectious diseases, toxic substances, physiological disorders, and traumas to free-ranging wildlife in North America. Each chapter presents an overview of the particular syndrome followed by sections that describe pathology, diagnostic features, and treatment.

Kendall, R., Dickerson, R., Giesy, J., and Suk, B. (Eds.) (1998)
Principles and Processes for Evaluating Endocrine Disruption in Wildlife
SETAC, Pensacola, FL

Uses a risk-based approach to provide current information, principles, and processes for evaluating the effects of endocrine-modulating chemicals on wildlife. This text is a reference tool for educational purposes and is useful to environmental and industrial managers and planners involved in environmental law and policies.

Louglin, T. R. (Ed.) (1994)
Marine Mammals and the Exxon Valdez
Academic Press, New York

Synthesizes data from the spill on marine mammals. Most of the contributions are from scientists on the scene within 24 hours of the spill. These results establish a baseline worst-case scenario. Useful for toxicologists, marine biologists, environmentalists, and engineers in assessing the true nature of this disaster.

Peterle, T. J. (1996)
Wildlife Toxicology
Van Nostrand–Reinhold, New York

Presents an historical overview leading to current regulatory positions and follows with specifics of agent-induced changes. For specific chemicals, information regarding the breakdown and environmental partitioning, transport to and through natural systems, accumulation potential, lethal and chronic effects, and impact on ecosystems is provided, with a discussion of the evolutionary implications for man.

See Also:
Section on Veterinary Toxicology

Journals

Journal of Wildlife Diseases

Journal of Wildlife Management

Journal of Zoo and Wildlife Managment

Journal Articles

Freemark, K. E. (1994). **Impacts of agricultural herbicide use on terrestrial wildlife: A review with special reference to Canada,** NTIS/MIC-95-03253.

Freemark, K., and Boutin, C. (1995). Impacts of agricultural herbicide use on terrestrial wildlife in temperate landscapes: A review with special reference to North America. ***Agric. Ecosys. Environ.*** **52**(2–3), 67–91.

Fry, D. M. (1995). Reproductive effects in birds exposed to pesticides and industrial chemicals. ***Environ. Health Perspect.*** **103,** 165–171.

Guillette, L. J., Jr., and Guillette, E. A. (1996, May–August). Environmental contaminants and reproductive abnormalities in wildlife: implications for public health? ***Toxicol. Ind. Health*** **12** (3/4), 537–550.

Jongbloed, R. H., *et al.* (1994). Model for environmental risk assessment and standard setting based on biomagnification. **Top Predators in Terrestrial Ecosystems,** NTIS/PB96-105473.

Luebke, R. W., *et al.* (1997). Aquatic pollution-induced immunotoxicity in wildlife species. ***Fundam. Appl. Toxicol.*** **37,** 1–15.

Nyholm, N. E. I. (1995). Monitoring of terrestrial environmental metal pollution by means of free-living insectivorous birds. ***Ann. Chim.*** **85,** 343–351.

Pascoe, G. A., *et al.* (1996). Food chain analysis of exposures and risks to wildlife at a metals-contaminated wetland. ***Arch. Environ. Contam. Toxicol.*** **30,** 306–318.

Sample, B. E., *et al.* (1996). **Toxicological benchmarks for wildlife: 1996 revision,** Department of Energy, NTIS/DE96012369.

Tyler, C. R., Jobling, S., and Sumpter, J. P. (1998). Endocrine disruption in wildlife: A critical review of the evidence. ***Crit. Rev. Toxicol.*** **28,** 319–361.

EPIDEMIOLOGY

Aldrich, T., and Griffith, J. (1993)
Environmental Epidemiology and Risk Assessment
Van Nostrand–Reinhold, New York

Addresses the historical development of environmental epidemiology, touching on incidents such as Love Canal and Chernobyl. Emphasizes exposure monitoring, biomarkers, lab practices for environmental safety, risk assessment and management, and environmental law.

Armstrong, B. K., White, E., and Saracci, R. (1992)
Principles of Exposure Measurement in Epidemiology
(*Monographs in Epidemiology and Biostatistics*, Vol. 21)
Oxford Univ. Press, New York

A textbook in epidemiology and a partial review of exposure measurement. It considers methods of measurement of exposure to particular agents or classes of agents of disease. The principles are viewed from the perspective of the causation by external agents of non-

infectious or ''chronic'' disease and not by genetic characteristics.

Bertollini, R., Lebowitz, M. D., Saracci, R., and Savitz, D. A. (1996)
Environmental Epidemiology: Exposure and Disease
Lewis, Boca Raton, FL

Identifies priorities for research relevant to public health in selected areas of environmental epidemiology. Covers various areas of environmental epidemiology from three different points of view: environmental exposures, epidemiological methodology, and major disease groups.

Close, B., Combes, R., Hubbard, A. and Illingworth, J. (Eds.) (1997)
Volunteers in Research and Testing
Taylor & Francis, New York

Use of human volunteers in the research and testing of medicinal and nonmedicinal products is examined. Topics include the ethical debate over the permissible limits of suffering, the demands for better protection, and the physicians viewpoint. Recruitment and selection are discussed as well as particular issues such as the use of volunteers with special needs.

Coulston, F., and Shubik, P. (Eds.) (1980)
Human Epidemiology and Animal Laboratory Correlations in Chemical Carcinogenesis
Ablex, Norwood, NJ

A variety of papers in such areas as effects of nutrition on human drug metabolism, halogenated hydrocarbons in the mammalian body, species and tissue differences in response to carcinogens, sex steroids and hepatic growth, estrogens, and tobacco epidemiology.

Draper, W. M. (Ed.) (1994)
Environmental Epidemiology: Effects of Environmental Chemicals on Human Health
American Chemical Society, Washington, DC

After an introductory chapter, the basic principles and nomenclature of epidemiology are reviewed. An overview of toxicology and toxicologic risk assessment is given, followed by in-depth discussion of environmental epidemiology in practice. This intends to highlight successful applications of the field in terms of identification and quantification of human hazards involved with exposure to various agents.

Elliott, P., Cuzick, J., English, D., and Stern, R. (Eds.) (1992)
Geographical and Environmental Epidemiology: Methods for Small-Area Studies
Oxford Univ. Press, Oxford

Brings together the experience of environmental epidemiologists, statisticians, and geographers in relation to the study of adverse health effects in small areas. The book contains an introduction, data requirements for small-area health studies, currently available methodology, historical perspectives, and some examples. The case studies are particularly interesting.

Federal Focus (1996)
Principles for Evaluating Epidemiologic Data in Regulatory Risk Assessment
Federal Focus, Washington, DC

Provides risk assessors with a set of guidelines for evaluating and using epidemiological studies and data in their assessments.

Graham, J. D. (Ed.) (1995)
The Role of Epidemiology in Regulatory Risk Assessment
Elsevier, Amsterdam

Covers the interface between epidemiology and risk assessment. The bulk of the presentation deals with application and limitations of human data, particularly the quantitative aspects of both exposure and response assessment. This book provides excellent insight into the need to carefully use even human data for human risk assessment.

Hernberg, S. (1992)
Introduction to Occupational Epidemiology
Lewis, Chelsea, MI

Designed to introduce occupational health professional to epidemiology. The major sections include an extensive introduction, some basic epidemiologic measures, and sources of information. This book is a valuable tool for those desiring a concise, clear overview and gives references for those interested in more depth.

Hill, M. J., Giacosa, A., and Caygill, C. P. J. (Eds.) (1994)
Epidemiology of Diet and Cancer
Horwood, New York

Reports on the collection and collation of cancer data in Europe. Diet is a contributor to cancer risk and this book attempts to demonstrate the wide regional variations within Europe and within some European countries in cancer risk and in diet pattern.

Hulka, B. S., Wilcosky, T. C., and Griffith, J. D. (1990)
Biological Markers in Epidemiology
Oxford Univ. Press, New York

Reviews this emerging field within the context of methodological issues facing epidemiologists in the selection of biomarkers, study design, and interpretation of results. Designed for the interaction of laboratory

investigators and epidemiologists to move toward a better science-based molecular epidemiology.

Kopfler, F. C., and Craun, G. F. (1986)
Environmental Epidemiology
Lewis, Chelsea, MI.

Focuses on the appropriate and accurate measure or assessment of exposure for use in epidemiology studies. The book discusses both the use of exposure data assumed to be a surrogate of dose and the use of biomarkers to accomplish more accurately individual dosage factors.

Lawson, A. (1999)
Disease Mapping and Risk Assessment for Public Health
Wiley, New York

Discusses a variety of sophisticated new methodologies for the statistical evaluation of disease mapping and risk assessment.

Lilienfeld, D. E., and Stolley, P. D. (1994)
Foundations of Epidemiology, 3rd ed.
Oxford Univ. Press, New York

Presents the concepts and methods of epidemiology as they are applied to a variety of health problems. The broad scope of the field is illustrated with studies of specific diseases. The epidemiologist's role in integrating knowledge obtained from a variety of scientific disciplines is described.

McDonald, J. C. (Ed.) (1995)
Epidemiology of Work Related Diseases
BMJ, London

Critically assesses the available scientific evidence for the main disease groups as causes of death, disability, and economic loss. Topics include occupational cancer, asthma, electromagnetic fields, noise and vibration, skin conditions, mental stress, pregnancy, agricultural hazards, back and limb disorders, neurobehavioral effects, and research methodology and evaluation.

National Research Council, Committee on Environmental Epidemiology (1991)
Environmental Epidemiology, Volume 1: Public Health and Hazardous Waste
National Academy Press, Washington, DC

Presents results of studies of hazardous wastes in air, water, soil, and food; reviews available evidence on the risk of exposure to toxic materials; and makes recommendations for filling gaps in the data on risk and improving health assessments.

National Research Council, Committee on Environmental Epidemiology (1997)
Environmental Epidemiology, Volume 2: Use of the Gray Literature and Other Data in Environmental Epidemiology
National Academy Press, Washington, DC

Describes effective epidemiological methods for analyzing data and focuses on errors that may occur in the course of analyses. Also investigates the utility of the gray literature in helping to identify the often elusive causative agent behind reported health effects.

Rappaport, S. M., and Smith, T. J. (Eds.) (1991)
Exposure Assessment for Epidemiology and Hazard Control
Lewis, Chelsea, MI

Reviews the state of the art for exposure assessment in epidemiologic studies and the application of health studies to hazard control.

Rothman, K. J., and Greenland, S. (1998)
***Modern Epidemiology,* 2nd ed.**
Lippincott-Raven, Philadelphia

Covers the principles and methods of contemporary epidemiologic research. Specific research areas include infectious diseases; ecologic studies; disease surveillance; analysis of vital statistics; screening; and clinical, environmental/occupational, reproductive/perinatal, genetic, and nutritional epidemiology.

Sahai, H., and Khurshid, A. (1996)
Statistics in Epidemiology
CRC Press, Boca Raton, FL

Attempts to provide a clear understanding of concepts and applications of methods and techniques of epidemiologic data analysis. Intended for students in epidemiology, public health, and biostatistics and provides as an appendix information on general-purpose and epidemiologic software for data analysis.

Selvin, S. (1996)
Statistical Analysis of Epidemiologic Data, 2nd ed.
Oxford Univ. Press, New York

Surveys many statistical methods with application to epidemiologic data. It draws from the fields of statistics, biostatistics, vital statistics, and epidemiology.

Steenland, K. (1993)
Case Studies in Occupational Epidemiology
Oxford Univ. Press, New York

Provides material for teaching epidemiology. Thirteen case studies are arranged in four parts: cohort studies, case-control and proportionate mortality studies,

cross-sectional studies, and surveillance and screening studies.

Steenland, K., and Savitz, D. (Eds.) (1997)
Topics in Environmental Epidemiology
Oxford Univ. Press, New York

Features selected issues and case studies from experts in the field. This book integrates the wide variety of experiences and approaches into a coherent presentation.

Stolley, P. D., and Lasky, T. (1995)
Investigating Diseases Patterns
Scientific American Library, New York

Conveys the excitement, importance, and challenge of the field of epidemiology. The book presents a highly readable, fair assessment of the contributions of epidemiologists to our understanding of diseases as diverse as infectious diseases, cardiovascular diseases, cancer, and occupational and environmentally caused illnesses.

Talbott, E. O., and Craun, G. F. (1995)
Introduction to Environmental Epidemiology
Lewis, Boca Raton, FL

Deals with nonoccupational exposures which are generally orders of magnitude below those in the workplace. This book attempts to identify sensitive populations and sensitive health-related end points that can be related to environmental contaminants. The 11 chapters include legal considerations, markers of exposure, risk factors, vectors, and chemically and physical agent-related problems.

Timmreck, T. C. (1998)
***Introduction to Epidemiology,* 2nd ed.**
Jones and Bartlett, Sudbury, MA

Presents foundations of epidemiology, practical disease concepts, selected historical developments, epidemiological measures (mortality and morbidity), vital statistics and health status indicators, etc.

Torrence, M. E. (1997)
Understanding Epidemiology
Mosby, St. Louis

Presents an in-depth look at how epidemiologists do their work. The chapters are presented in a manner proceeding from the how's to the why's, and a careful reading will allow the student to appreciate the skills needed to practice this art.

World Health Organization (WHO) (1993)
***Principles for Evaluating Chemical Effects on the Aged Population,* Environmental Health Criteria: No. 144**
WHO, Geneva

This monograph integrates relevant studies of toxicology and gerontology; toxicology examines the potential health effects of exposure to chemicals, whereas gerontology focuses on the scientific explanations for the phenomena and mechanism of aging.

See Also:

Friberg: *Cadmium and Health: A Toxicological and Epidemiological Appraisal* (Toxic Agents—Metals)

Higginson: *Human Cancer: Epidemiology and Environmental Causes* (Cancer)

Hunter: *Waterborne Disease, Epidemiology and Ecology* (Environmental Toxicology—Aquatic)

Parkin: *Cancer Incidences in Five Continents,* Vol. VI (Cancer)

Journals

American Journal of Epidemiology

American Journal of Public Health

Annals of Epidemiology

Environmental Epidemiology and Toxicology

Epidemiology

International Journal of Epidemiology

Journal of Epidemiology and Community Health

Journal of Exposure Analysis and Environmental Epidemiology

Journal Articles

Anonymous (1995). Guiding principles for the use of biological markers in the assessment of human exposure to environmental factors: An integrative approach of epidemiology and toxicology. ***Toxicology* 101**(1/2), 1–10.

Buckley, N. A. (1998). Poisoning and epidemiology: ''Toxicoepidemiology.'' ***Clin. Exp. Pharmacol. Physiol.* 25**(3/4), 195–203.

Parkin, D. M. (1998). Epidemiology of cancer: Global patterns and trends. ***Toxicol. Lett.* 102–103,** 227–334.

Perera, F. P. (1998). Molecular epidemiology of environmental carcinogenesis. ***Recent Results Cancer Res.* 154,** 39–46.

Thacker, S. B., *et al.* (1996). Surveillance in environmental public health: Issues systems, and sources. ***Am. J. Public Health* 86**(5), 633–638.

Wahrendorf, J. (1995, July 26). Design of studies for validation of biomarkers of exposure and their effective use in environmental epidemiology. ***Toxicology*** **101**(1/2), 89–92.

FOOD AND NUTRITION

Burdock, G. A. (1996)
Encyclopedia of Food and Color Additives, 3 vols.
CRC Press, Boca Raton, FL

This reference set provides descriptions of all substances listed in the Everything Added to Food in the U.S. (EAFUS) database, including food additive categories and some substances not considered to be ''additives,'' such as corn oil. Provides concise, understandable descriptions of the substances.

Clydesdale, F. M. (Ed.) (1996)
Food Additives: Toxicology, Regulation, and Properties
CRC Press, Boca Raton, FL

On CD-ROM. Contains facts regarding the chemical and toxicological effects of direct food additives. Based on FDA's Priority-Based Assessment of Food Additives (PAFA) database.

Crawford, L. M., and Franco, D. A. (Eds.) (1994)
Animal Drugs and Human Health
Technomic, Lancaster, PA

Reviews the issue of drug and chemical residues in meat and other animal products. It covers the regulatory aspects of risk assessment and risk management with respect to pesticides, herbicides, hormones, and other drugs. It provides summaries and references.

Creasey, W. A. (1985)
Diet and Cancer
Lea & Febiger, Philadelphia

Reviews the role of diet in carcinogenesis, procedures for dietary studies, and dietary modifications.

David, T. J. (1993)
Food and Food Additive Intolerance in Children
Blackwell, Oxford

Delineates food and food additive intolerance and establishes its importance in the context of pediatric symptoms and disorders. It attempts to set food intolerance into the proper context and examines the relative importance in specific disorders such as eczema, migraine, or the nephrotic syndrome. The author works mainly through specific examples in this well-designed, easy to read text.

Davidek, J. (Ed.) (1995)
Natural Toxic Compounds of Foods: Formation and Change during Processing and Storage
CRC Press, Boca Raton, FL

Summarizes knowledge in the field of naturally occurring toxic and antinutritive compounds of foods. Included here are plants or animals from which foods are derived and that have the potential for nutritive value. Sections include natural toxic components of food, toxic and antinutritive compounds formed during food processing and storage, and conclusions and future needs.

De Vries, J. (Ed.) (1996)
Food Safety and Toxicity
CRC Press, Boca Raton, FL

Examines many current problems and changes in food safety and toxicity affecting food researchers, regulators, and many other interest groups. The main sections explore the relationship between the origin of potentially toxic compounds and ingestion, the possible consequence of this ingestion, and the prevention and minimization of health risks.

Engel, K. H., Takeoka, G. R., and Teranishi, R. (1995)
Genetically Modified Foods—Safety Aspects
American Chemical Society, Washington, DC

Discusses the scientific basis of various genetic engineering projects involved in the production of foods and flavors. The book is intended to give the support information needed to clearly evaluate the real risks attendant to this emerging technology.

Friedman, M. (1984)
Nutritional and Toxicological Aspects of Food Safety
Plenum, New York

Volume 177 of *Advances in Experimental Medicine and Biology*. Covers natural phenolics such as anticarcinogens, defenses against aflatoxin carcinogenesis in humans, metabolism of food toxicants, safety of megavitamin therapy, and prenatal developmental toxicology of arsenicals. Other chapters review sources of *N*-nitrosamine contamination in foods, genetic and carcinogenic effects of plant flavonoids, and mutagens in cooked foods.

Hui, Y. H., Gorham, J. R., Murrell, K. D., and Cliver, D. O. (Eds.) (1996)
Foodborne Disease Handbook, 3 vols.
Dekker, New York

In-depth treatment of the transmission, identification, diagnosis, treatment, and prevention of foodborne pathogens. Volume 1 covers diseases caused by bacte-

ria, Vol. 2 discusses diseases caused by viruses, parasites, and fungi, and Vol. 3 discusses diseases caused by hazardous substances.

International Agency for Research on Cancer (1991)
Coffee, Tea, Mate, Methylxanthines, and Methylglyoxal
World Health Organization, Lyon

Volume 51 of the *IARC Monographs on the Evaluation of Carcinogenic Risks to Humans.* Convened by expert panels to review all of the long-term toxicity information on the chemicals in the title with particular emphasis on cancer. This book presents a thorough review of this information. The panels concluded that there is limited evidence that coffee is carcinogenic to the human urinary bladder and there is inadequate information for other sites; that tea and mate drinking is not classifiable as to its carcinogenicity, and that caffeine, theophylline, theobromine, and methylglyoxal are not classifiable. This book is an excellent source for the specific long-term information available on the compounds.

International Agency for Research on Cancer (1991)
Chlorinated Drinking Water, Chlorinated By-Products, Some Other Halogenated Compounds
World Health Organization, Lyon

Volume 52 of the *IARC Monographs on the Evaluation of Carcinogenic Risks to Humans.* Carcinogenic information on the compounds in the title is collected and reviewed by an expert panel with particular emphasis on long-term toxicity. This book thoroughly reviews these data and concludes that chlorinated drinking water, sodium chlorite, hypochlorite salts, bromoform, chlorodibromomethane, halogenated acetonitriles, and bromo-, chloro-, and trichloroethane are not classifiable as to carcinogenicity to humans, and that bromodichloromethane and cobalt and cobalt compounds are possibly carcinogenic to humans. The information is clearly organized and presented, although the basis for all the decisions is not clear.

Joint FAO/WHO Expert Committee on Food Additives (JECFA)
WHO Food Additive Series
WHO, Geneva

This important monographic series summarizes safety data on selected food additives and contaminants and individual volumes are based on meetings of the Joint FAO/WHO Expert Committee on Food Additives (JECFA). The data reviewed in these monographs form the basis for acceptable daily intakes (ADIs). Number 40, for example, published in 1998, covered such agents as TBHQ, microcrystalline cellulose, maltitol syrup, and aflatoxins.

Jones, J. M. (1992)
Food Safety
Eagan Press, St. Paul, MN

Provides a perspective on food safety issues. For each issue, the risks and benefits to consumers are considered as are environmental, agricultural, and economic concerns. The book is aimed at students and professionals working in the area of food and/or nutrition.

Kotsonis, F. N., Mackey, M., and Hjelle, J. J. (Eds.) (1994)
Nutritional Toxicology
Raven Press, New York

Contains chapters on the role of nutrients in protecting the body against toxicants. Also included are chapters on developments in food production. The book brings together diverse issues that are at the forefront in nutritional toxicology.

Kuhlmann, J., and Weihrauch, T. R. (Eds.) (1995)
Food–Drug Interactions
Zuckschwerdt Verlag, Munich

Derived from a symposium on clinical pharmacology covering the effects of food on the bioavailability and effect of drugs. The modification of drug distribution by factors such as gastrointestinal pH and motility are important for the practitioner to understand.

Madhavi, D. L., Deshpande, S. S., and Salunkhe, D. K. (1996)
Food Antioxidants
Dekker, New York

Covers the latest toxicological, technological, and nutritional developments in both natural and synthetic antioxidants used in the food industry. The chapters explore the sources of antioxidants, antioxidant classification, synergism, degradation in food systems, and techniques for identification. The book is intended for food scientists and technologists, nutritionists, students, and those desiring a better appreciation of the uses (and misuses) of this class of materials.

Maga, J. A., and Tu, A. T. (Eds.) (1995)
Food Additive Toxicology
Dekker, New York

Presents toxicological properties of food additives. Specific areas covered include types of food additives, food acidulants, antioxidants, food colors, curing agents, flavoring agents, flavor potentiators, salts,

modified food starches, incidental food additives, and antimicrobial agents.

Papas, A. M. (Ed.) (1998)
Antioxidant Status, Diet, Nutrition, and Health
CRC Press, Boca Raton, FL

Integrates the biological, nutritional, and health aspects of antioxidant status. Topics examined include factors affecting and methods for evaluating antioxidant status in humans, effect of diet and physiological stage, and the role of antioxidant status in nutrition, health, and disease.

Parke, D. V., *et al.* (Eds.) (1993)
Food: Nutrition and Chemical Toxicity
Smith–Gordon, London

Explains the biological and molecular mechanisms involved in defense against environmental toxic chemicals by the nutrients in food. It concentrates on two pathways, the detoxicating activity of the liver cytochrome P450 and ''reactive oxygen species'' (ROS). It includes examples of dietary supplements, regulatory aspects, and nutritional needs.

Shahidi, F. (Ed.) (1997)
Antinutrients and Phytochemicals in Food
American Chemical Society, Washington, DC

Volume 662 of the *ACS Symposium Series.* From the Preface: ''Antinutrients in foods are responsible for the deleterious effects that are related to the absorption of nutrients and micronutrients which may interfere with the function of certain organs . . . certain harmful effects might also be due to the breakdown products of these compounds.''

Shibamoto, T., and Bjeldanes, L. F. (1993)
Introduction to Food Toxicology
Academic Press, New York

Covers the principles and concepts of food toxicology. Toxicology, risk assessment, pesticides, microbial toxins, food additives, and naturally occurring poisons are covered.

Tschanz, C., Butchko, H. H., Stargel, W. W., and Kotsonis, F. N. (Eds.) (1996)
The Clinical Evaluation of a Food Additive: Assessment of Aspartame
CRC Press, Boca Raton, FL

Covers the rigorous scientific, regulatory, and clinical testing and evaluation applied to aspartame. The book provides an overview of the food additive evaluation process and describes the clinical studies used to evaluate anecdotal medical complaints such as headaches, seizure, and allergic-type reactions.

Tu, A. T. (Ed.) (1991)
Food Poisoning
Dekker, New York

Serves as a reference for food scientists as well as a practical guide to persons dealing with food manufacturing and processing. Main headings in this book include public health problems, bacterial origin problems, issues from plant and fungal origin, allergy, seafood, goiter, teratogens, antibiotics, and nitrosamines.

United Nations Food and Agricultural Organization (1966–)
Pesticide Residues in Food
United Nations Food and Agricultural Organization, Rome

An annual report sponsored jointly by the World Health Organizatioin and the Food and Agricultural Organization of the United Nations. Presents summaries of residue and toxicolgoical data considered at their meetings.

United Nations Food and Agricultural Organization (1977–)
FAO Food and Nutrition Paper
United Nations Food and Agricultural Organization, Rome

A well-regarded series covering various aspects of food and nutrition, including safety. Topics of published issues include residues of veterinary drugs in animals and foods, compendium of food additives, and specifications.

Vettorazzi, G. (Ed.) (1981)
Handbook of International Food Regulatory Toxicology
SP Medical & Scientific, New York

Consists of toxicity profiles of food additives. It includes principles for evaluation, interpretation of findings, toxicological features of each food additive, and safe use recommendations.

Walker, A. F., and Rolls, B. A. (Eds.) (1992)
Nutrition and the Consumer
Elsevier, London

Provides succinct information in the area of nutrition and food toxicology. It is directed at general practitioners, health professionals, food technologists, and research students. A total of 11 chapters are devoted to various aspects of food toxicology.

Ziegler, E. T., and Filer, L. J., Jr. (Eds.) (1996)
Present Knowledge in Nutrition
ILSI Press, Washington, DC

Reflects the growth in the science base and application of nutritional science to a wide variety of related disciplines. Principles of nutrition have evolved from the identification of their role in preventing deficiency states to the prevention of chronic rather than acute adverse states. A total of 64 specific chapters present detailed examples.

See Also:

Fong: *Pesticide Residues in Foods* (Chemicals—Pesticides)

Griffiths: *Nutrition and Cancer* (Cancer)

Hart: *Dietary Restriction* (Testing Methods and Toxicity Assessment)

Hill: *Epidemiology of Diet and Cancer* (Epidemiology)

Holt: *Food and Drug Interactions* (Chemicals—Drugs)

Leung: *Encyclopedia of Common Natural Ingredients Used in Food, Drugs, Cosmetics* (Chemicals—Cosmetics and Other Consumer Products)

McGuffin: *American Herbal Products* (Biotoxins)

Mertz: *Risk Assessment of Essential Elements* (Risk Assessment)

Moats: *Veterinary Drug Residues* (Veterinary Toxicology)

National Academy of Sciences: *Carcinogens and Anticarcinogens in the Human Diet* (Cancer)

National Research Council: *Pesticides in the Diet of Infants and Children* (Chemicals—Pesticides)

Niesink: *Introduction to Neurobehavioral Toxicology: Food and Environment* (Target Sites—Nervous System)

Redenbaugh: *Safety Assessment of Genetically Engineered Fruits and Vegetables* (Biotechnology)

Rice-Evans: *Free Radicals and Oxidative Stress: Environment, Drugs and Food Additives* (Molecular, Cellular and Biochemical Toxicology)

Roe: *Handbook on Drug and Nutrient Interactions* (Chemicals—Drugs)

Shibamoto: *Chromatographic Analysis of Environmental and Food Toxicants* (Analytical Toxicology)

World Health Organization: *Environmental Health Criteria, No. 104: Principles for the Toxicological Assessment of Pesticide Residues in Food* (Chemicals—Pesticides)

Journals

Advances in Food and Nutrition Research

American Journal of Clinical Nutrition

Environmental and Nutritional Interactions

Environmental Nutrition

Food Additives and Contaminants

Food and Chemical Toxicology

Food and Drug Law Journal

Journal of Nutritional and Environmental Medicine

Journal of Food Protection

Journal Articles

Ahmed, F. E., and Thomas, D. B. (1992). Assessment of the carcinogenicity of the nonnutritive sweetener cyclamate. ***Crit. Rev. Toxicol.* 22,** 81–118.

Aune, T. (1997). Health effects associated with algal toxins from seafood. ***Arch. Toxicol. Suppl.* 19,** 389–397.

Djuretic, T. (1997). Food poisoning: The increase is genuine. ***Practitioner* 241,** 752–756.

Ellwein, L. B., and Cohen, S. M. (1990). Health risks of saccharin revisited. ***Crit. Rev. Toxicol.* 20,** 311–326.

Farkas, J. (1998). Irradiation as a method for decontaminating food: A review. ***Int. J. Food Microbiol.* 44,** 189–204.

Hart, R. W., *et al.* (1996). The effects of dietary restriction on drug testing and toxicity. ***Exp. Toxicol. Pathol.* 48**(2/3), 121–127.

Hathcock, J. N. (1990). Nutritional toxicology: Basic principles and actual problems. ***Food Additives Contam.* 7,** 12–18.

Hoffman, D. (1996). Tobacco-specific N-nitrosamines: Recent advances. ***Crit. Rev. Toxicol.* 26,** 119–253.

Jones, D. P., *et al.* (1995). Impact of nutrients on cellular lipid peroxidation and antioxidant defense system. ***Fundam. Appl. Toxicol.* 26,** 1–7.

Liebler, D. C. (1993). The role of metabolism in the antioxidant function of vitamin E. ***Crit. Rev. Toxicol.* 23,** 147–170.

McCarthy, J. F. (1998). The 1996 Food Quality Protection Act: An evolution or a revolution for toxicology and risk assessment? ***Toxicol. Pathol.* 26,** 828–829.

Metcalf, D. D., *et al.* (1996). Allergenicity of foods produced by genetic modification. ***Crit. Rev. Food Sci. Nutr.* 36,** S1–S192.

Miller, M. A., and Altekruse, S. F. (1998). The president's national food safety initiative. ***J. Am. Vet. Med. Assoc.* 213,** 1737–1739.

Millstone, E. (1997). Adverse reactions of food additives: The extent and severity of the problem. ***J. Nutr. Environ. Med.* 7,** 323–332.

Mines, D., *et al*. (1997). Poisonings: Food, fish, shellfish. ***Emergency Med. Clin. North Am.* 15,** 157–177.

Ohta, T. (1993). Modification of genotoxicity by naturally occurring flavorings and their derivatives. ***Crit. Rev. Toxicol.* 23,** 127–146.

Parizek, J. (1990). Health effects of dietary selenium. ***Food Chem. Toxicol.* 28,** 763–766.

Parke, D. V., and Ioannides, C. (1994). The effects of nutrition on chemical toxicity. ***Drug Metab. Rev.*** **26**(4), 739–765.

Perharic, L., *et al*. (1994). Toxicological problems resulting from exposure to traditional remedies and food supplements. ***Drug Safety*** **11**(4), 284–294.

Reed, J. D. (1995). Nutritional toxicology of tannins and related polyphenols in forage legumes. ***J. Anim. Sci.*** **73**(5), 1516–1528.

Rico, A. (1990). Food toxicology: Free residues, bound residues: Respective toxicity. ***Bull. Acad. Nationale Med.* 174,** 365–369.

Sandstrom, B. (1998). Toxicity considerations when revising the Nordic nutrition recommendations. ***J. Nutr.*** **128**(Suppl. 2), 372S–374S.

Vergnaud, J. M. (1998). Problems encountered for food safety with polymer packages: Chemical exchange, recycling. ***Adv. Colloid Interface Sci.* 78,** 267–297.

FORENSIC

Cravey, R. H., and Baselt, R. C. (1981)
Introduction to Forensic Toxicology
Biomedical Publications, Davis, CA

Divided into three units: principles, practice, and applications of forensic toxicology. The book is meant to be an overview of the science and profession of forensic toxicology, designed primarily as an instructional tool. It should be useful to laboratory directors as a source of scientific, administrative, and procedural guidelines in forensic toxicology.

Eckert, W. G. (Ed.) (1996)
Introduction to Forensic Sciences, 2nd ed.
CRC Press, Boca Raton, FL

For students and practitioners, this text treats the various methods of applying forensic sciences in a logical and relatively nontechnical fashion. Features new to this edition include DNA typing, computerized fingerprint classification, serology instrumentation, drug and law enforcement, updated historical perspective, and updated lists of sources and addresses. Includes a chapter specifically on forensic toxicology.

Houts, M., Baselt, R. C., and Cravey, R. H. (1981)
Courtroom Toxicology, 6 vols.
Bender, New York

Provides a toxicolegal orientation to toxicology including the use of the expert witness. Chemical accidents involving multiple claimants are covered, with emphasis on chemical dumps and spills. Chemistry concepts and the toxicology laboratory, toxicological methodology ranging from chromatography to immunoassays, medical considerations, poisoning treatment, toxicolegal testimony, and pleadings are included.

Kaempe, B. (Ed.) (1991)
Forensic Toxicology
Mackeenzie Press, Copenhagen

Proceeding of the 29th international meeting includes 79 submitted papers. The program focuses on three main area—quality assurance, good laboratory practices, and systematic toxicological analysis.

Kintz, P. (Ed.) (1996)
Drug Testing in Hair
CRC Press, Boca Raton, FL

Aims to validate hair testing as an accepted form of evidence for use in courts and elsewhere such as the military and workplace. Presents the most recent experimental and clinical applications to provide insight into the utility of these techniques.

Knight, B. (1996)
Forensic Pathology, 2nd ed.
Arnold, London

Includes many chapters relevant to the forensic toxicologist—poisoning and the pathologist, forensic aspects of alcohol, carbon monoxide poisoning, agrochemical poisoning, poisoning by medicines, death from narcotic and hallucinogenic drugs, corrosive and metallic poisoning, and death from organic solvents.

Lowry, W. T., and Garriott, J. C. (1979)
Forensic Toxicology
Plenum, New York

Remains a resource tool for the active forensic chemist. The book is intended to give the reader an overall working knowledge of how to apply the appropriate laws, how they interrelate, and how to interpret them scientifically. The authors state that their intention is to bridge the gap between scientific and legal investiga-

tions in the fields of controlled substances and dangerous drugs.

Maes, R. A. A. (Ed.) (1984)
Topics in Forsenic and Analytical Toxicology
Elsevier, New York

Presents the proceedings of the annual European meeting of the International Association of Forensic Toxicologists in 1983. Topics include analytical methods, screening tests, tissue concentrations of drugs in postmortem and surgical patients, case studies of fatal poisonings, and use of computer modeling in predicting the outcome of overdoses.

Muller, R. K. (Ed.) (1994)
Contributions to Forensic Toxicology
Molinapress, Leipzig

Proceedings of the triennial meeting of the Industrial Association of Forensic Toxicologists. Book includes broad array of papers on the current state of forensic toxicology.

Oliver, J. S. (Ed.) (1992)
Forensic Toxicology
Scottish Academic Press, Edinburgh, UK

Discusses and presents the problems attendant to examination of biological tissues for levels of drugs and chemicals. This book highlights the scientific advances that have assisted in detecting increasingly lower levels of potent drugs and chemicals with the degree of confidence necessary for taking corrective or punitive actions. Over 50 contributions are included.

See Also:
Section on Analytical Toxicology

Section on Clinical Toxicology

Curry: *Poison Detection in Human Organs* (Clinical Toxicology)

Pfleger: *Mass Spectral and GC Data* (Analytical Toxicology)

Journals

Forensic Science

Forensic Science International

Japanese Journal of Forensic Toxicology

Veterinary and Human Toxicology

Journal Articles

Christophersen, A. S., and Morland, J. (1994). Drug analysis for control purposes in forensic toxicology, workplace testing, sports medicine and related areas. ***Pharmacol. Toxicol.* 74,** 202–210.

Galey, F. D. (1995). Diagnostic and forensic toxicology. ***Vet. Clin. North Am. Equine Practice* 11**(3), 443–454.

Lambert, W. E. (1997). Potential of high-performance liquid chromatography with photodiode array detection in forensic toxicology. ***J. Chromatogr. B Biomed. Appl.* 689,** 45–53.

Levine, B. (1993). Forensic toxicology. ***Anal. Chem.* 65**(5), 272A–276A.

Levine, B. S., *et al.* (1990). Postmortem forensic toxicology. ***Clin. Lab. Med.* 10,** 571–589.

Osselton, M. D., (1992). Analytical forensic toxicology. ***Arch. Toxicol. Suppl.* 15,** 259–267.

Pahwa, R. (1991). Forensic toxicology and insects: A minireview. ***Vet. Hum. Toxicol.* 33,** 272–273.

Peat, M. A. (1998). Advances in forensic toxicology. ***Clin. Lab. Med.* 18**(2), 263–278.

Pounder, D. J. (1991). Forensic entomotoxicology. ***J. Forensic Sci. Soc.* 31**(4), 469–472.

Stafford, D. T., and Logan, B. K. (1990). Information resources useful in forensic toxicology. ***Fundam. Appl. Toxicol.* 15,** 411–419.

Tagliaro, F., *et al.* (1995). Capillary electrophoresis: A new tool in forensic toxicology. Applications and prospects in hair analysis for illicit drugs. ***Forensic Sci. Int.* 70,** 93–104.

GENETIC TOXICOLOGY

Allen, J. W., Bridges, B. A., Lyon, M. F., Moses, M. J., and Bussell, L. B. (Eds.) (1990)
Biology of Mammalian Germ Cell Mutagenesis, Banbury Report No. 34
Cold Spring Harbor Laboratory Press, Cold Spring Harbor, NY

A compilation of presentations from a meeting on mammalian germ-cell mutagenesis held in November 1989. The emphasis of the presentations was on the male systems. Subjects of scientific discussion included testicular physiology; analysis of altered DNA sequences; modulation, characterization, and consequences of induced damage; induction and recovery of mutations; variables affecting mutations and rate of mutations; nonmutational genetic events; genomic imprinting; nonconventional pathways/expression of damage in the embryo; and new techniques (PCR amplification and transgenics).

Bora, K. C., Douglas, G. R., and Nestmann, E. R. (Eds.) (1982)
Chemical Mutagenesis, Human Population Monitoring and Genetic Risk Assessment
Elsevier, Amsterdam

Discusses the need to assess human genetic risk from experimental data even though the correspondence between animal studies and man is not known. The book emphasizes that the apparent differences are related more to our ability to detect genetic damage in man than to the actual presence or absence of genetic damage.

Brusick, D. (1987)
Principles of Genetic Toxicology, 2nd ed.
Plenum, New York

A good, basic textbook for genetic toxicologists and those in other fields who need to know about genetic toxicology. Chapters include origins of genetic toxicology, fundamentals, consequences of genotoxic effects, screening techniques, genetic risk estimation, applications to environmental monitoring, laboratory basics, description and evaluation of assays, applications of biotechnology, and the role of genetic toxicology in congenital malformations.

Brusick, D. (Ed.) (1994)
Methods for Genetic Risk Assessment
CRC Press, Boca Raton, FL

Covers the strategies and methods for genetic risk assessment. The focus of the information presented is on the potential for heritable damage to the human germline. Topics include hazard identification, assessment of exposure to genotoxins, methods for dose and effect assessment, risk characterization strategies, and monitoring environmental genotoxicants.

Dean, B. J. (Ed.) (1989)
Basic Mutagenicity Tests: UKEMS Recommended Procedures
Cambridge Univ. Press, Cambridge, UK

An essential guide to the four main test procedures used in evaluating chemical safety: bacterial mutation assays, metaphase chromosome aberration assays *in vitro*, gene mutation assays in cultured mammalian cells, and *in vivo* cytogenetic assays.

DeSerres, F. J., and Ashby, J. (Eds.) (1981)
Evaluation of Short-Term Tests for Carcinogens: Report of the International Collaborative Program
Elsevier, New York

Reports on 42 compounds tested in a variety of assays such as the Salmonella/microsome assay, the DNA polymerase-deficient assay, an *Escherichia coli* differential killing test, a yeast forward-mutation system, induction of mitotic gene conversion, and the micronucleus test.

Dracopoli, N. C., Haines, J., Korf, B. R., Morton, C., Seidman, C. E., Seidman, J. G., Moir, D. T., and Smith, D. R. (Eds.) (1997)
Current Protocols in Human Genetics
Wiley, New York

Provides comprehensive coverage of the latest methods in human genetics, including collecting family histories, linking analysis, molecular genetics, physical mapping, clinical procedures, and cytogenetics. The chapters allow the skilled practitioner to conduct sophisticated experimental projects for the analysis of human and other higher eukaryotic genomes.

European Chemical Industry Ecology and Toxicology Centre (ECETOC) (1987)
ECETOC Monograph No. 9: Assessment of Mutagenicity of Industrial and Plant Protection Chemicals
ECETOC, Brussels

A proposed strategy for the evaluation of the mutagenic potential of industrial and plant protection chemicals. The strategy recommends which test must be carried out and in what sequence in order to assess the mutagenicity of these chemicals in germ cells. The strategy also assesses whether such testing would meet regulatory requirements.

Friedberg, E. C., Walker, G. C., and Siede, W. (1995)
DNA Repair and Mutagenesis
ASM, Washington, DC

Provides 14 chapters covering the molecular basis of DNA interaction and mutagenesis. Extensive coverage is given to DNA repair in terms of its determination and biological significance. The text proceeds from the theoretical to the practical and should be of great use to researchers and regulators.

Grandjean, P. (Ed.) (1991)
Ecogenetics: Genetic Predisposition to the Toxic Effects of Chemicals
Chapman & Hall, London

Deals with subgroups of the human population that might be particularly sensitive to the adverse effects of certain chemicals. Topics include significance for public health, perspectives of genetic predisposition, experimental evidence, pharmacogenetic evidence, toxicogenetic evidence, and ethical and regulatory aspects.

Kilbey, B. J., Legator, M., Nichols, W., and Ramel, C. (Eds.) (1984)
Handbook of Mutagenicity Test Procedures, 2nd ed.
Elsevier, New York

A comprehensive bench guide to the techniques used for detection of mutagenic effects caused by various chemicals.

Kirkland, D. J., and Fox, M. (Eds.) (1993)
Supplementary Mutagenicity Tests
Cambridge Univ. Press, Cambridge, UK

Presents the supplementary tests and guidelines which are recommended when the first series of mutagenicity tests give conflicting results. This volume is an essential source of reference and practical guidance for those interested in safety assessment of chemicals. The specific tests covered in this book include yeast culture tests, *in vivo* rat liver UDS assay, measurement of covalent DNA binding, germ cell cytogenetics, and rodent dominant lethal assays.

Li, A. P., and Heflich, R. H. (Eds.) (1991)
Genetic Toxicology
CRC Press, Boca Raton, FL

Useful reference for students and researchers who are interested in the basic and applied principles of genetic toxicology as well as those responsible for safety evaluation of commercial products. The chapter titles include Introduction, Mechanisms of Gene Mutation, Mechanisms of Chromosomal Alterations, Human Genetic Disease, Mutations and Cancer, Assays for Genetic Toxicity, Chemical, Physical, and Biologic Mutagens, and Risk Assessment and Regulatory Perspectives.

Madle, S., and Muller, L. (Eds.) (1993)
Current Issues in Genetic Toxicology
MMV Medizin Verlag, Munich

Presents reports intended to assist in harmonizing test methods and strategies for genetic toxicology. A large amount of testing methodology is reviewed and governmental regulatory positions are covered. Eight of the currently used genetic tests are described and critically reviewed in this book.

Pritchard, J. F. (1996)
Pharmacogenetics: Bridging the Gap between Basic Science and Clinical Applications
IBC, Southborough, MA

Aimed at increasing the understanding of recent developments for drug development and evaluation. The six sections include nonoxidative enzymes, cytochrome P450 enzymes, industrial applications of pharmacogenetics, future directions, applying technology, and investigating drug–drug interactions.

Ramel, C., Lambert, B., and Magnusson, J. (1986)
Genetic Toxicology of Environmental Chemicals, 2 vols.
A. R. Liss, New York

Covers basic principles of genetic toxicology and the mechanisms of mutagenicity. Examines the relationship between mutation and end-point biologies such as cancer with respect to mechanisms. Among the topics included are mechanisms of DNA repair, DNA transfection and cell transformation, spindle structure and aneuploidy, modulators of mutagens, recombinant DNA technology, biotransformation of mutagens and carcinogens, and oncogenes.

Ruffolo, R. R. (Ed.) (1995)
Endothelin Receptors: From the Gene to the Human
CRC Press, Boca Raton, FL

Directed toward pharmacologists and researchers desiring an understanding of the molecular structure and function of the endothelin receptors. Features include dealing from the gene level to the human, clinical applications of receptor antagonists, signal transduction processes, pharmacological responses mediated in the periphery and in the brain, and the medicinal chemistry of endothelin receptor antagonists.

Sharma, A. K., and Sharma, A. (1994)
Chromosome Techniques
Harwood, Amsterdam

Laboratory manual covers the study of chromosomes in plants, animal, and human systems, dealing mainly with the protocols and principles involved. Only the principles of the methods, and not the exact details, are presented.

Sutherland, B. M., and Woodhead, A. D. (Eds.) (1989)
DNA Damage and Repair in Human Tissues
Plenum, New York

Describes techniques, applications, and interpretation of experiments dealing directly with DNA damage and repair in human tissues. The main sections include DNA lesion measurement, damage and repair in skin, biochemistry of human skin, model systems, DNA damage and repair in human blood cells, detection and analysis of human mutations, and internal organs.

Tardiff, R. G., Lohman, P. H. M., and Wogan, G. N. (1994)
Methods to Assess DNA Damage and Repair: Interspecies Comparisons
Wiley, Chichester, UK

Presents the information collected by the International Programme on Chemical Safety regarding the determination of DNA interaction with chemicals. The importance of this activity and the relationship to carcinogenic, mutagenic, and adverse reproductive outcomes in association with chemical exposure are discussed. This in-depth scientific review provides guidance for

risk assessors in using results from animal experiments to assess human health risks.

Trower, M. K. (Ed.) (1996)
In Vitro Mutagenesis Protocols
Humana Press, Totowa, NJ

Divided into two parts. The first comprises protocols for site-directed mutagenesis, incorporating methods based on strand selection, amber stop codon suppression, gapped-duplex formation, etc. The second part considers random mutagenic approaches encompassing protocols, combination activity with the polymerase chain reaction based on degenerated oligonucleotides, cassette mutagenesis, etc.

See Also:

Adams: *Methods in Yeast Genetics* (Testing Methods and Toxicity Assessment)

ECETOC: *Technical Report No. 38: A Guide to the Classification of Preparations Containing Carcinogens, Mutagens and Teratogens* (Testing Methods and Toxicity Assessment)

Forbes: *Genetics and Ecotoxicology* (Environmental Toxicology—General)

Gold: *Handbook of Carcinogenic Potency and Genotoxicity Data Bases* (Cancer)

Grice: *Interpretation and Extrapolation of Chemical and Biological Carcinogenicity Data to Establish Human Safety Standards; The Use of Short-Term Tests for Mutagenicity and Carcinogenicity in Chemical Hazard Evaluation* (Testing Methods and Toxicity Assessment)

Murray: *Antisense RNA and DNA* (Molecular Toxicology)

Sarkar: *Genetic Response to Metals* (Chemicals—Metals)

Schwab: *Genes and Environment in Cancer* (Cancer)

Watson: *Molecular Biology of the Gene* (Molecular, Cellular, and Biochemical Toxicology)

Wilson: *Environment and Birth Defects* (Developmental and Reproductive Toxicology)

Journals

Chromosoma

Cytogenetics and Cell Genetics

Environmental and Molecular Mutagenesis

Mutagenesis

Mutation Research

Somatic Cell and Molecular Genetics

Teratogenesis, Carcinogenesis, and Mutagenesis

Journal Articles

Anderson, D., Yu, T. W., and McGregor, D. B. (1998). Comet assay responses as indicators of carcinogen exposure. ***Mutagenesis* 13,** 539–555.

Ashby, J. (1994). Current issues in mutagenesis and carcinogenesis, No. 51: Dose-level selection for *in vivo* genetic toxicity assays. ***Mutat. Res.* 311,** 165–182.

Ashby, J. (1995). Genetic toxicity in relation to receptor-mediated carcinogenesis. ***Mutat. Res.* 333,** 209–213.

Colvin, M. E., Hatch, F. T., and Felton, J. S. (1998). Chemical and biological factors affecting mutagen potency. ***Mutat. Res.* 400**(1/2), 479–492.

Dearfield, K. L., and Benz, R. D. (1999). Can the new genetic toxicology tests be used for regulatory safety decisions? ***Environ. Mol. Mutagen* 33,** 91–93.

Houk, V. S. (1992). The genotoxicity of industrial wastes and effluents: A review. ***Mutat. Res.* 277,** 91–138.

Legator, M. S. (1994). Genetic toxicology: Lessons from the past, directions for the future. ***Environ. Mol. Mutagen.* 23**(Suppl. 24), 3–6.

Li, J. H., and Lin, L. F. (1998). Genetic toxicology of abused drugs: A brief review. ***Mutagenesis* 13,** 557–565.

MacGregor, J. T. (1994). Environmental mutagenesis: Past and future directions. ***Environ. Mol. Mutagen.* 23**(Suppl. 24), 73–77.

McGregor, D. (1998). Mutagenic chemicals: Their significance. ***Biotherapy* 11**(2/3), 169–180.

Miller, M. S., *et al.* (1997). Genetic polymorphisms in human drug metabolic enzymes. ***Toxicol. Appl. Pharmacol.* 40,** 1–14.

Mirsalis, J. C., *et al.* (1994). Transgenic animal models for measuring mutations *in vivo*. ***Crit. Rev. Toxicol.* 24,** 255–280.

Puga, A., *et al.* (1997). Genetic polymorphisms in human drug-metabolizing enzymes: Potential uses of reverse genetics to identify genes of toxicological relevance. ***Crit. Rev. Toxicol.* 27,** 199–222.

Richard, A. M. (1998). Structure-based methods for predicting mutagenicity and carcinogenicity: Are we there yet? ***Mutat. Res.* 400**(1/2), 493–507.

Rodi, C. P., *et al.* (1999). Revolution through genomics in investigative and discovery toxicology. ***Toxicol. Pathol.* 27,** 107–110.

Shelby, M. D., and Witt, K. L. (1995). Comparison of results from mouse bone marrow chromosome aberration and micronucleus tests. ***Environ. Mol. Mutagen.* 25,** 302–313.

Vamvakas, S., Vock, E. H., and Lutz, W. K. (1997). On the role of DNA double-strand breaks in toxicity and carcinogenesis. ***Crit. Rev. Toxicol.* 27,** 155–174.

Wang, D., Kreutzer, D. A., and Essigmann, J. M. (1998). Mutagenicity and repair of oxidative DNA damage: Insights from studies using defined lesions. ***Mutat. Res.* 400**(1/2), 99–115.

Wassermann, K. (1994). Intragenomic heterogeneity of DNA damage formation and repair: A review of cellular responses to covalent drug DNA interaction. ***Crit. Rev. Toxicol.* 24,** 281–322.

Waters, M. D., Stack, H. F., and Jackson, M. A. (1998). Inhibition of genotoxic effects of mammalian germ cell mutagens. ***Mutat. Res.* 402**(1/2), 129–138.

Weissenbach, J. (1998). Human genome mapping and sequencing: Perspectives for toxicology. ***Toxicol. Lett.*** 103, 1–4.

Zeiger, E. (1990). Strategies for the use of genetic toxicity. ***Drug Metab. Rev.* 22,** 765–776.

MOLECULAR, CELLULAR, AND BIOCHEMICAL TOXICOLOGY

Albert, A. (1985)
Selective Toxicity: The Physico-Chemical Basis of Therapy, 7th ed.
Chapman & Hall, London

Classic text describing the way in which drugs and agricultural agents work at the molecular level—particularly how they are able to affect certain cells without harming others. The mode of action of most drugs used for treating human beings and their economic animals are discussed, as is the mode of action of fungicides, herbicides, and insecticides.

Alberts, B., Bray, D., Lewis, J., Raff, M., Roberts, K., and Watson, J. D. (1994).
Molecular Biology of the Cell, 3rd ed.
Garland, London.

Aimed at the serious student of cell biology. It deals primarily with eukaryotic cells and thoroughly covers the structure and integrated function of cellular systems. The book is clearly written and continues to be a classic.

Aldridge, W. N. (1996)
Mechanisms and Concepts in Toxicology
Taylor & Francis, London.

Presents a chemist's view of mechanistic toxicology. Contributions from many disciplines are brought together, with the focus on the importance of understanding the molecular science of chemically induced perturbations in complex biological systems for both practical and basic toxicology.

Arinc, E., Schenkman, J. B., and Hodgson, E. (Eds.) (1995)
Molecular Aspects of Oxidative Drug Metabolizing Enzymes
Springer-Verlag, Berlin

Provides background and current concepts necessary for the understanding of the microsomal xenobiotic-metabolizing enzymes responsible for detoxification and activation of endogenous compounds in the body. The proceedings from an international symposium also extended this topic from mammalian to aquatic species. Thirty chapters are presented.

Baskin, S., and Salem, H. (Eds.) (1997)
Oxidants, Antioxidants, and Free Radicals
Taylor & Francis, Washington, DC

Includes 18 excellent articles from investigators on the cutting edge of antioxidant, oxidant, and free radical research. This book will stimulate interest in research into their roles in health and disease, particularly with respect to developing a better understanding about the many interactions between oxidants and antioxidants and how such substances may act as natural protectants and/or natural toxicants. Because of the potential of such a wide implication of the link between oxidative by-products and human diseases and the modulation of such by-products by various antioxidant-like compounds, readers from disciplines such as toxicology, nutrition, food science, pathology, pharmacology, and various medical fields will find this monograph a useful resource.

Bolander, F. F. (1994)
Molecular Endocrinology, 2nd ed.
Academic Press, San Diego

Presents a succinct summary of molecular endocrinology, offering a perspective and synthesis of the information and describing useful techniques for conducting this work. Chapters on receptors, transduction, gene regulation by hormones, and special topics are included.

Chapman, D., and Jones, M. N. (Eds.) (1994)
Micelles, Monolayers and Biomembranes
Wiley–Liss, New York

Provides a basic understanding of amphiprotic molecules and their importance in relation to the structure and function of biological membranes. Intended for students and researchers in the physical and biological sciences to bridge the gap between their respective interests.

Ciechanover, A. J., and Schwartz, A. L. (Eds.) (1994)
Cellular Proteolytic Systems
Wiley–Liss, New York

Provides a summary of the biochemistry, cellular biology, molecular genetics, and physiology of the major proteolytic processes. The book focuses on three major cellular proteolysis systems: the ubiquitin system, the lysosomal and vacuolar systems, and physiological and pathophysiological cellular proteolysis.

Clarkson, T. W., Sager, P. R., and Syversen, T. L. M. (Eds.) (1986)
The Cytoskeleton: A Target for Toxic Agents
Plenum, New York

Protein networks of micrcfilaments, intermediate filaments, and microtubules represent the cytoskeleton of mammalian and other eukaryotic cells. There is evidence that certain toxic and chemotherapeutic compounds, as well as physical agents such as radiation and hydrostatic pressure, disrupt the normal structure and function of the cytoskeleton. The toxicologic implications of these events are carefully discussed.

Cochrane, C. G., and Gimbrone, M. A. (Eds.) (1992)
Biological Oxidants: Generation and Injurious Consequences
Academic Press, San Diego

Major effector systems, numerous forms of inflammation, atherosclerotic plaques, and aging, for example, are influenced by the generation of oxidant free radicals. This book brings together important developments from the leading world laboratories. An understanding of the intracellular pathways responsible for generation, the formation of abnormal DNA bases, and pathways leading to cell injury as a result of oxidant interaction is the goal of this text.

Davis, L. G., Kuehl, W. M., and Battey, J. F. (1994)
Basic Methods in Molecular Biology
Appleton & Lange, Norwalk, CT

Guide to the practical application and use of the methodologies of today's molecular biology. The chapters cover general methods, cloning, enzyme modification, *in vitro* labeling, plasmid preparation, subcloning fragments, genomic cloning, sequence determinations, transfection, and protein analysis. The book is a how-to manual for the molecular biologist.

Dekant, W., and Neumann, H. G. (Eds.) (1992)
Tissue-Specific Toxicity: Biochemical Mechanisms
Academic Press, New York

Discusses the role of bioactivation in the toxicity of xenobiotics. It examines several metabolic pathways, including lipid peroxidation, damage to endoplasmic reticulum, and inhibition of protein synthesis.

De Matteis, F., and Smith, L. L. (Eds.) (1995)
Molecular and Cellular Mechanisms of Toxicity
CRC Press, Boca Raton, FL

Series of short reviews highlighting points of growing interest in mechanistic toxicology. The first section deals with molecular mechanisms, the second with interaction of carcinogens with DNA and other cellular macromolecules, and the final with cellular and genetic aspects.

Denison, M. S., and Helferich, W. G. (Eds.) (1998)
Toxicant–Receptor Interactions in the Modulation of Signal Transduction and Gene Expression
Taylor & Francis, Philadelphia

Reviews numerous research areas that employ molecular techniques to analyze the mechanisms by which xenobiotics modulate signal transduction and gene expression. Three sections are devoted to signal transduction systems affected by xenobiotics and the last section describes methodological approaches for the identification of inducible genes.

Eyer, P. (1994)
Metabolic Aspects of Cell Toxicity
Wissenschaftsverlag, Mannheim

Discusses the metabolic aspects of cell toxicity with special emphasis on the roles different organs may play in casting biotransformations. It examines metabolism in the gastrointestinal tract, lung, skin, and liver.

Favier, A. E., Cadet, J., Kalyanaraman, B., Fontecave, M., and Pierre, J. L. (1995)
Analysis of Free Radicals in Biological Systems
Birkhauser-Verlag, Boston

Provides a comprehensive survey on recent methodological aspects of the measurement of damage within cellular targets which may be used as an indicator of oxidative stress. Both practical aspects and general considerations on the applications and limitations of the assays are critically reviewed.

Fawcett, D. W., and Newberne, J. W. (Eds.) (1980)
Workshop on Cellular and Molecular Toxicology
Williams & Wilkins, Baltimore

Contains the proceedings of a workshop that was held in 1978. There were five sessions, the first of which dealt with cell surface membranes. The second session concerned membrane systems of cytoplasmic organelles. The third session dealt with the cell nucleus, the fourth session dealt with mutagenesis, and the fifth session dealt with lysosomes and lysosomal diseases.

Foulkes, E. (1998)
Biological Membranes in Toxicology
Taylor & Francis, Philadelphia

Addresses all aspects of biological membranes and their responses to toxicants. Chapters cover the toxicological significance of biological membranes, experimental approaches, constituents, properties and functions, toxic effects on, membrane transport of toxicants, adaptive changes, and homeostasis and the effects of toxicants.

Galli, C. L., Marinovich, M., and Goldberg, A. M. (Eds.) (1995)
Modulation of Cellular Responses in Toxicity
Springer, New York

Focuses on the modulation of cellular responses in understanding the toxic response. It covers methodologies and methodological approaches that are major contributors to the field of toxicology. It deals with major milestones in cellular toxicology and examines target organ toxicity.

Gutman, Y., and Lazarovici, P. (1997)
Toxins and Signal Transduction
Gordon & Breach, Berkshire, UK

Describes effects from many toxins which act by interfering with the signal transduction initiated by these chemicals (hormones, transmitters, growth factors, and other mediators). The text discusses the molecular mechanisms, involved in the action of these materials as well as the use of these toxins in potential therapeutic roles.

Hamminki, K., Dipple, A., Shuker, D. E. G., Kadlubar, F. F., Segerback, D., and Bartsch, H. (Eds.) (1994)
DNA Adducts, Identification and Biological Significance
IARC, Lyon

A compendium of knowledge on physicochemical properties, methods of synthesis and detection, and the biological relevance of several hundred known DNA adducts that are produced by approximately 20 classes of carcinogens and mutagens. The major sections include an overview of the field, reviews of adduct formation, reviews of the genetic effects of DNA adducts, and research communications interrelating these areas.

Hathway, D. E. (1984)
Molecular Aspects of Toxicology
Royal Society of Chemistry, London

Covers toxicity of foreign compounds, relations among dose and effect and time, metabolism, pharmacogenetics, biochemical lesions, chemical carcinogenesis, and toxicant allergy. This is a fine, well-organized introduction to the subject.

Hodgson, E., and Levi, P. E. (Eds.) (1994)
Introduction to Biochemical Toxicology, 2nd ed.
Appleton & Lange, Norwalk, CT [3rd ed. in preparation and to be published by Wiley by the year 2000]

A basic textbook which focuses on the biochemistry of toxicants—their uptake, distribution, metabolism, biochemical and molecular mode of action, and elimination. Chapters include absorption and distribution, pharmacokinetics, phase I and II reactions, physiological factors affecting the metabolism of xenobiotics, chemical and environmental factors affecting the metabolism of xenobiotics, excretion and elimination, comparative toxicology, reactive metabolites, mechanisms of injury and cellular protection, nutritional factors, receptor interactions, oxidative phosphorylation and photophosphorylation, effects of toxicants on nucleic acid and protein metabolism, carcinogenesis, biochemical toxicology of the peripheral nervous system and central nervous system, hepatotoxicity, pulmonary toxicity, renal toxicity, cardiovascular toxicity, and adaptation to toxicants.

Hornhardt, S. (1996)
Catalogue of Cell Lines in Toxicology and Pharmacology
GSF-Forschungszentrum fur Umwelt und Gesundheit, Neuherberg

Established cell lines are increasingly used for studying the metabolism of xenobiotics, analyzing their mechanism of action, and screening for potential biological effects. The cell lines in the catalog are all considered to be ''permanent,'' i.e., stable for at least 10–20 passages. They are supposed to exist in frozen stocks and to be available to research workers either commercially or from the scientists who established or used the cells. The catalog was supported by the European Centre for the Validation of Alternative Methods.

GSF-Forschungszentrum fur Umwelt und Gesundheit: phone, 08913187-0; fax, 08913187-3372.

Josephy, P. D. (1996)
Molecular Toxicology
Oxford Univ. Press, New York

Explains the principles of toxicology in depth and from the perspective of modern biochemistry and molecular biology. Emphasizing molecular approaches, the book covers xenobiotic transformation, reactive intermediates, cloning, expression, and analysis of enzymes involved in biotransformation, molecular toxicology of aromatic amines, nitrosamines, PAHs, and chlorinated compounds.

Kaufmann, S. H. (Ed.) (1997)
Apoptosis: Pharmacological Implications and Therapeutic Opportunities
Academic Press, San Diego

Reviews the various aspects of the biology of programmed cell death (PCD). The book provides an overview of PCD pathways and identifies key questions for future research and speculates about possible therapeutic possibilities.

Lackie, J. M., and Dow, J. A. T. (1995)
The Dictionary of Cell Biology, 2nd ed.
Academic Press, New York

Gathers together a broad collection of the most frequently used terms in cell and molecular biology as well as various related areas, including genetics, neurobiology, physiology, immunology, and pathology. The definitions are comprehensive and are aimed to assist both students and research workers.

Larson, R. A. (1998)
Naturally Occurring Antioxidants
CRC Press, Boca Raton, FL

Describes the most important classes of antioxidants and provides a general view of autooxidation and antioxidation.

Lasic, D. D., and Martin, F. J. (Eds.) (1995)
Stealth Liposomes
CRC Press, Boca Raton, FL

Examines stealth liposomes from a multidisciplinary approach, which includes theoretical polymer physics, organic synthesis, colloid science, and biology. Discussions include theory, chemistry, biochemistry, pharmacology, model systems, and medical applications in humans.

Levy, E. R., and Herrington, C. S. (Eds.) (1995)
Non-Isotopic Methods in Molecular Biology
Oxford Univ. Press, Oxford

Presents protocols used routinely in both diagnostic and research laboratories to allow the experienced laboratorian to convert existing techniques using radioactive probes to those using nonisotopic probes and to allow the beginner to start. Eight chapters cover these applications in great detail.

Lewis, D. (1996)
Cytochromes P450: Structure, Function and Mechanism
Taylor & Francis, Washington, DC

Focuses on current research on the importance of the cytochrome P450 superfamily to toxicology. The relevance of these enzymes to drug metabolism is reviewed and their importance in drug design is discussed. The author uses his own molecular modeling system to produce high-resolution graphics for illustrating key aspects of the enzyme structure and function.

Lodish, H., Baltimore, D., Berk, A., Zipursky, S. L., Matsudiara, P., and Darnell, J. (1995)
Molecular Cell Biology, 3rd ed
Freeman, New York

Focuses on the central dogma of the new integrated science of cell biology. The four parts include sections introducing the basic concepts and experimental methodologies, describing the working of genes, describing the structure of proteins, and finally discussing cellular interaction.

Marnett, L. J. (Ed.) (1992)
Frontiers in Molecular Toxicology
American Chemical Society, Washington, DC

Presents invited reviews and perspectives in four specific areas in this book. The reviews include toxic agents and their actions, enzymes of activation, inactivation, and repair, physical methods, and macromolecular modification.

Meyers, R. A. (Ed.) (1995)
Molecular Biology and Biotechnology
Wiley–VCH, New York

Provides a professional-level reference work with coverage of the molecular basis of life for application in genetics, medicine, and agriculture. The sections in the book include life processes at the molecular level, genetic disease and therapy, theory and techniques for understanding biological molecules, and application of these to improve plants or animals or to develop microorganisms for specific uses.

Moody, D. E. (Ed.) (1994)
Peroxisome Proliferators: Unique Inducers of Drug-Metabolizing Enzymes
CRC Press, Boca Raton, FL

Collection of 12 chapters written on this little-studied cellular component. Included in this book are sections defining the occurrence of peroxisome proliferators in a variety of species, the acute response to them, mechanisms of proliferation, their role/relationship to liver carcinogenesis, and their role/relationship to drug-metabolizing enzymes.

Murray, J. A. H. (Ed.) (1992)
Antisense RNA and DNA
Wiley–Liss, New York

Explores the use of antisense nucleic acids for regulating gene expression. This is a uniquely comprehensive volume providing an essential reference for researchers in the fields of molecular, cellular, and developmental biology.

Puga, A. (Ed.) (1998)
Molecular Biology of the Toxic Response
Taylor & Francis, Philadelphia

Presents a simple, easy to understand introduction to the fundamental principles of molecular biology for practicing toxicologists. Particularly important are the examples of how molecular biology has been successfully applied to the investigation of important toxicological issues.

Reddy, J. K., Suga, T., Mannaerts, G. P., Lazarow, P. B., and Subramani, S. (Eds.) (1996)
Peroxisomes: Biology and Role in Toxicology and Disease
New York Academy of Sciences, New York

Covers proceedings of an international symposium held in 1995. The papers presented demonstrate the rapid growth in the field of peroxisome biogenesis, peroxisomal protein targeting signals and their receptors, peroxisomal genetic disorders, and proliferators and mechanisms by which these agents exert their varying responses, including liver cancer. The closing sections deals with the relevance of peroxisome–proliferator-inducing effects to human health.

Reiss, C., *et al.* (Eds.) (1998)
Advances in Molecular Toxicology
VSP, Utrecht, The Netherlands

Eight selected topics in molecular toxicology are examined, including cellular and intracellular monitoring of xenobiotics, cell cycle toxicants, skin toxicity, molecular toxicity in kidney, liver, and nerve cells, and probing of DNA damage and repair.

Rice-Evans, C., Halliwell, B., and Lunt, G. G. (1995)
Free Radicals and Oxidative Stress: Environment, Drugs and Food Additives
Portland Press, London

Covers the basics of the chemistry of free radicals (including nitric acid); the way in which side effects of certain drugs and air pollutants can be mediated by free radicals; the mechanisms of action of antioxidants in foods, both as dietary phytochemicals and in food preservation; and the use of antioxidants in the treatment of human disease.

Schenkman, J. B., and Greim, H. (Eds.) (1993)
Cytochrome P450
Springer-Verlag, Berlin

Provides an all-encompassing compendium of the latest information on the many different aspects of the cytochrome P450 monooxygenase system. The book includes the biosynthetic forms as well as the xenobiotic forms of the enzyme and covers many tissue-specific forms. Particularly useful is the section on uniform nomenclature of this enzyme system.

Seiler, J. P., Kroftova, O., and Eybl, V. (Eds.) (1996)
Toxicology—From Cells to Man
Springer, Berlin

Presents proceedings from EUROTOX congress dealing with cellular and subcellular models aimed at improving knowledge about mechanistic aspects of toxicologic effects. Specific topics include intercellular communication, functional teratogenicity, heterocyclic amines in foods, peptide and protein toxicity, human immunotoxicity, and individual susceptibility to occupational toxicants.

Testa, B. (1994)
Biochemistry of Redox Reactions
Academic Press, New York

Covers the wide variety and biochemical and toxicologic significance of this series of reactions. The focus is on the role of these reactions in xenobiotic metabolism and the toxicologic implications of modifications.

Thomas, C. E., and Kalyanaraman, B. (Eds.) (1998)
Oxygen Radicals and the Disease Process
Gordon & Breach, Berkshire, UK

Provides a detailed presentation of the evidence implicating oxygen radicals in the etiology of 11 different human diseases or conditions. Included are case histories in cerebral ischemia, membrane damage, Alzheimer's disease and stroke, aging, rheumatoid arthritis, and inflammatory bowel disease.

Timbrell, J. A. (1991)
Principles of Biochemical Toxicology, 2nd ed.
Taylor & Francis, London

An introductory text on the basic principles and mechanisms underlying the toxicity of foreign agents. It

includes an overview of the principles of absorption, distribution, metabolism, excretion, and dose–response relationships.

Tomei, L. D., and Cope, F. O. (1994)
Apoptosis II: The Molecular Basis of Apoptosis in Disease
Cold Spring Harbor Laboratory Press, Cold Spring Harbor, NY

Provides a look at the hypothesis of apoptosis with an emphasis on application of these concepts to medicine. The concept of apoptosis provides a new look at the behavior of living cells which has afforded the opportunity to generate innovative strategies for the treatment and prevention of disease.

Tyson, C. A., and Frazier, J. M. (Eds.) (1994)
In Vitro Toxicity Indicators *(Methods in Toxicology* Vol. 1B)
Academic Press, New York

Covers toxicity indicators for use in conjunction with *in vitro* systems, primarily for detecting and investigating cytotoxic injury. The introductory chapters provide overviews of toxicity mechanisms. The remaining chapters describe diverse methods for detecting and monitoring critical events within cells that can occur as a result of a cytotoxic challenge.

Tyson, C. A., and Frazier, J. M. (Eds.) (1993)
In Vitro Biological Systems *(Methods in Toxicology* Vol. 1A)
Academic Press, New York

Provides the basic techniques used to prepare and maintain the biological components of *in vitro* model systems. Covers primary cell and cell culture lines. Several models are described.

Vanden Heuvel, J. P. (Ed.) (1998)
PCR Protocols in Molecular Toxicology
CRC Press, Boca Raton, FL

A guide to the use of polymerase chain reaction (PCR) to examine on a molecular and cellular level how toxic responses are manifested. One of the *Methods in Toxicology* series.

Vermeulen, N. P. E., Mulder, G. J., Nieuwenhuyse, H., Peters, W. H. M., and van Bladeren, P. J. (1996)
Glutathione S-Transferases: Structure, Function, and Clinical Implications
CRC Press, Boca Raton, FL

Presents the most recent scientific developments in this enzyme system and covers its role not only in susceptibility to cancer but also in cancer prevention. Divided into sections covering enzymology, structure and function of GSTs, control and regulation of GST-expression and GSH-conjugation *in vivo,* and the clinical relevance of GSTs.

Wagner, C. D. (Ed.) (1994)
Adhesion Molecules
Academic Press, New York

Presents the biology of these molecules with particular emphasis on the impact of modification on human health. The sections of the book include cell adhesion molecules (background), regulation and specificity, role in disease, and role in infection.

Wallace, K. B. (1997)
Free Radical Toxicology
Taylor & Francis, Philadelphia

Provides insight into the involvement of free readicals in the pathogenesis of chemical-induced toxic tissue injury.

Walum, E., Stenberg, K., and Jenssen, D. (1990)
Understanding Cell Toxicology: Principles & Practice
Ellis Horwood, New York

Describes in detail the physiology of the cell, how to culture cells, cell proliferation, toxicology issues, and oncogenicity. It is a valuable textbook on the subject.

Watson, J. D., Hopkins, N. H., Roberts, J. W., Steitz, J. A., and Weiner, A. M. (1987)
Molecular Biology of the Gene, 4th ed.
Benjamin/Cummings, Menlo Park, CA

Aimed at being a text for teaching molecular biology to the undergraduate while providing molecular biologists an easy reference for facts about genes. This is the fourth edition of this important book which covers the essentials of the field on a theoretical basis.

Wu, R. (Ed.) (1995)
Recombinant DNA Methodology II
Academic Press, San Diego

Presents selected articles covering the application of recombinant DNA methods in biomedical research. The material presented includes extensive description or theoretical discussion of important methods in an easy to use style.

See Also:
Aschner: *The Role of Glia in Neurotoxicity* (Target Sites—Nervous System)

Barile: *Introduction to in Vitro Cytotoxicology* (Testing Methods and Toxicity Assessment)

Bonifacino: *Current Protocols in Cell Biology* (Testing Methods and Toxicity Assessment)

Coulson: *Molecular Mechanisms of Drug Action* (Chemicals—Drugs)

Daston: *Molecular and Cellular Methods in Developmental Toxicology* (Developmental and Reproductive Toxicology)

DeBruin: *Biochemical Toxicology of Environmental Agents* (Environmental)

Devillers: *Culture of Epithelial Cells* (Testing Methods and Toxicity Assessment)

Freshney: *Culture of Animal Cells* (Testing Methods and Toxicity Assessment)

Gibson: *Peroxisomes* (Target Sites—Liver)

Goyer: *Toxicology of Metals: Biochemical Aspects* (Chemicals—Metals)

Gregory: *Apoptosis and the Immune Response* (Target Sites—Immune)

Moody: *Molecular Basis of Anesthetics* (Chemicals—Drugs)

Rogiers: *Human Cells in in Vitro Pharmacotoxicology* (Testing Methods and Toxicity Assessment)

Salisbury: *Molecular Pathology* (Pathology)

Shaw: *Glutathione in the Nervous System* (Target Sites—Nervous System)

Sluyser: *Apoptosis in Normal Development and Cancer* (Cancer)

Journals

Cell Biology and Toxicology

Chemico-Biological Interactions

Environmental and Molecular Mutagenesis

Free Radical Biology and Medicine

Free Radical Research

In Vitro and Molecular Toxicology

Journal of Biochemical Toxicology

Molecular Carcinogenesis

Journal Articles

Ahmed, F. E. (1995). Applications of molecular biology to biomedicine and toxicology. ***J. Environ. Sci. Health C Environ. Carcinogen. Ecotoxicol. Rev.* 13,** 1–51.

Anders, M. W., and Dekant, W. (1998). Glutathione-dependent bioactivation of haloalkenes. ***Annu. Rev. Pharmacol. Toxicol.* 38,** 501–537.

Aust, S. D., *et al.* (1993). Free radicals in toxicology. ***Toxicol. Appl. Pharmacol.* 120,** 168–178.

Bortner, C. D., and Cidlowski, J. A. (1998). A necessary role for cell shrinkage in apoptosis. ***Biochem. Pharmacol.* 56,** 1549–1559.

Boyd, R. T. (1997). The molecular biology of neuronal nicotinic acetylcholine receptors. ***Crit. Rev. Toxicol.* 27,** 299–324.

Brown, B. G., *et al.* (1995). Molecular toxicology endpoints in rodent inhalation studies. ***Exp. Toxicol. Pathol.* 47**(2/3), 183–191.

Cohen, S. D., *et al.* (1997). Selective protein covalent binding and target organ toxicity. ***Toxicol. Appl. Pharmacol.* 143,** 1–12.

Corcoran, G. B., *et al.* (1994). Apoptosis: Molecular control point in toxicity. ***Toxicol. Appl. Pharmacol.* 128,** 169–181.

Cupp, M. J., and Tracy, T. S. (1998). Cytochrome P450: New nomenclature and clinical implications. ***Am. Fam. Physician* 57,** 107–116.

Garrigue, J. L., *et al.* (1995). Predictive molecular and genetic toxicology. Application to the detection of sensitizing potential of xenobiotics. ***Clin. Rev. Allergy Immunol.* 13**(3), 189–200.

Goeptar, A. R. (1995). Oxygen and xenobiotic reductase activities of cytochrome P450. ***Crit. Rev. Toxicol.* 25,** 25–66.

Halpert, J. R., *et al.* (1994). Selective inhibitors of cytochromes P450. ***Toxicol. Appl. Pharmacol.* 125,** 163–175.

Herman, B., *et al.* (1991). Calcium and pH in anoxic and toxic injury. ***Crit. Rev. Toxicol.* 21,** 127–148.

Hertz, R., and Bar-tana, J. (1998). Peroxisome proliferator-activated receptar (PPAR) alpha activation and its consequences in humans. ***Toxicol. Lett.* 102–103,** 85–90.

Hines, R. N., *et al.* (1994). The mammalian flavin-containing monooxygenases: Molecular characterization and regulation of expression. ***Toxicol. Appl. Pharmacol.* 125,** 1–6.

Hinson, J. A., and Roberts, D. W. (1992). Role of covalent and noncovalent interactions in cell toxicity: Effects on proteins. ***Annu. Rev. Pharmacol. Toxicol.* 32,** 471–510.

Kehrer, J. P. (1993). Free radicals as mediators of tissue injury and disease. ***Crit. Rev. Toxicol.* 23,** 21–48.

Laskin, D. L., and Pendino, K. J. (1995). Macrophages and inflammatory mediators in tissue injury. ***Annu. Rev. Pharmacol. Toxicol.* 35,** 655–678.

Lewis, D. F., Ioannides, C., and Parke, D. V. (1998). Cytochromes P450 and species differences in xenobiotic metabolism and activation of carcinogen. ***Environ. Health Perspect.* 106,** 633–641.

Lin, J. H., and Lu, A. Y. (1998). Inhibition and induction of cytochrome P450 and the clinical implications. ***Clin. Pharmacokinet.* 35,** 361–390.

LoPachin, R. M., and Lehning, E. J. (1997). Mechanism of calcium entry during axon injury and degeneration. ***Toxicol. Appl. Pharmacol.* 143,** 233–244.

Masters, C., and Crane, D. (1998). On the role of the peroxisome in cell differentiation and carcinogenesis. ***Mol. Cell. Biochem.* 187,** 85–97.

Merrill, A. H., Jr., *et al.* (1997). Sphingolipids—The enigmatic lipid class: Biochemistry, physiology, and pathophysiology. ***Toxicol. Appl. Pharmacol.* 142,** 208–225.

Monks, T. J., and Lau, S. S. (1998). The pharmacology and toxicology of polyphenolic–glutathione conjugates. ***Annu. Rev. Pharmacol. Toxicol.* 38,** 229–255.

Monks, T. J., *et al.* (1992). Quinone chemistry and toxicity. ***Toxicol. Appl. Pharmacol.* 112,** 2–16.

Nelson, S. D., and Pearson, P. G. (1990). Covalent and noncovalent interactions in acute lethal cell injury caused by chemicals. ***Annu. Rev. Pharmacol. Toxicol.* 30,** 169–195.

Nestmann, E. R. (1996). Toxicological significance of DNA adducts: Summary of discussions with an expert panel. ***Reg. Toxicol. Pharmacol.* 24,** 9–18.

Novak, R. F. (1997). Molecular and cellular toxicology [Proposal for a Center in Molecular and Cellular Toxicology with Human Applications]. ***CRISP Database,*** CRISP/97/ES06639-03. (National Institutes of Health, Bethesda, MD).

Nuwaysir, E. F., *et al.* (1999). Microarrays and toxicology: The advent of toxicogenomics. ***Mol. Carcinogen* 24,** 153–159.

Pasanen, M., and Pelkonen, O. (1994). The expression and environmental regulation of P450 enzymes in human placenta. ***Crit. Rev. Toxicol.* 24,** 211–230.

Raffray, M., and Cohen, G. M. (1997, September). Apoptosis and necrosis in toxicology: A continuum or distinct modes of cell death? ***Pharmacol. Ther.* 75**(3), 153–177.

Reed, D. J. (1992). Glutathione: Toxicological implications. ***Annu. Rev. Pharmacol. Toxicol.* 32,** 471–510.

Reuhl, K. R., *et al.* (1994). Cytoskeleton and cell adhesion molecules: Critical targets of toxic agents. ***Neurotoxicology* 15,** 133–145.

Roberts, R. A., *et al.* (1997). Perturbation of the mitosis/apoptosis balance: A fundamental mechanism in toxicology. ***Toxicol. Appl. Pharmacol.* 38,** 107–115.

Rowlands, J. C., and Gustafsson, J. A. (1997). Aryl hydrocarbon receptor-mediated signal transduction. ***Crit. Rev. Toxicol.* 27,** 109–134.

Ryan, T. P., and Aust, S. D. (1992). The role of iron in oxygen-mediated toxicities. ***Crit. Rev. Toxicol.* 22,** 119–142.

Seydel, U. (1998). Molecular basis of endotoxin toxicity. ***Ann. N.Y. Acad. Sci.* 851,** 406–407.

Smith, C. V., *et al.* (1996). Compartmentation of glutathione: Implications for the study of toxicity and disease. ***Toxicol. Appl. Pharmacol.* 140,** 1–12.

Smith, R. P., and Wilcox, D. E. (1994). Toxicology of selected nitric oxide-donating xenobiotics, with particular reference to azide. ***Crit. Rev. Toxicol.* 27,** 355–378.

Testa, B., and Mayer, J. (1998). Molecular toxicology and the medicinal chemist. ***Farmaco* 53**(4), 287–291.

Vainio, H. (1995). Molecular approaches in toxicology: Change in perspective. ***J. Occup. Environ. Med.* 37,** 14–18.

Vanden Heuvel, J. P. (1999). Peroxisome proliferator-activated receptors: A critical link among fatty acids, gene expression and carcinogenesis. ***J. Nutrition* 129,**(2S Suppl.), 575S–580S.

Wallace, K. B., *et al.* (1997). Mitochondria-mediated cell injury. ***Toxicol. Appl. Pharmacol.* 38,** 23–37.

Wolf, C. R., and Henderson, C. J. (1998). Use of transgenic animals in understanding molecular mechanisms of toxicity. ***J. Pharm. Pharmacol.* 50**(6), 567–574.

Youssel, J., and Badr, M. (1998). Extraperoxisomal targets of peroxisome proliferators: Mitrochondrial, microsomal, and cytosolic effects. Implications for health and disease. ***Crit. Rev. Toxicol.* 28,** 1–33.

NOISE

Axelsson, A., *et al.* (Eds.) (1996)
Scientific Basis of Noise-Induced Hearing Loss
Thieme, Stuttgart

Papers are grouped into four sections, all with respect to noise-induced hearing loss: biological basis, experimental studies, auditory performance changes, and human studies.

Cowan, J. P. (1994)
Handbook of Environmental Acoustics
Van Nostrand–Reinhold, New York

Provides easy to follow explanations of acoustic terminology, noise control design, and regulatory noise issues. Key aspects of environmental noise are clarified in basic language in such areas as common noise sources, current noise regulations, guidelines and standards, effects of noise on people and animals, relevant noise rating methods, and noise control designs.

Dancer, A. L., *et al.* (Eds.) (1992)
Noise-Induced Hearing Loss
Mosby/Year Book, New York

Examines noise-induced hearing loss from the perspectives of cochlear mechanisms, central changes, cofactors, performance changes, hearing protection, susceptibility and resistance to noise, and parameters of the exposure.

Dobie, R. A. (1993)
Medical–Legal Evaluation of Hearing Loss
Van Nostrand–Reinhold, New York

Covers the physics of sound, normal hearing, disorders causing hearing loss, hearing evaluation, hearing conservation programs, and operational guidance for prevention of hearing loss. Case studies are used to illustrate both methods of analysis and typical reports.

Fay, T. H. (Ed.) (1991)
Noise and Health
New York Academy of Medicine, New York

Discusses sources of noise and its effect on the cardiovascular, neuroendocrine, immunological, and gastrointestinal systems. Specific strategies for noise abatement and reviews of noise legislation are included. The last section deals with public awareness of the hazards of noise.

Kryter, K. D. (1994)
The Handbook of Hearing and the Effects of Noise: Physiology, Psychology, and Public Health
Academic Press, San Diego

Presents the methods and results of research for quantitatively describing the major attributes of hearing and the effects of sound and noise on people.

Salvi, R. J., *et al.* (1986)
Basic and Applied Aspects of Noise-Induced Hearing Loss
Plenum, New York

Volume III, Series A: Life Sciences of the *NATO ASI Series*. The initial focus is on anatomical and physiological disturbances resulting from noise-induced hearing loss. Then, sections including general auditory performance in noise, noise-exposure criteria, nonauditory effects of noise, and interaction of noise with other agents are discussed.

See Also:
Section on Occupational Health (especially entry on National Institute for Occupational Safety and Health, which publishes documents related to noise)

Journal Articles

Arslan, E., and Orzan, E. (1998). Audiological management of noise induced hearing loss. ***Scand. Audio. Suppl.* 48,** 131–145.

Boettcher, F. A., *et al.* (1995). Effects of noise and age on the auditory system. ***Occup. Med.* 10,** 577–591.

Cary, R., Clarke, S., and Delic, J. (1997). Effects of combined exposure to noise and toxic substances; Critical review of the literature. ***Ann. Occup. Hygiene*** **41**(4), 455–465.

Casali, J. G., and Berger, E. H. (1996). Technology advancements in hearing protection circa 1995: Active noise reduction, frequency/amplitude-sensitivity, and uniform attenuation. ***Am. Ind. Hygiene Assoc. J.* 57,** 175–185.

Dancer, A. L. (1995). Use of animal models in the study of the effects of noise on hearing. ***Occup. Med.*** **10**(3), 535–544.

Fechter, L. D. (1995). Combined effects of noise and chemicals. ***Occup. Med.* 10,** 609–621.

Gomez-Cano, H. M. (1994). Ergonomic aspects of noise. ***Salud Trabajo*** **102,** 33–41.

Hale, D. R. (1996). Noise in the hospital: A quality improvement approach. ***J. Nursing Admin.* 26,** 4–18.

Henderson, D., and Hamernik, R. P. (1995). Biologic bases of noise-induced hearing loss. ***Occup. Med.*** **10,** 513–534.

Henderson, D., and Salvi, R. J. (1998). Effects of noise exposure on the auditory functions. ***Scand. Audiol. Suppl.* 48,** 63–73.

Malchaire, J., and Piette, A. (1997). A comprehensive strategy for the assessment of noise exposure and risk of hearing impairment. ***Ann. Occup. Hyg.* 41,** 467–484.

Merry, C. J., and Franks, J. R. (1995). Historical assessment and future directions in the prevention of occupational hearing loss. ***Occup. Med.* 10,** 669–681.

Morata, T. C., and Lemasters, G. K. (1995). Epidemiologic considerations in the evaluation of occupational hearing loss. ***Occup. Med.* 10,** 641–656.

Morata, T. C., *et al.* (1994). Occupational exposure to noise ototoxic organic solvents. ***Arch. Environ. Health* 49,** 359–365.

Morioka, I., *et al.* (1995). Evaluation of noise-induced hearing loss by reference to the upper limit of hearing. ***Int. Arch. Occup. Environ. Health* 67,** 301–304.

Porter, N. D. (1995). **Assessment of industrial noise: Subjective listening tests and objective assessment procedures,** NTIS/PB96-152848.

Staples, S. L. (1997). Public policy and environmental noise: Modeling exposure or understanding effects. ***Am. J. Public Health* 87**(12), 2063–2067.

Tearle, P. (1998). Noise at work. ***Commun. Dis. Public Health* 1,** 138–140.

OCCUPATIONAL HEALTH

American Conference of Governmental Industrial Hygienists (ACGIH)
TLVs and BEIs (annual)
ACGIH, Cincinnati, OH

TLVs are threshold limit values, and BEIs are biological exposure indices. This annual pocket-sized publication is used in recognizing, evaluating, and controlling exposures to hazardous agents. Recommendations or guidelines are presented for chemical substances, physical agents, and biological exposure determinants. Chemical Abstract Service Registry numbers are listed with each chemical substance. An electronic version on diskette is also available from ACGIH.

American Conference of Governmental Industrial Hygienists (ACGIH) (1993)
Documentation of Threshold Limit Values (TLV) and Biological Exposure Indices (BEI), 6th ed.
ACGIH, Cincinnati, OH

ACHIH Publication No. 0206. Provides the basic rationale for the development of TLVs for chemical substances and physical agents and of BEIs for selected chemicals. In the chemical substances TLV section, ''timelines'' present an historical overview of the TLV adoption process. Information is also provided on the OSHA PELs, NIOSH RELs, and NTP studies; carcinogen designations from various sources; and values from selected other countries. ACGIH also offers a CD-ROM product, *TLVs and Other Occupational Exposure Values,* which includes this documentation of the TLVs, the NIOSH analytical methods, and all the TLVs and BEIs which have appeared in their booklets since 1946. Also included in this CD-ROM package are selected compounds from RTECS, selected International Occupational Exposure Limits, synonyms, CAS numbers, the NIOSH RELs, as well as IDLH values and international carcinogenicity designations.

American Conference of Governmental Industrial Hygienists (ACGIH) (1998)
Industrial Ventilation. A Manual of Recommended Practice, 23rd ed.
ACGIH, Cincinnati, OH

A guide to design, maintenance, and evaluation of industrial exhaust ventilation systems. It presents a logical method of designing and testing these systems. Details are provided on calculating velocity pressure and stack height.

American Industrial Hygiene Association (AIHA) (1998)
AIHA 1998 Emergency Response Planning Guidelines and Workplace Environmental Exposure Level Guides Handbook
AIHA, Fairfax, VA

Presents an overview of AIHA established exposure limits. Pocket-sized format for quick reference.

Anderson, K., and Scott, R. (1981).
Fundamentals of Industrial Toxicology
Ann Arbor Science, Ann Arbor, MI

Presents the concepts of industrial toxicology in a concise, easily readable manner. The principles of toxicology are introduced, specific examples are given, and further readings/references are included, all in a compact and convenient format.

Ashford, N. A., and Miller, C. S. (1991)
Chemical Exposures—Low Levels and High Stakes
Van Nostrand–Reinhold, New York

Deals with chemical sensitivity relating to low-level chemical exposure. Part one defines the problem of chemical sensitivity. Part two describes possible mechanisms, diagnostic approaches and therapies, areas of agreement and disagreement between allergist and clinical ecologists. Part three addresses research needs, patient and community concerns, health care, insurance and compensation needs, and recommendations.

Bisesi, M. S., and Kohn, J. P. (1995)
Industrial Hygiene Evaluation Methods
Lewis, Boca Raton, FL

To be used in education and training of students in health programs. The 27 chapters present the basics for the detection of atmospheric contaminants, the implementation of programs, and guidance for remediation and control strategies.

Boleij, J. S., Buringh, E., Heederik, D., and Kromhout, H. (1995)
Occupational Hygiene of Chemical and Biological Agents
Elsevier, New York

Focuses on the assessment of exposures to potentially hazardous agents in the workplace. Key concepts and methods of exposure modeling are addressed and the wide applicability of these strategies is illustrated. It includes compliance testing, quantification of local sources of exposure, and exposure assessment in epidemiologic surveys.

Brooks, S., Gochfeld, M., Herzstein, J., Schenker, M., and Jackson, R. (1995)
Environmental Medicine
Mosby, St. Louis

Intended to give the reader a comprehensive resource of scientific information on environmental health—the effects (physical, chemical, and biological) of the environment on man. The book is directed to the general practitioner. The major sections deal with principles, basic science, clinical environmental medicine, susceptible populations, specific exposure sources, and preventive approaches.

Burgess, W. A. (1995)
Recognition of Health Hazards in Industry, 2nd ed
Wiley, New York

A practical guide to identifying major health issues in the workplace with an overview of common control approaches. The book contains a detailed survey of work tasks in a wide range of industries enabling the reader to recognize health problems in design and operation.

Burgess, W. A., and Mumford, C. J. (1996).
The Safe Handling of Chemicals in Industry
Wiley, New York

This two-volume set is a practical handbook on the safe handling of chemicals in the lab, factory, office, or school. It provides guidelines on the safe storage, transport, handling, and disposal of many commonly used chemicals. Included are many illustrative brief histories to depict problems that can arise in practice.

Burke, R. (1997)
Hazardous Materials Chemistry for Emergency Responders
Lewis, Boca Raton, FL

Designed for ready use by emergency responders. The book includes sections on the top 50 industrial chemicals and other common hazardous materials, excerpts from actual incidents, definitions of widely used chemical terms, and basic concepts in chemistry. All of these are presented with reference to what emergency responders need to know.

Burton, D. J. (1997)
Industrial Ventilation Workbook, 4th ed.
American Industrial Hygiene Association, Fairfax, VA

Provides the latest information and items such as checklists, forms, charts, testing and sampling techniques, control, and case studies needed to understand the topic. This book includes chapters on the behavior of industrial air, problem characterization, hood and duct design, loss factors, makeup air and recirculation, dilution ventilation, troubleshooting and system testing, fan selection, and stack design.

Cheremisinoff, N. P. (1995)
Handbook of Emergency Response and Toxic Chemical Releases: A Guide to Compliance
Noyes, Park Ridge, NJ

Working reference designed for safety officers, environmental engineers, and consultants. The text provides detailed guidelines on preparing right-to-know reporting audits, establishing training programs, and developing and implementing emergency response programs. It also offers extensive technical data on toxic chemical properties and detailed instructions on how to prepare release inventories.

Choudhary, G. (Ed.) (1981)
Chemical Hazards in the Workplace
American Chemical Society, Washington, DC

Gives an excellent perspective on the measurement and control of chemical hazards in the workplace. The chapters are organized into methodology, monitoring, control, special toxicants, quality assurance, and emerging technologies. The basis for chemical control in the workplace is well described.

Commission of the Investigation of Health Hazards of Chemical Compounds in the Work Area (1997)
List of MAK and BAT Values 1997, No. 33
Wiley–VCH, New York

Classifies about 600 chemical compounds with information on the maximum concentrations at the work-

place (MAK) and the biological tolerance values (BATs).

Costa, L. G., and Manzo, L. G. (1998)
Occupational Neurotoxicology
CRC Press, Boca Raton, FL

Discusses neurotoxic agents commonly encountered in the workplace, signs, symptoms of neurotoxicity, biomarkers, occupational neurotoxicity in developing countries, and many other subjects.

Craighead, J. E. (Ed.) (1995)
Environmental and Occupational Disease
Mosby/Year Book, Chicago

Reviews the interaction between environmental and occupational health. The chapters are written by those well-known in their defined areas and the information is presented well.

Crowl, D. A., and Louvar, J. F. (1990)
Chemical Process Safety: Fundamentals with Applications
Prentice Hall, Engelwood Cliffs, NJ

Designed to teach and apply the fundamentals of chemical process safety. The fundamentals are presented to help the student and practicing scientist understand the concepts and apply them accordingly. The material presented is limited to that deemed essential for industrial and university practice.

Danse, I. R. (1991)
Common Sense Toxics in the Workplace
Van Nostrand–Reinhold, New York

Covers diagnosis, treatment, and prevention of toxic injuries in the workplace. This book explains toxic substances in terms of human health, clarifies common work-related problems, and offers solutions for workers' compensation claims.

DiBerandinis, L. J. (Ed.) (1998)
Handbook of Occupational Safety and Health, 2nd ed.
Wiley, New York

Presents a complete program of effective responses to a wide range of workplace health and safety problems. Thirty chapters.

DiNardi, S. R. (Ed.) (1997)
The Occupational Environment—Its Evaluation and Control
AIHA Press, Fairfax, VA

A primary reference for anyone interested in industrial hygiene. The book provides coverage of the appropriate disciplines and is organized along the practice model of anticipation, recognition, evaluation, and control. The book contains 50 separate chapters covering background, hazard recognition and evaluation, physical agents, the human at work, controlling the occupational environment, and program management.

Donham, K. J., Rautianen, R., Schuman, S. H., and Lay, J. A. (1997)
Agricultural Health and Safety: Recent Advances
Haworth, Binghamton, NY

Considers agricultural health and safety problems and effective interventions worldwide. The book reviews the proper use of pesticides, the Migrant Network Coalition, dust, inhaled agents, and other environmental exposures in the farm setting. The book is designed to raise awareness in the farming and farming services communities.

European Chemical Industry Ecology and Toxicology Centre (ECETOC) (1991)
Technical Report No. 43: Emergency Exposure Indices for Industrial Chemicals
ECETOC, Brussels

Examines the criteria for defining indices of exposure which could be used as guidance on the potential health effects from accidental chemical releases. It develops guidelines for their setting and use and provides a few representative samples. There is a bibliography.

European Centre for Ectoxicology and Toxicology of Chemicals (ECETOC) (1994)
Technical Report No. 59: Testing for Worker Protection
ECETOC, Brussels

Presents a practical approach to risk assessment for occupational exposure standard setting and practical guidance on requirements for animal and human data. The various types of occupational exposure limits, the way in which health may be affected by exposure, and the processes used by authorities and company specialists when setting these provisional limits are explained.

Fleming, D. O., and Richardson, J. (Ed.) (1995)
Laboratory Safety: Principles and Practices, 2nd ed.
ASM Press, Washington, DC

Begins with a statement on the epidemiology of laboratory-acquired infections during the past decade and includes, in subsequent chapters, documentation of additional previously unreported laboratory infections. The accompanying hazard assessments provide a structured means for evaluating the risks.

Furr, A. K. (Ed.) (1995)
CRC Handbook of Laboratory Safety
Lewis, Boca Raton, FL

Keeps managers and laboratory personnel up-to-date on effective programs to meet the needs of new laboratory safety regulations.

Greenberg, M. I., Hamilton, R. J., and Phillips, S. D. (Eds.) (1997)
Occupational, Industrial, and Environmental Toxicology
Mosby, St. Louis

Presents the basics of the three main facets of toxicology in the title in an overview fashion. Features a nonagent-specific organization. Each of the main sections is cross-referenced to allow the reader access to key information. This book is particularly useful to those trying to gain an appreciation of the interconnections between these areas.

Hall, S. K., Chakraborty, J., and Ruch, R. (1997)
Chemical Exposure and Toxic Response
CRC Press, Boca Raton, FL

Intended as an overview of occupational toxicology for practitioners and students. The main sections in this book include general principles, toxic responses, and the work environment.

Hamilton, A., Hardy, H. L., and Harbison, R. D. (1998)
Hamilton and Hardy's Industrial Toxicology, 5th ed.
Mosby, St. Louis

The newest edition of a classic text in industrial toxicology. Covers metals and metalloids, assorted chemical compounds, organic high polymers, pesticides, physical agents, dusts, and selected topics in industrial toxicology. Risk is included where pertinent.

Harber, P., Schenker, M. B., and Balmes, J. R. (Eds.) (1996)
Occupational and Environmental Respiratory Disease
Mosby, St. Louis

Approaches to understanding respiratory disease are intertwined and all must be integrated to prevent and/or manage these disorders. There is a strong emphasis on the relationship between disease and exposure. The results of fundamental biologically oriented research are blended with descriptive examples in the text.

Harrington, J. M., *et al.* (1998)
Pocket Consultant: Occupational Health, 4th ed.
Blackwell, Malden, MA

Covers both medicine (managing occupational disease) and hygiene (prevention of occupational disease and minimization of risks). Additional sections on nursing and law. Reorganized to mirror new international regulations on occupational health.

Henschler, D. (1991–)
Occupational Toxicants: Critical Data Evaluation for MAK Values and Classification of Carcinogens
Wiley, New York

As of mid-1999, twelve volumes have been published in this important project to translate into English the detailed annual listing in Germany of MAK (maximum concentration at the workplace) values, classification of carcinogenic substances, and BAT (biological tolerance values for working materials) values. Provides very thorough toxicological data on a cross section of chemicals.

Herington, T. N., and Morse, L. H. (Eds.) (1995)
Occupational Injuries
Mosby, St. Louis

Presents 37 chapters covering the field of occupational injury. Occupational injuries by organ/organ system are discussed, followed by prevention and control options. A section on special topics such as pain management and building-related disorders is included.

International Program on Chemical Safety, United Nations Environment Programme
Health and Safety Guides
World Health Organization, Geneva

Brief companion volumes to the *Environmental Health Criteria* series, these guides provide concise summaries of chemical information. Includes data on exposure, environmental fate, kinetics and metabolism, effects on humans and animals, emergency actions, and regulations.

Johnson, H., Lund, S. P., Matikainen, E., Midtgard, U., Simonsen, L., and Wennberg, A. (1992)
Occupational Neurotoxicity: Critical Document for Evaluation of Existing Data
Nordic Council of Ministers Report, Copenhagen

Describes and discusses the criteria for evaluating existing data on neurotoxicity of chemicals. This document is mainly meant as a tool for identification of hazardous chemicals which are important for risk assessment in their impact to the nervous system.

Kipp, J. D., and Loflin, M. E. (1996)
Emergency Incident Risk Management: A Safety and Health Perspective
Van Nostrand–Reinhold, New York

Emphasis on risk management for fire-fighting personnel; the book shows how to develop and implement a program that can reduce on-the-job fatalities, injuries, and harmful exposures while minimizing property and equipment damage. The book gives examples on how

to analyze accident, injury, and illness data. The book contains excellent chapters on bloodborne pathogens, confined spaces, respiratory protection, and hazardous wastes.

Kohn, J. P., Friend, M. A., and Winterberger, C. A. (1996)
Fundamentals of Occupational Safety and Health
Government Institutes, Rockville, MD

Presents the basic information safety and health professionals need to control hazards and losses and protect the health and lives of workers. The book covers topics from basic principles to emerging trends in areas such as ergonomics, psychology and safety, and fire science. There is also a section identifying safety information resources.

LaDou, J. (Ed) (1994)
Occupational Health and Safety, 2nd ed.
National Safety Council, Chicago

Provides the basic working knowledge necessary to accomplish the goal of workplace injury and illness prevention. It encompasses legal considerations, managing the health and safety process, and managing human resources.

Langley, R. L., McLymore, R. L., Meggs, W. J., and Roberson, G. T. (1997)
Safety and Health in Agriculture, Forestry, and Fisheries
Government Institutes, Rockville, MD

Intended to be a comprehensive source of information on safety and health on farms, in forests, and on the waters. The book discusses the health and safety issues facing these groups and identifies each group's unique hazards and characteristics.

Levy, B., and Wegman, D. H. (Eds.) (1995)
Occupational Health. Recognizing and Preventing Work-Related Disease, 3rd ed.
Little, Brown, New York

Covers the context of work and health and approaches to recognizing, responding to, and preventing the consequences of work-related health problems. It includes hazardous exposures and their effects, occupational disorders by organ system, and workers.

Lewis, P. (1993)
Health Protection from Chemicals in the Workplace
Ellis Horwood, Chichester, UK

Deals with the protection of the health of people at work from the effects of hazardous chemicals. It covers the provision of health services in industry, the auditing of occupational health, and evaluation of chemical hazards, the assessment of health risks, and approaches for the prevention or minimization of exposure to chemicals. It addresses the principal health effects which can arise from short- or long-term exposure to chemicals.

Lipton, S., and Lynch, J. (1994)
Handbook of Health Hazard Control in the Chemical Process Industry
Wiley, New York

Designed for industrial hygienists and other health professionals, the book deals with occupational health hazards, sources of exposure, exposure evaluation, regulations, emission controls, and storage. The environmental aspects of process control are well covered.

Lowe, E. A., Warren, J. L., and Moran, S. R. (1997)
Discovering Industrial Ecology
Battelle, Columbus, OH

Offers a practical overview of the emerging field of industrial ecology. The book focuses on applications to industry, infrastructure, public operations, and public policy. It includes both actual and hypothetical cases to advance understanding of the full implications of industrial ecology.

Manuele, F. A. (Ed) (1997)
On the Practice of Safety, 2nd ed.
Wiley, New York

Presents the fundamental practices and principles of safety for students and practitioners. Topics include basic principles, causation models, hazard analysis and risk assessment, safety management, audits, and OSHA's role. The book is a useful training guide as well as a good update for the expert.

McCunney, R. J. (1994)
A Practical Approach to Occupational and Environmental Medicine, 2nd ed.
Little Brown, New York

Offers 50 chapters in areas such as occupational medical services, occupational-related illnesses, evaluating a health hazard or work environment, challenges in occupational medicine, and environmental medicine. The book includes useful appendices covering health effects of common substances, resource availability, and informational services.

Nagda, N. L., and Harper, J. P. (Eds.) (1989)
Design and Protocol for Monitoring Indoor Air Quality
ASTM, Philadelphia

Focuses on the designs and protocols used in indoor air monitoring studies. From an ASTM-sponsored

symposium, the book provides case studies, in-depth views of design and protocol, and the relationship of these to the study results. Technical papers present latest developments and offer valuable practical experience.

National Institute for Occupational Safety and Health (NIOSH)
NIOSH publications
NIOSH, Cincinnati, OH

NIOSH publishes extensively in the field of occupational safety and health. Their *Criteria Documents* provide the basis for comprehensive occupational safety and health standards. These contain critical reviews of scientific and technical information on the prevalence of hazards, existence of safety and health risks, and adequacy of methods to identify and control hazards. They recommend criteria or measures to protect workers. Meant to complement these publications are the *Special Hazard Reviews* and the *Occupational Hazard Assessments*. NISOH also produces *Joint Occupational Health Documents* in collaboration with foreign governments. The *Current Intelligence Bulletins* review and evaluate new and emerging information about occupational hazards. Their *Pocket Guide to Chemical Hazards* provides general industrial hygiene information on workplace chemicals and contains information, including NIOSH RELs, OSHA PELs, IDLH values, odor thresholds, health hazards, target organs, and symptoms. The NIOSH *Manual of Analytical Methods* provides methods for sampling and analysis (see Eller: Analytical Toxicology). Many of these publications are available in diskette or CD-ROM form. The general phone number for NIOSH publications is 1-800-35-NIOSH. The Web page address for NIOSH publications is *http://www.cdc.gov/niosh/pubs.html*.

National Research Council (1990)
Tracking Toxic Substances at Industrial Facilities
National Academy Press, Washington, DC

Reports on the need to track chemicals through their life cycle to assess potential impact on human health. Mass balance information by itself is not sufficient. The report focuses on engineering and technical, not economic, issues. Included in the book are topics such as obtaining mass balances, use of material accounting data, toxic chemical release information, assessment of waste-reduction efficiency, and chemical management strategies.

National Research Council (1995)
Prudent Practices in the Laboratory: Handling and Disposal of Chemicals, 3rd ed.
National Academy Press, Washington, DC

An authoritative reference on the handling and disposal of chemicals from ''cradle to grave'' at the laboratory level. In addition, there is a section on how to handle compounds that pose special hazards which includes special chemical and toxicological information on 88 compounds commonly found in laboratories.

Ness, S. A. (1994)
Surface and Dermal Monitoring for Toxic Exposures
Van Nostrand–Reinhold, New York

Text offers current information on sampling methods for contamination from chemicals, microorganisms, and radiation. The contents include a complete description of dermal sampling techniques, strategies for determining when dermal exposures are significant, and insight into interesting case examples.

Occupational Medicine and State of the Art Reviews
Hanley & Belfus, Philadelphia

A monographic series. Past volumes have examined issues such as the pharmaceutical industry, occupational hearing loss, firefighters, women workers, and occupational epidemiology.

Occupational Safety and Health
Dekker, New York

Recent volumes of this monographic series include Vol. 24, *Occupational Hearing Loss,* 2nd ed.; Vol. 25, *Protective Clothing Systems and Materials;* Vol. 26, *Biohazards Management Handbook;* and Vol. 27, *Occupational Ergonomics.*

Perkins, J. L. (1997)
Modern Industrial Hygiene: Recognition and Evaluation of Chemical Agents
Academic Press, New York

Covers topics ranging from overview of industrial hygiene through discussions of sampling strategy, exposure assessment, statistics, instrumentation, and sampling media. Appendices provide hard-to-find data on vapor pressure and other physical–chemical constants. It is multidisciplinary and focuses on practical issues and examples.

Perkins, J. L., and Rose, V. E. (Eds.) (1987)
Case Studies in Industrial Hygiene
Wiley–Interscience, New York

Presents situations and solutions from the workplace regarding commonly occurring events. Written for industrial hygienists desiring examples of situational problems.

Peterson, J. E. (1991)
Industrial Health
ACGIH, Cincinnati, OH

Gives the reader a clear understanding of the fundamentals and principles behind attempts to evaluate and control hazards in the environment. Occupational hazards are the focus, ranging from chemical toxins to energy forms. There are 16 chapter dealing with entry and toxic action of chemical substances, solvents, pesticides, etc.

Plog, B. A. (Ed.) (1996)
Fundamentals of Industrial Hygiene, 4th ed.
National Safety Council, Chicago

Provides a reference on the recognition, evaluation, and control of occupational health hazards. The chapters provide an overview of the fundamentals of industrial hygiene, aspects of the anatomy, physiology, hazards, and pathology of the lungs, skin, ears, and eyes, and specific environmental factors including methods of evaluating these hazards. Additionally, the book provides guidance on conducting and organizing industrial hygiene programs and examines governmental regulations.

Plunkett, E. R. (1987)
Handbook of Industrial Toxicology, 3rd ed.
Chem. Pub. Co., New York

Quick reference guide to the toxicity of industrial chemicals. Each entry lists the name, synonyms, physical description, potential for occupational exposure, the TLV (if available), brief description of the toxicity, and preventative measures.

Pohanish, R. P. (1994)
Rapid Guide to Hazardous Chemicals in the Workplace, 3rd ed.
Wiley, New York

Contains quick reference information including expanded toxic hazard reviews and updated information of exposure standards. Information available at a glance includes safety hazards, transportation hazards, and cross-references to regulatory status.

Rafferty, P. J. (1993)
The Industrial Hygienist's Guide to Indoor Air Quality Investigations
American Industrial Hygiene Association, Fairfax, VA

Designed to help the industrial hygienist carry out IAQ studies in a cost-effective manner. Changes affecting indoor air quality are discussed and a step-by-step outline for identifying and solving problems is presented. An occupant health and comfort questionnaire suitable for use in the field is included.

Raffle, P. A. B., Adams, P. H., Baxter, P. J., and Lee, W. R. (Eds.) (1994)
Hunter's Diseases of Occupations, 8th ed.
Arnold, London

Primarily targeted to occupational physicians and hospital clinicians. The book includes sections on diseases associated with chemical agents, diseases associated with physical agents, muscular and skeletal problems, diseases associated with microbiological agents, mental health, occupational cancer, occupational diseases of the skin, and reproductive hazards at work.

Richardson, M. R. (1997)
Managing Worker Safety and Health for Excellence
Van Nostrand–Reinhold, New York

Focuses on management aspects of safety and health programs. The main sections include descriptions of model programs and gaining the involvement of the workers and discuss hazard assessment and evaluation. The final section provides practical examples.

Rom, W. N. (1998)
Environmental and Occupational Medicine, 3rd ed.
Lippincott/Williams & Wilkins, Philadelphia

An outstanding one-volume work covering all areas of occupational and environmental medicine. New topics in the 3rd edition include molecular carcinogenesis, biological markers, genetic susceptibility, and recently recognized diseases and hazards such as carpal tunnel syndrome, hazards in petroleum refining, and sick building syndrome.

Rosenstock, L., and Cullen, M. R. (Eds.) (1994)
Textbook of Clinical Occupational and Environmental Medicine
Saunders, Philadelphia

Directed to students and clinicians needing a resource to integrate occupational and environmental medicine into routine clinical practice. The text is divided into four major sections: principles and practice; core disciplines needed to diagnose, treat, and prevent; organ system approaches to control; and presentation of specific hazards.

Scott, R. M. (1998)
Basic Concepts of Industrial Hygiene
Lewis, Boca Raton, FL

Covers the basics of toxicology, problems arising from skin or inhalation exposure, detection and control of airborne contaminants, injury from sound, radiation, heat, and ergonomics.

Seaton, A., Agius, R., McCloy, E., and D'Auria, D. (1994)
Practical Occupational Medicine
Little, Brown, Boston

Directed toward the medical student to complement other course areas. This book is concerned mainly with diagnosis and treatment of disease and occupational practices which attempt to prevent work-related disease and with nonpharmacological management of ill health in relation to the workplace.

Stacey, N. H. (Ed.) (1994)
Occupational Toxicology
Taylor & Francis, London

Offers an overview of toxicology with a special emphasis on the workplace and occupational hazards produced by the broad spectrum of chemicals and environmental circumstances on the job.

Stellman, J. M. (Ed.) (1998)
Encyclopedia of Occupational Health and Safety, 4th ed.
International Labor Office, Geneva

In four volumes, the new edition is an authoritative reference with over 1000 contributors. An invaluable resource for lawyers, doctors, nurses, engineers, hygienists, toxicologists, and regulators. Disciplines such as medicine, ergonomics, safety engineering, occupational hygiene, epidemiology, organizational psychology, toxicology, and law are thoroughly covered and easily accessed with extensive cross-referencing. A CD-ROM version is also available. Available in the United States at ILO Publications Center, P.O. Box 753, Waldorf MD 20604-0753; phone, 301-638-3152).

Stricoff, R. S., and Walters, D. B. (1995)
Handbook of Laboratory Health and Safety, 2nd ed.
Wiley–Interscience, New York

Feasible, easy to implement approach to ensure a safe workplace and surrounding community. This book contains the latest regulatory requirements of international agencies. A framework that can be customized to create site-specific health and safety requirements is presented.

Tarcher, A. B. (Ed.) (1992)
Principles and Practice of Environmental Medicine
Plenum, New York

A basic text in environmental medicine. It covers fundamental exposure to environmental chemicals and physical agents, the body's defense mechanisms, clinical considerations, and disorders associated with exposure. It concludes with methods for assessing exposure and methods for controlling exposure to environmental chemicals.

Valciukas, J. A. (1996)
Foundations of Environmental and Occupational Neurotoxicology
Van Nostrand–Reinhold, New York

Examines the database on neurotoxins including epidemiology of neurotoxic illnesses and addresses issues such as drug and alcohol abuse. Provides useful information on the source and occurrence of potentially neurotoxic agents, their movements into and through the body, their effects on the nervous system, and the confounders that make interpretation of these findings difficult.

Vincent, J. H. (1995)
Aerosol Science for Industrial Hygienists
Pergamon, Oxford

Deals specifically with aerosols and provides a broad introductory overview of modern aerosol science as it relates to industrial hygiene and occupational health. This book is intended to provide a graduate-level familiarity with the properties, behavior, and effects of airborne contaminants. The 12 chapters do an excellent job of building from principle to practice with aerosol particulates.

Vincoli, J. W. (1995)
Basic Guide to Industrial Hygiene
Van Nostrand–Reinhold, New York

For practicing safety professionals who may have little formal training in the area. Understanding industrial hygiene is covered by overview, regulatory needs, examples of industrial hygiene programs, and health effects. The second major section includes assessing workplace health hazards.

Wald, P. H., and Stave, G. M. (1994)
Physical and Biological Hazards of the Workplace
Van Nostrand–Reinhold, New York

Provides practical information in a single source on emerging and classic hazards due to industrial agents. Topics include electromagnetic fields, ionizing radiation, ergonomics, and occupational exposures to tuberculosis, HIV, and hanta virus. Each of the 29 chapters has ample references for follow-up reading.

Weeks, J. L., Levy, B. S., and Wagner, G. R. (Eds.) (1991)
Preventing Occupational Disease and Injury
American Public Health Association, Washington, DC

Presents an integrated and multidisciplinary approach to prevention, surveillance, analysis, and control in the workplace. The technical aspects of disease entities,

causes, and prevention methods are considered as well as the social environment of work. The second part deals with specific adverse health outcomes and the third part with overviews of musculoskeletal and infectious diseases.

Williams, P. L., and Burson, J. L. (Eds.) (1996)
Industrial Toxicology: Safety and Health Applications in the Workplace
Van Nostrand–Reinhold, New York

Focuses on the evaluation and control of toxic hazards such as heavy metals, pesticides, and organic solvents. Case histories and examples demonstrating the application of toxicologic principles to strategies for reducing exposure to dangerous materials are presented.

Williams, P. L., James, R. C., and Roberts, S. M. (1998)
The Principles of Toxicology: Environmental and Industrial Applications, 2nd ed.
Wiley, New York

Focuses on the evaluation and control of toxic hazards such as heavy metals, pesticides, and organic solvents. Case histories and examples from industry demonstrate the application of toxicologic principles to strategies for reducing exposure to dangerous materials.

World Health Organization (WHO) (1992)
Quality Management for Chemical Safety Testing, **Environmental Health Criteria No. 141**
WHO, Geneva

Addresses basic elements of a quality management program for chemical safety testing with the aim of promoting the quality assurance concept in testing facilities throughout the world and of facilitating the global sharing of useful information on chemicals.

Zenz, C., Dickerson, O. B., and Horvath, E. P. (Eds.) (1994)
Occupational Medicine, 3rd ed.
Mosby, St. Louis

Addresses worker safety and health under a variety of environmental conditions. The book is divided into eight parts: clinical factors, occupational pulmonary diseases, the physical occupational environment, the chemical occupational environment, specific work categories of concern (clinics, hospitals, aviation industry, welding, etc.), behavioral considerations, prevention and control, and specialized activities in occupational health (alochol and drug abuse, risk assessment, international travel, etc.).

See Also:
Section on Analytical Toxicology

Section on Biomonitoring/Biomarkers

Adams: *Occupational Skin Disease* (Target Sites—Skin)

Araki: *Neurobehavioral Methods and Effects* (Target Sites—Nervous System)

Bernstein: *Asthma in the Workplace* (Target Sites—Pancreas)

Bleecker: *Occupational Neurology and Clinical Neurotoxicology* (Target Sites—Nervous System)

Clayton: *Patty's Industrial Hygiene and Toxicology* (General Texts)

Craighead: *Pathology of Environmental and Occupational Disease* (Pathology)

ECETOC: *Monograph No. 2: A Contribution to the Strategy for the Identification and Control of Occupational Carcinogens* (Cancer)

ECETOC: *Monograph No. 3: Risk Assessment of Occupational Chemical Carcinogens* (Risk Assessment)

Eller: *NIOSH Manual of Analytical Methods* (Analytical Toxicology)

Feldman: *Occupational and Environmental Neurotoxicology* (Target Sites—Nervous System)

Frazier: *Reproductive Hazards of the Workplace* (Developmental and Reproductive Toxicology)

Hallenbeck: *Quantitative Risk Assessment for Environmental Occupational Health* (Risk Assessment)

Hernberg: *Introduction to Occupational Epidemiology* (Epidemiology)

Hogan: *Occupational Skin Disorders* (Target Sites—Skin)

Kenen: *Reproductive Hazards in the Workplace: Mending Jobs, Managing Pregnancies* (Developmental and Reproductive Toxicology)

Koren: *Illustrated Dictionary of Environmental Health and Occupational Safety* (Environmental Toxicology—General)

Lauwerys: *Industrial Chemical Exposure* (Biomonitoring/Biomarkers)

Lewis: *Sax's Dangerous Properties of Industrial Materials* (Chemical Compendia)

Maibach: *Occupational and Industrial Dermatology,* 2nd ed. (Target Sites—Skin)

Marks: *Contact and Occupational Dermatology* (Target Sites—Skin)

McDonald: *Epidemiology of Work Related Diseases* (Epidemiology)

McDuffie: *Agricultural Health and Safety; Workplace, Environment, Sustainability* (Chemicals—Pesticides)

Mendelsohn: *Biomarkers and Occupational Health* (Biomonitoring/Biomarkers)

Montgomery: *Health and Safety Guidelines for the Laboratory* (Regulatory Toxicology)

Morgan: *Occupational Lung Disorders,* 3rd ed. (Target Sites—Respiratory)

Parkes: *Occupational Lung Disorders,* 3rd ed. (Target Sites—Respiratory)

Paul: *Occupational and Environmental Reproductive Hazards: A Guide for Clinicians* (Developmental and Reproductive Toxicology)

Proctor: *Chemical Hazards of the Workplace* (Chemical Compendia)

Rosenberg: *Occupational and Environmental Neurology* (Target Sites—Nervous System)

Rosenstock: *Textbook of clinical, Occupational and Environmental Medicine* (Clinical Toxicology)

Smith: *Chemical Risk Assessment and Occupational Health* (Risk Assessment)

Thomas: *Toxicology of Industrial Compounds* (Miscellaneous)

Waxman: *Hazardous Waste Site Operations* (Environmental Toxicology—Hazardous Waste)

Zielhuis: *Health Risks to Female Workers in Occupational Exposure to Chemical Agents* (Developmental and Reproductive Toxicology)

Journals

American Industrial Hygiene Association Journal

American Journal of Industrial Medicine

Annals of Occupational Hygiene

Applied Occupational and Environmental Hygiene

Archives of Environmental Health

International Archives of Occupational and Environmental Health

International Journal of Occupational and Environmental Health

Journal of Occupational and Environmental Medicine

Occupational and Environmental Medicine

Occupational Hygiene

Occupational Medicine

Scandinavian Journal of Work, Environment and Health

Toxicology and Industrial Health

Journal Articles

Aitio, A. (1994). Reference limits in occupational toxicology. ***Clin. Chem.* 40,** 1385–1386.

Aldridge, W. N. (1995). Defining thresholds in occupational and environmental toxicology. ***Toxicol. Lett.* 77,** 109–118.

Bold, H. M. (1996). Genetic predisposition in occupational toxicology. ***Arch. Toxicol. Suppl.* 18,** 362–366.

Checkoway, H., and Eisen, E. A. (1998). Developments in occupational cohort studies. ***Epidemiol. Rev.* 20,** 100–111.

Claycamp, H. G. (1996). Industrial health risk assessment: Industrial hygiene for technology transition. ***Am. Ind. Hygiene Assoc. J.* 57,** 423–435.

Craig, P. H., *et al.* (1993). A method for estimating safe levels of exposure to reproductive and developmental toxins in the occupational setting. ***Teratology* 47,** 415–416.

Hallock, M. F., *et al.* (1995). Patterns of chemical use and exposure control in the Semiconductor Health Study. ***Am. J. Ind. Med.* 28,** 681–697.

Harper, M., *et al.* (1997). Industrial hygiene. ***Anal. Chem.* 69**(12), 307R–327R.

Hotz, P., and Lauwerys, R. R. (1997). Hematopoietic and lymphatic malignancies in vehicle mechanics. ***Crit. Rev. Toxicol.* 27,** 443–494.

Johnsen, H., *et al.* (1992). ***Occupational Neurotoxicity: Criteria Document for Evaluation of Existing Data,*** 2nd ed. National Institute for Occupational Safety and Health, Cincinnati, OH.

Lison, D. (1996). Human toxicity of cobalt-containing dust and experimental studies on the mechanism of interstitial lung disease (hard metal disease). ***Crit. Rev. Toxicol.* 26,** 585–616.

Morgan, M. S. (1997). The biological exposure indices: A key component in protecting workers from toxic chemicals. ***Environ. Health Perspect.* 105**(Suppl. 1), 105–115.

Nelson, B. K. (1997). Exposure interactions in occupational/environmental toxicology. ***Appl. Occup. Environ. Hygiene* 12**(5), 356–361.

Steenland, K., *et al.* (1996). Review of occupational lung carcinogens. ***Am. J. Ind. Med.* 29,** 474–490.

Tas, S., *et al.* (1996). Occupational hazards for the male reproductive system. ***Crit. Rev. Toxicol.* 26,** 261–308.

PATHOLOGY

Bancroft, J. D., and Cook, H. C. (1994)
Manual of Histological Techniques and Their Diagnostic Application
Churchill Livingstone, Edinburgh, UK

Includes scientific and medical background to the basic technical methodology used in histopathology. This book is primarily designed to cover demonstration techniques and includes 17 chapters.

Benirschke, K., Garner, F. M., and Jones, T. C. (Eds.) (1978)
Pathology of Laboratory Animals, 2 vols.
Springer-Verlag, New York

Covers a large amount of information on the pathologic aspects of disease in laboratory animals. The text is directed toward those with knowledge of pathology principles.

Boorman, G. A., Eustis, S. L., Elwell, M. R., Montgomery, C. A., Jr., and MacKenzie, W. F. (Eds.) (1990)
Pathology of the Fischer Rat
Academic Press, San Diego.

Provides a readable text useful not only to pathologists but also to investigators from a variety of disciplines that use the rat as an experimental model. The data used in this book derive from the NTP program covering hundreds of specific studies. A total of 35 chapters, each devoted to a single organ, are included in this work.

Cheville, N. F. (Ed.) (1994)
Ultrastructural Pathology, An Introduction to Interpretation
Iowa State Univ. Press, Ames

Designed as a treatise on ultrastructural analysis to fill the gap between what is seen in the electron microscope and what the pathologist encounters in the laboratory. Electron microscopy of pathologic tissues is covered in 15 separate chapters with full illustrations.

Cotran, R. S., Kumar, V., Robbins, S. L., and Schoen, F. J. (Eds.) (1999)
Pathologic Basis of Disease, 6th ed.
Saunders, Philadelphia

Integrates information of pathologic processes and disorders into morphological, molecular, and genetic components. The information is presented in chapters employing logical, uniform approaches to facilitate readability and comprehension. This has served as the standard reference for many years.

Craighead, J. E. (1995)
Pathology of Environmental and Occupational Disease
Mosby, St. Louis

Addresses environmental disease broadly; occupational diseases are considered to be the result of specific types of exposure experienced in the workplace. The book integrates concepts of causation and pathogenesis in the context of the resulting disease and the tissue changes that accompany it.

Faccini, J. M., Abbott, D. P., and Paulus, G. J. J. (1990)
Mouse Histopathology, A Glossary for Use in Toxicity and Carcinogenicity Studies
Elsevier, Amsterdam.

Provides a bench reference for the lesions observed during the histopathologic examination of tissues from routine studies for the assessment of toxicologic or carcinogenic potential of a test substance. The authors have restricted their information base to the most commonly used mouse strain, the CD-1 mouse.

Ghadially, F. N. (1996)
Ultrastructural Pathology of the Cell and Matrix, 4th ed., 2 vols.
Butterworth-Heinemann, Boston

Serves as a brief textbook and atlas of cellular pathology, with each chapter including a discussion of normal structure and function. Each of 17 cellular organelles or matrix material is covered in a specific chapter.

Glaister, J. R. (1986)
Principles of Toxicological Pathology
Taylor & Francis, Philadelphia.

Global view across the principles of toxicological pathology and their applications, especially in target organ pathology and the pathology of laboratory animals, is offered. The examples presented emphasize the science involved.

Gopinath, C., Prentice, D. E., and Lewis, D. J. (1987)
Atlas of Experimental Toxicological Pathology
MTP Press, Lancaster, UK

Essential to those working in the fields of drug testing, experimental pathology, and clinical pharmacology. This is a comprehensive volume dealing with changes that are induced by a wide variety of agents in many species of animals. Each of 11 different organs/organ

systems is discussed in detail with photomicrographic examples.

Greaves, P., and Facci, J. M. (1992)
Rat Histopathology, A Glossary for Use in Toxicity and Carcinogenicity Studies, 2nd ed.
Elsevier, Amsterdam

Provides a detailed description of typical histopathological findings that support the use of the given diagnostic term, together with the expected circumstances that accompany the condition. Ample reference is made to human pathology since the aim of studying the rat is to extrapolate the findings to man. This is valuable text for the pathologist working in toxicity testing.

Haschek, W. M., and Rousseaux, C. G. (Eds.) (1998)
Fundamentals of Toxicologic Pathology
Academic Press, San Diego.

Examines the interface between toxicology and pathology to provide an overview of structural alterations caused by toxicants and the mechanisms which result in those changes. The book is in textbook format and is intended for students in the fields of pathology, toxicology, and environmental health. After the introduction, the major organs or organ systems are examined in detail. A chapter on chemical carcinogenesis is included.

International Agency for Research on Cancer (IARC)
Pathology of Tumours in Laboratory Animals
IARC, Lyon

Part of the monographic series *IARC Scientific Publications.* Vol. 1, *Tumours of the Rat* (No. 99, 1990); Vol 2, *Tumours of the Mouse* (No. 111, 1994); Vol. 3, *Tumours of the Hamster*, 2nd ed. (No. 126, 1996).

Jasani, B., and Schmid, K. W. (1993)
Immunocytochemistry in Diagnostic Histopathology
Churchill Livingstone, Edinburgh, UK

A relatively nonspecialized text on the role and scope of immunocytochemistry in routine diagnostic histopathology. The target readership is students and practitioners with practical orientation. The text is organized to include introductory chapters, immunocytochemistry in both neoplastic and nonneoplastic disease states, and the organizational routine for providing such services.

Jones, T. C. (primary editor, with others) (1983–)
Monographs on Pathology of Laboratory Animals
Springer-Verlag, New York

An ongoing series of valuable monographs, some already in their second edition, which has covered the following specific organs and systems:

1. Cardiovascular and musculoskeletal system
2. Digestive system
3. Endocrine system
4. Eye and ear
5. Genital system
6. Hemopoetic system
7. Integument and mammary glands
8. Nervous system
9. Respiratory system
10. Urinary system

Jubb, K. V. F., Kennedy, P. C., and Palmer, N. (Eds.) (1993)
Pathology of Domestic Animals, 4th ed., 3 vols.
Academic Press, San Diego

Directed to veterinary pathologists, this book covers the spontaneous and chemically induced lesions present in domestic animals. The volume is organized by organ/organ system and includes 17 chapters. It is a key textbook on the subject.

Mohr, U., Dungworth, D. L., and Capen, C. C. (Eds.) (1992)
Pathobiology of the Aging Rat
ILSI, Washington, DC

Provides information on age-associated changes which influence the interpretation of pathologic data derived from experiments in laboratory rats. The information is presented by system, and emphasis is on the prevalence and nature of the lesions and the current state of knowledge concerning the pathogenesis.

Mohr, U., Dungworth, D. L., Ward, J., Capen, C. C., Carlton, W., and Sundberg, J. (Eds.) (1996)
Pathobiology of the Aging Mouse, Vols. 1 and 2
ILSI, Washington, DC

Provides up-to-date information on the pathologic data from major strains of laboratory mice used throughout the world. Emphasis is placed on the prevalence and nature of naturally occurring and artificially induced lesions and on what is known about their pathogenesis.

Percy, D. H., and Barthold, S. W. (1993)
Pathology of Laboratory Rodents and Rabbits
Iowa State Univ. Press, Ames

Designed to serve as a general reference for veterinary pathologists requiring general information on diagnostic features of the diseases of commonly used laboratory animals. The six species covered in this useful volume are the rat, mouse, hamster, gerbil, guinea pig, and rabbit.

Salisbury, J. (Ed.) (1997)
Molecular Pathology
Taylor & Francis, Washington, DC

Provides a simple description of how specific aspects of molecular pathology are important to the understanding of disease processes. Each chapter focuses on a common disease and explains how such aspects as histopathology, genetic polymorphism, and molecular techniques can help us comprehend the onset and development of disease.

Scarpelli, D. G., Craighead, J. E., and Kaufman, N. (Eds.) (1985)
The Pathologist and the Environment (*Monographs in Pathology,* No. 26)
Williams & Wilkins, Baltimore

Covers the role of the anatomic pathologist in the detection of environmental effects. Considers toxicity of drugs and heavy metals and the biochemical epidemiology of cancer. Problems associated with the litigation of asbestos-associated diseases are also presented.

Sternberg, S. S. (Ed.) (1992)
Histology for Pathologists
Raven Press, New York

Attempts to bridge the gap between histologists and pathologists. To this end, each of the 48 chapters considers the significance and function of many histological structures in terms of pathological interpretation. This text is useful to those interpreting structural deviations from the norm to assess biological significance.

Turton, J. A., and Hooson, J. (Eds.) (1997)
Target Organ Pathology
Taylor & Francis, London

Describes the major organs of the body as targets for chemically induced effects. This text reviews the mechanisms of these toxic effects and the structural and functional changes which occur in the target organ tissues as a result of exposure to toxicants (including drugs, agrochemicals, industrial chemicals, radiation, and heat).

See Also:
Section on Forensic Toxicology

Dail: *Pulmonary Pathology,* 2nd ed. (Target Sites—Respiratory)

Davis: *Texbook of Neuropathology* (Target Sites—Nervous System)

Greaves: *Histopathology of Preclinical Toxicology Studies* (Testing Methods and Toxicity Assessment)

Heptinsall: *Pathology of the Kidney* (Target Sites—Kidney)

Lechago: *Bloodworth's Endocrine Pathology* (Target Sites—Endocrine)

MacSween: *Pathology of the Liver,* 2nd ed. (Target Sites—Liver)

Turton: *Target Organ Pathology* (Target Sites—General)

Yanoff: *Ocular Pathology, a Text and Atlas,* 2nd ed. (Target Sites—Sensory)

Journals

Experimental and Toxicologic Pathology

Journal of Environmental Pathology, Toxicology and Oncology

Toxicologic Pathology

Journal Articles

Bertram, T. A. (1996). Role of toxicologic pathology in advancing understanding of previously identified hazards, current safety assessments, and mechanism of action for therapeutic xenobiotics. ***Toxicol. Pathol.* 24,** 151–152.

Bertram, T. A. (1996). Validation of in vitro methods: Societies' expectations require the involvement of toxicological pathologists. ***Toxicol. Pathol.* 24,** 509–510.

Copley, M. P. (1997). Environmental Protection Agency risk assessment—Process and toxicologic pathology. ***Toxicol. Pathol.* 25,** 68–71.

Delnomdedieu, M., *et al.* (1996). Magnetic resonance microscopy—A new tool for the toxicologic pathologist. ***Toxicol. Pathol.* 24,** 36–44.

Dietrich, D. R. (1993). Toxicology and pathological applications of proliferating cell nuclear antigen (PCNA), a novel endogenous marker for cell proliferation. ***Crit. Rev. Toxicol.* 23,** 77–110.

Documentation of pathology peer review. Position of the Society of Toxicologic Pathologists (1997). ***Toxicol. Pathol.* 25**(6), 655.

German Society for Toxicologic Pathology (1996). Ninth annual symposium of the German Society for Toxicologic Pathology. ***Exp. Toxicol. Pathol.* 48,** 217–223.

Gopinath, C. (1996). Pathology of toxic effects on the immune system. ***Inflammation Res.* 45**(Suppl. 2), PS74–PS78.

Iatropoulos, M. J. (1994). Endocrine considerations in toxicologic pathology. ***Exp. Toxicol. Pathol.* 45,** 391–410.

Maronpot, R. R. (1996). Laboratory animal pathology—Emphasis on an area of relevance to the toxicologic pathologist. ***Toxicol. Pathol.* 24,** 506.

Moch, R. W., *et al.* (1997). Food and Drug Administration risk assessment—Process and toxicologic pathology. ***Toxicol. Pathol.* 25,** 61–67.

Wagner, B. M. (1996). The future of environmental and toxicologic pathology. ***Hum. Pathol.* 27,** 1003–1004.

Ward, J. M. (1995). Peer review in toxicologic pathology. ***Toxicol. Pathol.* 23**(2), 226–234.

Weingand, K., *et al.* (1996). Harmonization of animal clinical pathology testing in toxicity and safety studies. The Joint Scientific Committee for International Harmonization of Clinical Pathology Testing. ***Fundam. Appl. Toxicol.* 29**(2), 198–201.

PHARMACOKINETICS AND METABOLISM

Anders, M. W. (Ed.) (1985)
Bioactivation of Foreign Compounds
Academic Press, New York

Summarizes the body of knowledge on chemical bioactivation. Introductory chapters deal with historical developments and factors which affect all chemicals. The emphasis of the bulk of this text is on the mechanisms of bioactivation of chemical classes.

Baselt, R. C., and Cravey, R. H. (1995)
Disposition of Toxic Drugs and Chemicals in Man, 4th ed.
Chemical Toxicology Institute, Foster City, CA.

A highly respected book summarizing current information on the fate of toxic drugs and chemicals in the human body. Chemical entries include data on occurrence and usage, blood concentrations, metabolism and excretion, toxicity, and analysis.

Bock, K. W., Gerok, W., Matern, S., and Schmid, R. (Eds.) (1990)
Hepatic Metabolism and Disposition of Endo- and Xenobiotics
Kluwer, Dordrecht

From a symposium which updates knowledge about the handling of lipophilic endo- and xenobiotics by the hepatobiliary system starting with its morphology and development. The regulation of cytochromes P450 and of conjugating enzymes involved in the biotransformation is discussed, as are regulatory aspects and genetic control.

Caldwell, J., and Jakoby, W. B. (Eds.) (1983)
Biological Basis of Detoxication
Academic Press, New York

Covers topics such as the formation of toxic metabolites and compounds that are not metabolized at all. Tissue distribution and nutritional considerations, kinetics and mechanisms of the metabolic and excretory processes, and other examples of selective toxicity are examined in this useful text.

Caldwell, J., and Paulson, G. D. (Eds.) (1984)
Foreign Compound Metabolism
Taylor & Francis, Philadelphia

Covers cell biology of xenobiotic metabolism, prediction of metabolic pathways, comparative xenobiotic metabolism in plants, bacteria, aquatic species, and mammals, metabolic basis of chemical toxicity, and physiological control of metabolism. Considerable chemistry detail is involved in these presentations.

de Montellano, P. R. O. (Ed.) (1995)
Cytochrome P450: Structure, Mechanism, and Biochemistry, 2nd ed.
Plenum, New York

Updates the progress made in the field since the first edition. The first section reviews work with model systems and peroxidases. The second section deals with the structurally defined bacterial enzymes and the role of protein residues. Following sections deal with structure and mechanism of membrane-bound P450 enzymes and the regulatory mechanisms and physiological roles of the various enzyme forms.

European Chemical Industry Ecology and Toxicology Centre (ECETOC) (1992)
Technical Report No. 46: EC 7th Amendment: Role of Mammalian Toxicokinetic and Metabolic Studies in the Toxicological Assessment of Industrial Chemicals
ECETOC, Brussels

Reviews the principles and methods used in the conduct of toxicokinetic and metabolic studies. Discusses the use of these studies, including the interpretation of results and their impact on hazard assessment. Includes an extensive bibliography.

Fouts, J. R., and Gut, I. (Eds.) (1978)
Industrial and Environmental Xenobiotics in Vitro versus in Vivo Biotransformation and Toxicity
Excerpta Medica, Amsterdam

Improves understanding of the applicability of *in vitro* biotransformation data to the living organism, the relationship between hepatic and extrahepatic biotransfor-

mation rates, disposition and excretion of xenobiotics, and the applicability of drug biotransformation data to the biotransformation and toxicological studies of industrial and environmental xenobiotics.

Hrudey, S. E., Chen, W., and Rousseaux, C. G. (1996)
Bioavailability in Environmental Risk Assessment
Lewis, Boca Raton, FL

Reviews the basic knowledge on human bioavailability which is relevant to health risk assessment. The potential for wider application of bioavailability data in quantitative risk assessment is illustrated and important factors that can influence bioavailability are explored. Absorption mechanisms for xenobiotics are discussed and experimental approaches are explored.

Hutson, D. H., and Paulson, G. D. (Eds.) (1995)
The Mammalian Metabolism of Agrochemicals
Wiley, New York

Explores the fate of xenobiotics in mammals, metabolism in rodents, metabolism of fungicides in mammals, species differences, and other topics.

Ioannides, C. (Ed.) (1996)
Cytochromes P450: Metabolic and Toxicological Aspects
CRC Press, Boca Raton, FL

Focuses on the role of the cytochrome P450 system in the metabolism of foreign chemicals and its relevance to toxic effects. All chapters are prepared by experts in the particular area. The sections include general considerations, cytochrome P450 families/subfamilies, and current issues. The rapid progress in this field has been well captured here.

Jakoby, W. B. (Ed.) (1980)
Enzymatic Basis of Detoxication
Academic Press, New York

In two volumes, presents the state-of-the-art information regarding foreign compound metabolism at the level of specific enzymes. These become the tools of today for those investigating biological responses to xenobiotics. The first volume covers detoxication enzymes as an overview, physiological aspects, mixed-function oxygenase systems, and other oxidation-reduction systems.

Jakoby, W. B., *et al.* (Eds.) (1982)
Metabolic Basis of Detoxication: Metabolism of Functional Groups
Academic Press, New York

This book covers ''what is known of the pathways of metabolism of xenobiotics based on the behavior of functional groups.'' Topics discussed include oxidation of foreign compounds at carbon atoms, N-dealkylation and deamination, reductive metabolism of nitrogen-containing functional groups, conjugation of phenols, role of intestinal microflora, and urinary excretion.

Jeffery, E. H. (Ed.) (1993)
Human Drug Metabolism
CRC Press, Boca Raton, FL

Presents current research in the way that man metabolizes drugs. In a series of chapters, the theme of human and animal comparisons is stressed to allow a thorough understanding of both metabolism and drug safety. A theme throughout this book is that both inter- and intraspecies differences as demonstrated by genetic variations, alternative metabolic pathways, homogeneity, and polymorphism are important.

Kauffman, F. C. (1994)
Conjugation–Deconjugation Reactions in Drug Metabolism and Toxicity
Springer-Verlag, New York

Emphasizes the functions of both synthetic and hydrolytic enzymes in determining the net production and utilization of xenobiotic and biotic conjugates. It covers the advances in describing the expression and regulation of enzymes involved in conjugation–deconjugation reactions, the regulation of these reactions in intact cells, and research areas.

Powis, G. (Ed.) (1994)
Anticancer Drugs: Reactive Metabolism and Drug Interactions
Pergamon, Oxford

Covers metabolism and reactions of alkylating agents, cyclophosphamide, triazine anticancer and antitumour agents, 2-chloroethylnitrosoureas, procarbazine, etc.

Renwick, A. G. (1997)
Pharmacokinetics and Toxicokinetics: Understanding Biodisposition Data
CRC Press, Boca Raton, FL

Covers three main areas—general principles, pharmacokinetics, and toxicokinetics. Extensively illustrated to aid understanding of general principles and concepts, and also allows for interpretation of data rather than just mathematical modeling.

Royal Society of Chemistry (1988–)
Biotransformations
Royal Society of Chemistry, Cambridge, UK

A monographic series (Vol. 7 was published in 1996) that encompasses biotransformation of chemical entities whether they are pharmaceuticals, agrochemicals,

food additives, or environmental or industrial chemicals in vertebrates within the animal kingdom, a group including mammals, birds, and fish. Provides a ready way of accessing information on the known pathways for the biotransformation of structurally related compounds.

Snyder, R., Sipes, I. G., Jollow, D. J., Monks, T. J., Kocsis, J. J., Kalf, G. F., Greim, H., and Witmer, C. M. (Eds.) (1996)
Biological Reactive Intermediates: Basic Mechanistic Research in Toxicology and Human Risk Assessment
Plenum, New York

From an international symposium with 45 invited speakers and 97 poster presentations. Topics covered in this book include the chemistry and formation of biologically reactive intermediates, cellular damage and control of gene expression by biological reactive intermediates, impact on cellular redox states, organ-specific effects, organ–organ interactions, modeling of bioactivation, and linking of mechanistic studies to human risk assessment.

Welling, P. G. (1997)
Pharmacokinetics: Processes, Mathematics, and Applications. 2nd ed.
American Chemical Society, Washington, DC

Provides the basic principles of pharmacokinetics, including drug transport, parenteral and enteral routes of administration, and factors affecting drug absorption, distribution, and metabolism. The mathematics are presented with various single and multicompartment models. The book also describes renal and hepatic drug clearance and the influence of kidney and liver dysfunction on these processes.

Welling, P. G., and De La Iglesia, F. A. (Eds.) (1993)
Drug Toxicokinetics
Dekker, New York

Presents a wide range of topics including saturable and nonsaturable pharmacokinetics, practical considerations of specific therapeutic areas, and a projection of the evolving nature of toxicokinetics. A total of 16 excellent chapters covering drug metabolism and kinetics are presented in this useful text.

See Also:
Section on Molecular, Cellular, Biochemical Toxicology

Section on Target Sites (especially liver and kidney)

Anders: *Renal Disposition and Nephrotoxicity of Xenobiotics* (Target Sites—Kidney)

Arinc: *Molecular Aspects of Oxidative Drug Metabolizing Enzymes* (Molecular, Cellular, and Biochemical Toxicology)

Baskin: *Oxidants, Anti-Oxidants, and Free Radicals* (Molecular, Cellular, and Biochemical Toxicology)

Craigmill: *Handbook of Comparative Pharmacokinetics and Residues of Veterinary Therapeutic Drugs* (Toxic Agents—Veterinary Drugs)

Eyer: *Metabolic Aspects of Cell Toxicity* (Molecular, Cellular, and Biochemical Toxicology)

Moody: *Peroxisome Proliferators* (Molecular, Cellular, and Biochemical Toxicology)

Reddy: *Peroxisomes: Biology and Role in Toxicology and Disease* (Molecular, Cellular, and Biochemical Toxicology)

Sundlof: *Handbook of Comparative Pharmacokinetics* (Chemicals—Pesticides)

Vermuelen: *Glutathione S-Transferases* (Molecular, Cellular, and Biochemical Toxicology)

Journals

Biochemical Pharmacology

Drug Metabolism and Disposition

Drug Metabolism and Drug Interactions

Drug Metabolism Reviews

Pharmacology and Toxicology

Xenobiotica

Journal Articles

Bachmann, K., *et al.* (1996). Scaling basic toxicokinetic parameters from rat to man. ***Environ. Health Perspect.* 104,** 400–407.

Beatty, D. A., and Piegorsch, W. W. (1997). Optimal statistical design for toxicokinetic studies. ***Stat. Methods Med. Res.* 6**(4) 359–376.

Buchanan, J. R., *et al.* (1997). Purpose and guidelines for toxicokinetic studies within the National Toxicology Program. ***Environ. Health Perspect.* 105,** 468–471.

Conolly, R. B., and Andersen, M. E. (1991). Biologically based pharmacodynamics models: Tools for toxicological research and risk assessment. ***Annu. Rev. Pharmacol. Toxicol.* 31,** 503–523.

Delaforge, M. (1998). Importance of metabolism in pharmacological studies: Possible in vitro predictability. ***Nucl. Med. Biol.* 25,** 705–709.

Gargas, M. L., *et al.* (1995). Pharmacokinetic modeling approaches for describing the uptake, systemic distribution and disposition of inhaled chemicals. ***Crit. Rev. Toxicol.* 25,** 237–254.

Goehl, T. J. (1997). Toxicokinetics in National Toxicology Program. ***NIDA Res. Monogr.* 173,** 273–304.

Hakkola, J., Pelkonen, O., Pasanen, M., and Raunio, H. (1998). Xenobiotic-metabolizing cytochrome P450 enzymes in the human feto-placental unit: Role in intrauterine toxicity. ***Crit. Rev. Toxicol.* 28,** 35–72.

Igarashi, T., and Sekido, T. (1996). Case studies for statistical analysis of toxicokinetic data. ***Reg. Toxicol. Pharmacol.* 23,** 193–208.

Igarashi, T., *et al.* (1996). Study design and statistical analysis of toxicokinetics: A report of JPMA investigation of case studies. ***J. Toxicol. Sci.* 21**(5), 497–504.

Kato, R., *et al.* (1993). Toxicokinetics: Its significance and practical problems. ***J. Toxicol. Sci.* 18**(4), 211–238.

Marzo, A. (1996). Toxicokinetics of endogenous: A neglected issue. ***Arzneimittelforschung* 46,** 1–10.

Olsen, R. H. (1997). Biodegradation and biotransformation of xenobiotic compounds. ***CRISP Database,*** CRISP/97/ES04911-080010. National Institutes of Health, Bethesda, MD.

Omiecinski, C. Xenobiotic biotransformation and disposition research project. ***CRISP Database,*** CRISP/97/ES07033040001. National Institutes of Health, Bethesda, MD.

Pang, A., *et al.* (1992). Determinants of metabolite disposition. ***Annu. Rev. Pharmacol. Toxicol.* 32,** 623–670.

Simmons, J. E. (1996). Application of physiologically based pharmacokinetic modelling to combination toxicology. ***Food Chem. Toxicol.* 34**(11/12), 1067–1073.

Slob, W., Janssen, P. H. M., and van den Hof, J. M. (1997). Structural identifiability of PBPK models: Practical consequences for modeling strategies and study designs. ***Crit. Rev. Toxicol.* 27,** 261–272.

Sugiyama, Y., *et al.* (1996). Future prospects for toxicokinetics: Its ability to predict drug adverse events in humans. ***J. Toxicol. Sci.* 21**(5), 511–516.

Wrighton, S. A., and Stevens, J. C. (1992). The human hepatic cytochromes P450 involved in drug metabolism. ***Crit. Rev. Toxicol.* 22,** 1–22.

Yang, R. S. H., *et al.* (1995). The application of physiologically based pharmacokinetic/pharmacodynamic (PBPK/PD) modeling for exploring risk assessment approaches of chemical mixtures. ***Toxicol. Lett.* 79,** 193–200.

Yuzuriha, T., *et al.* (1996). Points to be considered for conducting toxicokinetic studies under GLP and for validating analytical methods. ***J. Toxicol. Sci.* 21**(5), 505–509.

RADIATION

Blank, M. (Ed.) (1995)
Electromagnetic Fields: Biological Interactions and Mechanisms
American Chemical Society, Washington, DC

Volume 250 in the series *Advances in Chemistry.* Combines the knowledge of many experts in the field on various aspects of electromagnetic field environmental problems to provide an introductory survey at a scientifically sophisticated level. Following an overview of the field and problem, the physical characteristics of environmental electromagnetic fields, intrinsic biologic fields, health-related aspects, biophysical aspects, and cellular mechanism sections are covered.

Bomberger, A. S., and Dannenfelser, B. A. (1984)
Radiation and Health: Principles and Practice in Therapy and Disaster Preparedness
Aspen Systems, Rockville, MD

Reviews radiation and its effects, the practical aspects of treatment, and disaster preparedness. Appendices cover radiological isolation principles and wet decontamination methods.

Carpenter, D. O., and Ayrapetyan, S. (1994)
Biological Effects of Electric and Magnetic Fields, Vols. 1 and 2
Academic Press, New York

Covers both the sources and mechanisms of electric and magnetic fields in the first volume and the beneficial and harmful effects in the second volume. Sections include exposure to and mechanisms of action of electric and magnetic fields, behavioral and neural effects, clinical applications and therapeutic effects, cell and molecular biology, cancer, and other human health effects.

Casarett, G. W. (1980)
Radiation Histopathology
CRC Press, Boca Raton, FL

Focuses on the effects of ionizing radiation on normal tissues and organs as observed with light microscopy. Chapters discuss general radiation biophysics and biol-

ogy, general radiation cytopathology, and relative radiosensitivities of cells, tissues, and organs.

Clark, C. (1992)
The Radium Dialpainters, the Consumers, and Industrial Health Reform
UMI Dissertation Services, Ann Arbor, MI

Details the history and emergence of radium in industry as a public health issue. Main chapter headings include Background, The Industrial Hygiene Movement, Radium Toxicity and Use as a Medicine, Establishment of Radium Poisoning, Compensation, and Specific Case Histories.

Dennis, J. A., and Stather, J. (Eds.) (1994)
Non-Ionizing Radiation
Elsevier, New York

Contains 17 papers on the growing interest in the possible health effects of nonionizing electromagnetic radiation. Public concern centers on man-made sources, e.g., radar, microwave ovens, power lines, mobile phones, and lasers. The greatest risks to health in this region of the spectrum come from naturally occurring ultraviolet radiation.

Dowd, S. B., and Tilson, E. R. (1999)
Practical Radiation Protection and Applied Radiobiology
Saunders, Philadelphia

Presents both theory and clinical practice of radiation protection and radiobiology, from X-ray production and nuclear medicine to radiation therapy.

Environmental UV-Radiation, Risk of Skin Cancer, and Primary Prevention (1996)
Gustav Fischer, Stuttgart

A description of the latest findings on the assessment of the effects of UV radiation on human health, compiled by internationally recognized experts. Based on an international congress and volume 34 of *Veroffentlichungen der Strahlenschutzkommission*

Greene, M. W. (Ed.) (1992)
Non-Ionizing Radiation
International Radiation Protection Association, London

Directed at those in public health, occupational hygiene, safety, radiation protection, and other health professionals. Included are a series of papers covering both nonionizing radiation and ultrasound. These papers review the recent scientific developments and changes in standards, highlighting the issues that drive the regulations.

Hendee, W. R., and Edwards, F. M. (Eds.) (1996)
Health Effects of Exposure to Low-Level Ionizing Radiation, 2nd ed.
Institute of Physics, Philadelphia

Written for those interested in an overview of radiation physics and biology and the science of risk estimation and radiation protection. Particular detail is paid to dosimetry and exposure assessments. Effects of radiation at the cellular, organ, and whole system level are considered and risk estimates in various human activities involving potential contact with radiation are presented.

Hendry, J. H., and Lord, B. I. (Eds.) (1995)
Radiation Toxicology: Bone Marrow and Leukaemia
Taylor & Francis, London

Describes the effects of low and high doses of radiation on bone marrow. It includes radiation dose levels and epidemiological studies of exposed populations. It also includes treatment methods for accidentally exposed individuals or therapeutically irradiated patients.

Hinkelbein, W., Bruggmoser, G., Frommhold, H., and Wannenmacher, M. (1993)
Acute and Long-Term Side-Effects of Radiotherapy: Biological Basis and Clinical Relevance
Springer-Verlag, New York

Provides an overview of both the current scientific basis and the clinical experience of how normal tissues respond to curative radiotherapy. Basic principles of early and late normal tissue injuries are summarized. Experimental data and the clinical effects of irradiation on mucosa and skin, muscle, and the urinary bladder are discussed.

Hiroshima International Council for Medical Care of the Radiation-Exposed (1995)
Effects of A-Bomb Radiation on the Human Body
Harwood, Reading, UK

Attempts to explain radiation effects with respect to different diseases in a manner that is easy to comprehend. It is a reference manual on the medical care, health management, and research concerning atomic bomb survivors.

Hitchcock, R. T., and Patterson, R. M. (1995)
Radio-Frequency and ELF Electromagnetic Energies: A Handbook for Health Professionals
Van Nostrand–Reinhold, New York

A practical guide to understanding, evaluating, and controlling human health effects of radiofrequency (RF) and extremely low-frequency (ELF) electromagnetic fields. Also discusses radiation safety and how to set up a safety program.

Irvin, R. (1996)
Naturally Occurring Radioactive Materials: Principles and Practices
Lewis, Boca Raton, FL

Designed as a reference and training guide for radioprotection professionals. The text includes sections with easy to understand basics of radiation science, practical information on surveying and sampling, personal protection, and thorough explanations of radiation detectors and their use.

Luxin, W., *et al.* (Eds.) (1997)
High Levels of Natural Radiation, 1996: Radiation Dose and Health Effects
Elsevier, Amsterdam

Procedings of the 4th International Conference on High Levels of Natural Radiation, held in Beijing, China, in 1996. Considers dose estimation, radioactive aerosols, natural radionuclides, fallout from nuclear tests, epidemiology, radiation hormesis, and adaptive response and genetic effects.

Mettler, F. A., and Upton, A. C. (1995)
Medical Effects of Ionizing Radiation, 2nd ed.
Saunders, Philadelphia

Source book for professionals interested in the effects of ionizing radiation on humans. The book discusses both high and low-level effects as well as sources and dose–response relationships. Advances covered in this edition include radiation protection, improved dosimetry, and examples of recent accidents such as Chernobyl and further learnings for atomic bomb survivors.

National Research Council (1995)
Adverse Reproductive Outcomes in Families of Atomic Veterans: The Feasibility of Epidemiologic Studies
National Academy Press, Washington, DC

This book addresses the feasibility of conducting an epidemiologic study to determine if there is an increased risk of adverse reproductive outcomes in the spouses, children, and grandchildren of ''atomic veterans'' (those who participated in the atmospheric testing of nuclear weapons at the Nevada Test Site or in the Pacific Proving Grounds, who served with occupation forces in or near Hiroshima and Nagasaki, or who were prisoners of war near these cities at approximately the time of the atomic bombings).

National Research Council, Commission on Life Sciences, Board on Radiation Effects Research, Committee on the Biological Effects of Ionizing Radiation
Biological Effects of Ionizing Radiation (BEIR) Reports
National Academy Press, Washington, DC

This highly influential series of reports is designed to advise the U.S. government on the health consequences of radiation exposures. Recent reports include *BEIR V, Health Effects of Exposure to Low Levels of Ionizing Radiation* (1990), *BEIR VI, Health Effects of Exposure to Radon* (1999), and *BEIR VII Health Effects of Exposure to Low Levels of Ionizing Radiation: Time for Reassessment?* (1998)

National Research Council (1997)
Possible Health Effects of Exposure to Residential Electric and Magnetic Fields
National Academy Press, Washington, DC

Examines what is known about three kinds of health effects associated with electric and magnetic fields: cancer, primarily childhood leukemia; reproduction and development; and neurobiological effects.

Niemz, M. H. (1996)
Laser–Tissue Interactions: Fundamentals and Applications
Springer, New York

Surveys the current state of laser–tissue interactions. It discusses photoablation, plasma-induced ablation, and photodisruption. Photodynamic therapy, photothermal applications, and laser-induced interstitial thermotheraphy are extensively addressed.

Peterson, L. E. and Abrahamson, S. (Eds.) (1998)
Effects of Ionizing Radiation: Atomic Bomb Survivors and Their Children (1945–1995)
Joseph Henry, Washington, DC

Reviews what is known about human exposure to ionizing radiation from the perspective of physics, dosimetry, cancer statistics and epidemiology, genetics, and the psychological effects of radiation catastrophes.

Polk, C., and Postow, E. (Eds.) (1996)
Handbook of Biological Effects of Electromagnetic Fields, 2nd ed.
CRC Press, Boca Raton, FL

Presents a complete overview of the latest thinking in terms of the biological effects of electromagnetic fields. Particularly interesting is the balanced presentation of the data relating long-term health problems to exposure.

Prasad, K. N. (1995)
Handbook of Radiobiology, 2nd ed.
CRC Press, Boca Raton, FL

Presents the most current information on the effects of ionizing radiation on mammalian cells with emphasis on human tissues. Dose–effect relationships are covered in a quantitative manner. Included is a major discussion of the late effects of low levels of radiation

on humans and the consequences of radiation therapy detected among cancer survivors.

Schull, W. J. (1995)
Effects of Atomic Radiation: A Half-Century of Studies from Hiroshima and Nagasaki
Wiley, New York

Review of the health consequences of the atomic bomb exposures to these two populations from 50 years later. Written in simple language and free of emotional overtones, the author examines the early effects, changing research strategies, exposure and dose factors, postnatally exposed survivors, and prenatally exposed survivors and projects risks as a function of dose.

Shapiro, J. (1990)
Radiation Protection, 3rd ed.
Harvard Univ. Press, Cambridge, MA

Provides a detailed treatment of the radiation-protection concerns of society. It includes dose calculations, medical radiation, natural radiation, calibration and use of detectors, regulations, and control methods. It also deals with nuclear power, nuclear weapons, and major radiation accidents.

Shleien, B., Slaback, Jr., L. A., and Birky, B. K. (Eds) (1998)
Health Physics and Radiological Health Handbook, 3rd ed.
Williams and Wilkins, Baltimore

Indispensable data on interactions of radiation with matter, exposure and shielding from external radiation, radionuclide data, patient doses in the healing arts, bioassay and radiobiological data, radiation dosimetry, ionizing radiation bioeffects and risks, and nonionizing radiation.

Sliney, D. H., and Thompson, B. J. (1995)
Selected Papers on Laser Safety
SPIE Optical Engineering Press, Bellingham, WA

Series containing a collection of reprints of milestone papers. Topics include historical perspectives of laser beams, laser safety, ocular effects, and dermal effects.

Wilson, A. (1991)
Register of U.K. Research on the Biological Effects of Ionizing Radiation
Medical Research Publishers, Chilton, UK

Presentation of ongoing research work. The aim of the book is to inform scientists about current research on the biological effects of ionizing radiation, to facilitate interaction between researchers, to minimize duplication of effort, to allow appropriate emergency responses on accidental exposures, and to increase awareness of the data gaps in our knowledge base.

Wilson, B. W., Stevens, R. G., and Anderson, L. E. (Eds.) (1990)
Extremely Low Frequency Electromagnetic Fields: The Question of Cancer
Battelle, Columbus, OH

Focuses on the question of whether ELF electromagnetic fields can interact with biological systems in such a way as to increase cancer risk. The main potential interaction points involve effects on the pineal gland and circadian biology and effects on calcium homeostasis in cells.

World Health Organization (WHO) (1992)
Electromagnetic Fields, Environmental Health Criteria No. 137
WHO, Geneva

Reviews data relevant to the assessment of human health effects associated with exposure to electromagnetic fields in the frequency range of 300 Hz to 300 GHz. Emphasis is placed on new data that shed light on the interactions of electromagnetic fields with biological systems and on the specific biological effects and responses that result. Over 500 recent studies were rigorously assessed.

World Health Organization (WHO), (1994)
Ultraviolet Radiation: An Authoritative Scientific Review of Environmental and Health Effects of UV, with Reference to Global Ozone Layer Depletion
WHO, Geneva

Presents detailed review of ultraviolet radiation, including physical characteristics, sources, exposures, dosimetry, mechanisms, animal and human studies (skin and other targets), and conclusions. This comprehensive review also provides recommendations for further research.

Yaroshinskaya, A. (1995)
Chernobyl: The Forbidden Truth
Univ. of Nebraska Press, Lincoln

Presents the details of the reactor misfunction at the Chernobyl site in semiscientific terms. The lessons and warnings are appropriate for all in this time of nuclear energy.

Journals

Annals of the ICRP

Bioelectromagnetics

Health Physics

International Journal of Radiation Biology

Journal of Environmental Radioactivity

Journal of Radiation Research

Journal of Radiological Protection

Radiation and Environmental Biophysics

Radiation Research

Journal Articles

American Academy of Pediatrics Committee on Environmental Health (1998). Risk of ionizing radiation exposure to children: A subject review. ***Pediatrics*** **101**(4, Pt. 1), 717–719.

Anonymous (1997). Ionizing radiation. An overview for the occupational health nurse. Agency for Toxic Substances and Disease Registry. ***AAOHN J.*** **45**(4), 170–183.

Beninson D. (1996). Risk of radiation at low doses. ***Health Phys.*** **71**(2), 122–125.

Cardis, E. (1996). Epidemiology of accidental radiation exposures. ***Environ. Health Perspect.*** **104**(Suppl. 3), 643–649.

Clarke, R. H. (1997). Managing radiation risks. ***J. R. Soc. Med.*** **90**(2), 88–92.

Cohen, B. L. (1995). How dangerous is low level radiation? ***Risk Anal.*** **15**(6), 645–653.

Creech, L. L. and Mayer, J. A. (1997) Ultraviolet radiation exposure in children: A review of measurement strategies. ***Ann. Behav. Med.*** **19**(4), 399–407.

Densow, D. (1995). Are there ''common denominators'' in different radiation exposure scenarios as a target for predictive assessment? ***Stem Cells*** **13**(Suppl. 1), 307–317.

Doll, R. (1998). Effects of small doses of ionising radiation. ***J. Radiol. Prot.*** **18,** 163–174.

Fong, F., and Schrader, D. C. (1996). Radiation disasters and emergency department preparedness. ***Emergency Med. Clin. North Am.*** **14**(2), 349–370.

Fry, R. J. (1996). Effects of low doses of radiation. ***Health Phys.*** **70**(6), 823–827.

Geis, P. H., *et al.* (1998). Protection against solar ultraviolet radiation. ***Mutat. Res.*** **422,** 15–22.

Harris, D., *et al.* (1997). Radiation therapy toxicities. ***Vet. Clin. North Am. Small Anim. Practice*** **27,** 37–46.

Hawkins, M. M., *et al.* (1996). Radiotherapy, alkylating agents, and risk of bone cancer after childhood cancer. ***J. Natl. Cancer Inst.*** **88,** 270–278.

Jankowski, J. (1996). The consequences of the Chernobyl accident one decade after the disaster. ***Int. J. Occup. Med. Environ. Health*** **9**(4), 365–374.

Jauchem, J. R. (1995). Alleged health effects of electromagnetic fields: The misconceptions continue. ***J. Microwave Power Electromagnetic Energy*** **30**(3), 165–177.

Kaminester, L. H. (1996). Current concepts. Photoprotection. ***Arch. Family Med.*** **5,** 289–295.

Kheifets, L. I., Sussman, S. S., and Preston-Martin, S. (1999). Childhood brain tumors and residential electromagnetic fields (EMF). ***Rev. Environ. Contam. Toxicol.*** **159,** 111–120.

Langlais, R. P., and Langland, O. E. (1995). Risks from dental radiation in 1995. ***J. California Dental Assoc.*** **23,** 33–34.

Little, J. B. (1997). What are the risks of low-level exposure to alpha radiation from radon. ***Proc. Natl. Acad. Sci. USA*** **94**(12), 5996–5997.

Liu, S. (1996). Radiation risks: Threshold or no threshold. The centenary of the discovery of X-rays by W. C. Roentgen. ***Chinese Med. J.*** **109**(2), 122–126.

Mathes, S. J., and Alexander, J. (1996). Radiation injury. ***Surg. Oncol. Clin. North Am.*** **5**(4), 809–824.

Movsas, B., *et al.* (1997). Pulmonary radiation injury. ***Chest*** **111**(4), 1061–1076.

Pass, B. (1997). Collective radiation biodosimetry for dose reconstruction of acute accidental exposures: A review. ***Environ. Health Perspect.*** **105**(Suppl. 6), 1397–1402.

Plappert, U., and Rutzen-Loesevitz, L. (1995). What is the status of molecular and cell biology approaches relevant to radiation effects assessment? ***Stem Cells*** **13**(Suppl. 1), 318–322.

Reme, C., *et al.* (1996). Light damage revisited: Converging evidence, diverging views? ***Graefes Arch. Clin. Exp. Ophthalmol.*** **234,** 2–11.

Robbins, J. (1997). Lessons from Chernobyl: The event, the aftermath fallout: Radioactive, political, social. ***Thyroid*** **7**(2), 189–192.

Robbins, M. E., and Bonsib, S. M. (1995). Radiation nephropathy: A review. ***Scanning Microsc.*** **9**(2), 535–560.

Saclarides, T. J. (1997). Radiation injuries of the gastrointestinal tract. ***Surg. Clin. North Am.* 771,** 261–268.

Sammei, E., and Kearfott, K. J. (1995). A limited bibliography of the federal government-funded human radiation experiments. ***Health Phys.* 69**(6), 885–891.

Streffer, C., and Tanooka, H. (1996). Biological effects after small radiation doses. ***Int. J. Radiation Biol.* 69,** 269–272.

Von Zallinger, C., and Tempel, K. (1998). The physiologic response of domestic animals to ionizing radiation: A review. ***Vet. Radiol. Ultrasound* 39,** 495–503.

Ziegler, B. L., *et al.* (1995). Biological indicators of exposure: Are markers associated with oncogenesis useful as biologic markers of effect. ***Stem Cells* 13**(Suppl. 1), 326–338.

REGULATORY TOXICOLOGY

Ariel Research
Bethesda, MD

Ariel Research makes available a wide variety of databases related to regulatory toxicology in the United States and worldwide. Their North America database, for example, contains chemical listings from U.S. federal, U.S. state, Canadian, and Mexican regulations, including TSCA, SARA, CERCLA, OSHA, ACGIH, AIHA, IARC, NIOSH, NTP, RCRA, Clean Air Act, Clean Water Act, DEA, DOT, regulations of 25 states, Canadian WHMIS, and Mexican OELs. Detailed standards, thresholds, deadlines, and other ciritcal references are provided. See the Databases Section of the Internet and Other Digital Information chapter. Ariel Web site: *http://www.arielres.com/*. Ariel's Roytech Division also publishes the *Suspect Chemicals Sourcebook: A Guide to Industrial Chemicals Covered under Major Regulatory and Advisory Programs*.

Ashford, N. A., and Caldart, C. C. (Eds.) (1996)
Technology, Law, and the Working Environment
Island Press, Washington, DC

Aimed at those who will play a critical role in stimulation and planning the development of new production technology and who will be responsible for the extent to which that technology meets environmental, health, and safety concerns. The text is designed to provide an understanding of the roles of the agencies, courts, and industry and how technical, scientific, and economic considerations interface within the legal framework.

Benson, B. W., and Lang, PL (1998)
Handbook of Good Laboratory Practice
Taylor & Francis, Washington, DC

Provides a detailed analysis for the clear understanding of and compliance with GLP regulations for field and laboratory studies. Using key examples, the book details what each regulation means and why it is important to the process of safety evaluation. The book also offers practical means of implementation.

Chengelis, C. P., Holson, J. F., and Gad, S. C. (Eds.) (1995)
Regulatory Toxicology
Raven Press, New York

Presents a clear and practical guide to the government regulations that govern why and how toxicology/safety testing is done and how the results of such testing are reported and used in regulating the entry and use of products in the marketplace. Each chapter includes the history behind the category of regulations covered and a road map of the current regulations. The key requirements and guidelines for each set of regulations are presented.

European Centre for Ectoxicology of Chemicals and Toxicology (ECETOC) (1985)
Monograph No. 7: Recommendations for the Harmonization of International Guidelines for Toxicity Studies
ECETOC, Brussels

Compares the requirements for subchronic (14–90 days), chronic, carcinogenicity, combined chronic and carcinogenicity, and reproductive toxicity studies on industrial chemicals and pesticides with the aim of identifying the main differences. The organizations that have issued guidelines for industrial chemicals are OECD, EEC, UK/HSC, and EPA/TSCA; the organizations that have issued guidelines for pesticides are EPA/FIFRA and Japan/MAFF. This book includes a description of the current test guidelines, the differences between the guidelines, and recommendations for harmonization.

Environmental Law Institute
Miscellaneous publications
Environmental Law Institute, Washington, DC

The Environmental Law Institute publishes the periodical *Environmental Law Reporter* and books such as *Environmental Laws Deskbook, Toxic Substances and Pesticides Regulation Deskbook,* and *Clean Air Deskbook.*

Fisher, L. J., Holmstead, C. R., Hayes, D. J., Holmstead, J. R., Slater, G. S., Rawson, W. K., and Winik, P. L. (1995)
Toxic Substances and Pesticides Regulation Deskbook
Environmental Law Institute, Washington, DC

Provides full text for the currently existing 19 environmental laws. The book is designed to benefit anyone in the field by providing access to the text in an orderly and understandable fashion.

Geltman, E. G. (1998)
Environmental Law Library
Lewis, Boca Raton, FL

In three volumes, this book presents a library of explanations of environmental regulations. Includes permit procedures and provides case law references.

Government Institutes
Miscellaneous publications
Government Institutes, Rockville, MD

Government Institutes is a major publisher in the area of regulatory toxicology. Among their 1997 publications are *Environmental Law Handbook* (14th ed.), *Environmental Statutes, Environmental Guide to the Internet* (3rd ed.), *Book of Lists for Regulated Substances* (8th ed.), *Environmental Statutes on Disk,* and *CFR Chemical Lists on CD-ROM*. They also publish an *Environmental Regulatory Glossary*. (Government Institutes, 4 Research Place, No. 20, Rockville, MD 20850; phone 301-921-2355; fax, 301-921-0373; e-mail, giinfo@govinst.com; web, *http://www.govinst.com*.)

Holcomb, M. L. (1995)
International Toxicology: Worldwide Regulatory Toxicology Support
Western Printers, Eugene, OR

Written for toxicologists and regulatory individuals responsible for providing safe and legal consumer products. Since each industry has its own set of rules and regulations, the needs for local, regional, and international areas differ. The book presents the regulations by country or country equivalent.

Marcus, P. A., and Willig, J. T. (Eds.) (1997).
Improving Environmental Management and Advancing Sustainable Development
Wiley, New York

Focuses on the implementation of the ISO 14,000 program by the industrial community. The book contains five sections dealing with the global challenge of voluntary management standards; gaining support within a company; registration, certification, and implementation issues; implementation impact and tools; and advancing sustainable development as a competitive tool.

Montgomery, L. (1995)
Health and Safety Guidelines for the Laboratory
ASCP Press, Chicago

Describes the essentials of the standards, interpreting the basic requirements for compliance and the scope and terminology of the hazard communication standard, the formaldehyde standard, the occupational exposures to hazardous chemicals in laboratories standard, and the bloodborne pathogen standard. It includes information on the regulatory agencies, successful compliance, latex sensitivity, handling radiological materials, and waste management.

Morgenstern, R. D. (Ed.) (1997)
Economic Analyses at EPA: Assessing Regulatory Impact
Resources for the Future, Washington, DC

Presents a careful review of the role that benefit–cost analysis and other analytical techniques have played in EPA's decision making during the past two decades. Issues/topics covered in this highly readable book include lead in gasoline, ozone depletion, asbestos, landfill management, agricultural products and worker protection, reformulated gasolines, and Great Lakes water quality guidance.

See Also:
Hoel: *Risk Quantitation and Regulatory Policy* (Banbury Report No. 19)(Risk Assessment)

Vettorazzi: *Handbook of International Food Regulatory Toxicology* (Food and Nutrition)

Wagner: *The Complete Guide to Hazardous Waste Regulations* (Environmental Toxicology—Hazardous Waste)

Journals

Food and Drug Law Journal

Regulatory Toxicology and Pharmacology

Journal Articles

Balls, M. (1995). In vitro test in regulatory toxicology: Symposium chairman's summing-up. ***Arch. Toxicol. Suppl.* 17,** 205–208.

Balls, M. (1995). In vitro methods in regulatory toxicology: The crucial significance of validation. ***Arch. Toxicol. Suppl.* 17,** 155–162.

Bass, R. (1995). In vitro methods in regulatory toxicology. ***Arch. Toxicol. Suppl.* 17,** 192–204.

Brown, K. S. (1997). A decent proposal? EPA's new clean air standards. ***Environ. Health Perspect.* 105**(4), 378–383.

Contrera, J. F., *et al.* (1997). Carcinogenicity testing and the evaluation of regulatory requirements for phar-

maceuticals. ***Regul. Toxicol. Pharmacol.*** **25**(2), 130–145.

Davis, C. (1995). The EPA and the implementation of hazardous waste laws. ***Environ. Professional*** **17**(4), 342–350.

Dernbach, J. C. (1997). The unfocused regulation of toxic and hazardous pollutants. ***Harvard Environ. Law Rev.*** **21.**

Johnson, B. L. (1995). Nature, extent, and impact of Superfund hazardous waste sites. ***Chemosphere*** **31,** 2415–2428.

Kirkland, D. G. (1993). Genetic toxicology testing requirements: Official and unofficial views from Europe. ***Environ. Mol. Mutagen.*** **21,** 8–14.

Klees, A. A. (1996, January–March). The interface of environmental regulation and public health. ***Occup. Med.*** **11,** 173–192.

Lauderdale, J. W. (1996). Industry's responsibility to the consumer. ***J. Nutr.*** **126,** 1007S–1009S.

Mason, R. (1997). Options for the regulation and control of the environmental impact and human health consequences of chemicals in the European Union. ***Arch. Toxicol. Suppl.*** **19,** 113–122.

Merrill, R. A. (1997). Food safety regulation: Reforming the Delaney Clause. ***Annu. Rev. Public Health*** **18,** 313–340.

Picut, C. A., and Parker, G. A. (1992). Interpreting the Delaney Clause in the 21st century. ***Toxicol. Pathol.*** **20,** 617–627.

Pugh, D. M. (1997). The precautionary principle and science-based limits in regulatory toxicology: The human experience, individual protection. ***Arch. Toxicol. Suppl.*** **19,** 147–154.

Rulis, A. M. (1996). Review of macronutrient substitutes by the Food and Drug Administration. ***Regul. Toxicol. Pharmacol.*** **23,** S47–S50.

Santos, S. L., *et al.* (1996). Industry response to SARA Title III: Pollution prevention, risk reduction, and risk communication. ***Risk Anal.*** **16,** 57–66.

Shoaf, S. E., and Brown, R. N. (1990). Role of pharmacokinetics in safety evaluation and regulatory considerations. ***Annu. Rev. Pharmacol. Toxicol.*** **30,** 197–218.

Walum, E., *et al.* (1995). Scientific, ethical and legal aspects of the acceptance of in vitro methods in regulatory toxicology. ***Arch. Toxicol. Suppl.*** **17,** 163–169.

Weisburger, J. H. (1994). Does the Delaney Clause of the U.S. food and drug laws prevent human cancers? ***Fundam. Appl. Toxicol.*** **22,** 483–493.

Zeeman, M., *et al.* (1995). U.S. EPA regulatory perspectives on the use of QSAR for new and existing chemical evaluations. ***SAR QSAR Environ. Res.*** **3**(3), 179–201.

RISK ASSESSMENT

Bankowski, Z., and Levine, R. J. (Eds.) (1993)
Ethics and Research on Human Subjects
World Health Organization, Geneva

Records the main presentations and discussions of an international conference to review revised ethical guidelines for biomedical research. These reflect the need for a fundamental rethinking of several principles issued earlier.

Burke, T. A., Tran, N. L., Roemer, J. S., and Henry, C. J. (Eds.) (1993)
Regulating Risk: The Science and Politics of Risk
ILSI Press, Washington, DC

Probes questions bearing on the politically sensitive issues which permeate the evolving science of risk identification, assessment, and communication. Chapters prepared by experts in the field discuss key issues.

Clayson, D. B., Kerwski, D., and Munro, I. (Eds.) (1985)
Toxicological Risk Assessment, 2 vols.
CRC Press, Boca Raton, FL

This text discusses the extrapolation of drug and genetic toxicity data, including pharmacokinetic and metabolic differences between species. Dosage level effects are stressed and low-dose extrapolation is well covered. Also included are epidemiological methods for assessing human cancer risk from environmental contaminants and the influence of nutrition and other factors in cancer etiology.

Clewell, H. J. (Ed.) (1992)
Conference on Chemical Risk Assessment in the DOD: Science, Policy, and Practice
ACGIH, Cincinnati, OH

Describes risk assessment methodologies and applications of these methodologies for the DOD. It covers principles of chemical risk assessment, issues surrounding risk assessment, current applications and future directions of risk assessment, and issues in risk management.

Cothern, C. R. (1995)
Handbook for Environmental Risk Decision Making
Lewis, Boca Raton, FL

Reflects the outcome of a symposium dealing with issues in risk assessment. The main sections include introduction and background, issues in environmental risk decision making, values and value judgments, and commentary. A total of 27 chapters describe the field and make suggestions for improvements.

Covello, V. T., and Merkhofer, M. W. (1993)
Risk Assessment Methods: Approaches for Assessing Health and Environmental Risks
Plenum, New York

Brings together all the methods for assessing risk into a common framework showing how they relate to one another. It evaluates and compares existing methodology, provides guidance for planning and conducting risk assessments, and presents a generalized way of thinking about the issues.

Crawford-Brown, D. J. (1997)
Theoretical and Mathematical Foundations of Human Health Risk Analysis
Kluwer, Norwell, MA.

This book, subtitled *Biophysical Theory of Environmental Health Science,* includes sections on the structure of theories in environmental health science, linking the population to the environment, the movement of pollutants into the body, inhalation—uptake into the respiratory tract, principles of pharmacokinetic modeling, modeling dose–response relationships, and environmental health risk analysis.

Crouch, E. A., and Wilson, R. (1982)
Risk/Benefit Analysis
Ballinger, Cambridge, MA

Text provides chapters on perspective, meaning, estimation, and perception of risk, comparison of risk and benefit, and case studies. A catalog of risks is presented.

Crump, K., Allen, B., and Faustman, E. (1995)
The Use of the Benchmark Dose Approach in Human Risk Assessment
U.S. EPA, Washington, DC

Focuses on the critical decisions that must be made in deriving the benchmark dose and applying this to risk assessment. The document also identifies many unresolved issues in benchmark dose application and identifies research needs. Helpful references for study selection, data selection, and model selection are provided.

Daugherty, J. E. (1998)
Assessment of Chemical Exposures: Calculation Methods for Environmental Professionals
Lewis, Boca Raton, FL

Begins with a discussion of the history of exposure assessments and discusses the potential impact of chemical exposures on humans, the environment, and communities. Provides clear explanations of the many components of the art of exposure assessment.

(U.S.) Environmental Protection Agency (EPA) (annual)
***Health Effects Assessment Summary Tables* (*HEAST*)**
U.S. EPA, Washington, DC

Prepared by EPA's National Center for Environmental Assessment (Cincinnati, OH). A comprehensive listing of provisional risk assessment information relative to oral and inhalation routes for chemicals of interest to Superfund, the Resource Conservation and Recovery Act (RCRA), and the EPA in general. The FY-1997 Update was published in July 1997 (PB97-921199). Available from the National Technical Information Service at 703-487-4650.

(U.S.) Environmental Protection Agency (EPA) (1996)
Proposed Guidelines for Carcinogen Risk Assessment
U.S. EPA, Washington, DC

Published in the *Federal Register* in April 1996. When final, these will replace the 1986 cancer guidelines. The proposed guidelines provide an analytical framework that allows for the incorporation of all relevant biological information, recognizes a variety of situations regarding cancer hazard, and is flexible enough to allow for consideration of future scientific advances. Available in various media from various source. It can be downloaded from *http://www.epa.gov/ordntrnt/ORD/WebPubs/carcinogen/index.html.*

(U.S.) Environmental Protection Agency (EPA)
***Integrated Risk Information System* (*IRIS*)** (database)
U.S. EPA, Washington, DC

This is the EPA's official repository of agency-wide consensus chronic human health risk information. Available through the National Library of Medicine's TOXNET system, as well as through EPA's Web site (*http://www.epa.gov/iris*).

(U.S.) Environmental Protection Agency (EPA)
Toxicological Reviews
U.S. EPA, Washington, DC

Prepared in support of summary information on the *Integrated Risk Information System* (*IRIS*). These reviews provide scientific support and rationale for the hazard identification and dose–response assessments for both cancer and noncancer effects (the oral reference dose and the inhalation reference concentration) from chronic exposure to the chemical under discussion. Available online through EPA's Web site at *http://www.epa.gov/iris/toxreviews/index.html.*

(U.S.) Environmental Protection Agency (EPA)
Miscellaneous publications
U.S. EPA, Washington, DC

The EPA has published a host of other important documents related to risk and risk assessment, including *Unfinished Business: A Comparative Assessment of Environmental Problems* (1987), *Reducing Risk: Setting Priorities and Strategies for Environmental Protection* (1990), *Guidelines for Exposure Assessment* (1992), and *Framework for Ecological Risk Assessment* (1992).

European Chemical Industry Ecology and Toxicology Centre (ECETOC) (1982)
Monograph No. 3: Risk-Assessment-of Occupational Chemical Carcinogens
ECETOC, Brussels

Reports the work of two task forces on the study of hazard identification and on a proposed approach to risk assessment. It includes a discussion on the limitations of risk assessment. There is an excellent bibliography.

European Centre for Ectoxicology and Toxicology of Chemicals (ECETOC) (1994)
Technical Report No. 58: Assessment of Non-Occupational Exposure to Chemicals
ECETOC, Brussels

Reviews the assumptions and equations used to assess non occupational exposure to chemicals. It recommends a stepwise approach to assess consumer exposure and indirect human exposure. Several case studies are included.

European Centre for Ectoxicology and Toxicology of Chemicals (ECETOC) (1995)
Technical Report No. 68: Assessment Factors in Human Health Risk Assessment
ECETOC, Brussels

Reviews the background to the role of ''assessment factors'' in human health risk assessment. The use of these factors is described in the context of risk assessment and risk management processes. The report recommends an approach to the use of these factors which will allow consistency across the spectrum of human exposure.

Fan, A. M., and Change, L. W. (Eds.) (1996)
Toxicology and Risk Assessment: Principles, Methods, and Applications
Dekker, New York

Provides the background in basic toxicology to understand the principles and not just follow the mechanical steps in risk assessment. To that end, the book discusses limitations and uncertainties attendant to any risk assessment methodology. The major sections, each well developed, include general toxicology, toxicologic testing, basic elements on risk assessment, assessment of mixtures, models and statistical methods, use of human data and animal to man extrapolation, requirements and resource needs, and risk management.

Farland, W., Olin, S., Park, C., Rhomberg, L., Scheuplein, R., Starr, T., and Wilson, J. (1994)
Low-Dose Extrapolation of Cancer Risks: Issues and Perspectives
ILSI Press, Washington, DC

Reviews the historical reasons for using high-dose animal studies to arrive at low-dose safe exposure levels for humans. The book then examines the strengths, weaknesses, and applicability of the various models and approaches used to describe these relationships in risk assessment and suggests ways to improve extrapolation models.

Glickman, T. S., and Gough, M. (Eds.) (1990)
Readings in Risk
Resources for the Future, Washington, DC

For readers seeking a convenient, objective, and stimulating introduction to risk assessment and management. The main topics include basic concepts, risk comparisons, regulatory issues, health risk assessment, technological risk assessment, and risk communication.

Graham, J. D., and Hartwell, J. K. (Eds.) (1996)
The Greening of Industry: A Risk Management Approach
Harvard Univ. Press, Cambridge, MA

Presents six case studies which provide examples of how federal risk-based regulation has encourages industry investment in pollution control. The examples cited involve lead in gasoline, ozone-depleting chemicals, and emissions from the dry cleaning, pulp and paper, coke, and municipal waste combustion industries.

Graham, J. D., and Wiener, J. B. (Eds.) (1995)
Risk vs. Risk: Tradeoffs in Protecting Health and the Environment
Harvard Univ. Press, Cambridge, MA

Provides both a critique of counterproductive risk-reduction efforts and a new method of analysis that is designed to illuminate and resolve risk trade-offs. Offers nine case studies illustrating the complexities of risk trade-offs, ranging from personal medical choices to control of toxic substances to prevention of global crises.

Hallenbeck, W. H. (1993)
Quantitative Risk Assessment for Environmental and Occupational Health, 2nd ed.
Lewis, Boca Raton, FL

Presents information regarding calculation of human dose rate and dose from experimental studies, quantitation of response, tests for significance, calculation of excess risk, calibration of confidence levels, individual and group risk estimates, and acceptable concentrations. The approach of this text is to illustrate the points with examples and it simplifies a complex subject.

Hoel, D. G., Merrill, R. A., and Perera, F. P. (Eds.) (1985)
Risk Quantitation and Regulatory Policy, Banbury Report No. 19
Cold Spring Harbor Laboratory Press, Cold Spring Harbor, NY

Contains papers from the Banbury Center conference on risk (May 1984). It covers the use of risk quantitation in regulatory decision making, the current methods for identifying and quantifying human health risks, several case studies, and the mechanisms for incorporating results into regulatory policy.

Louvar, J. F., and Louvar, B. D. (1998)
Health and Environmental Risk Analysis: Fundamentals with Applications
Prentice Hall, Upper Saddle River, NJ

Part of the *Ecological and Environmental Toxicology* series. Presents current techniques for assessing exposures, predicting carcinogenic and noncarcinogenic effects, and analyzing the risks of ionizing radiation.

Mertz, W., Abernathy, C. O., and Olin, S. S. (Eds.) (1994)
Risk Assessment of Essential Elements
ILSI Press, Washington, DC

Discusses information from experts in nutrition, toxicology, medical, and risk assessment communities on the nutritional and biochemical aspects of trace elements. The elements concerned include zinc, selenium, chromium, manganese, and arsenic. Each element is treated in a separate case study after the background is presented.

Molak, V. (Ed.) (1997)
Fundamentals of Risk Analysis and Risk Management
CRC Press, Boca Raton, FL

Topics include the theoretical background of risk analysis, applications of risk analysis, and risk perception and management.

National Research Council (1983)
Risk Assessment in the Federal Government: Managing the Process
National Academy Press, Washington, DC

Reports on the relations between science and policy in the assessment of the risk of cancer and other adverse health effects associated with exposure to toxic substances. It provides a mechanism to manage the partnership of good scientific assessment and regulatory procedures.

National Research Council, Committee on Risk Perception and Communication (1990)
Improving Risk Communication
National Academy Press, Washington, DC

Aimed at several audiences—public agencies in the government, consumer and citizen groups, media, and scientists and organizations employing them. The report should significantly improve understanding of the problems in risk communication, particularly these activities of government and industry.

National Research Council (1993)
Issues in Risk Assessment
National Academy Press, Washington, DC

Addresses three issues related to risk assessment: use of the maximum tolerated dose in animal bioassays for carcinogenicity, the two-stage model of carcinogenicity, and the paradigm for ecologic risk assessment.

National Research Council (1994)
Science and Judgment in Risk Assessment
National Academy Press, Washington, DC

Product of a National Academy of Science panel charged with reviewing the underlying assumptions and practices of risk assessment and examining reducing uncertainty in the process. Major topics covered in this text include a review of current approaches to risk assessments, strategies for improving risk assessments, and methods for implementation of the findings. Also included as appendices are abbreviated versions of some of the approved and useful current methodologies.

National Research Council (1996)
Understanding Risk: Informing Decisions in a Democratic Society
National Academy Press, Washington, DC

Addresses the detailed scientific and technical information that is essential when people making the decision are not scientists. This volume illustrates that making risks understandable to the public involves much more than translating scientific knowledge. This is important to anyone involved in risk issues—federal, state, and local policymakers, scientists, researchers, and concerned individuals.

Neely, W. B. (1994)
Introduction to Chemical Exposure and Risk Assessment
Lewis, Boca Raton, FL

Provides an introduction to the principles involved in assessing risks from chemical exposure, including how risk is perceived, how numbers are handled, and how chemicals affect health. Then, it describes how environmental concentrations and effects are assessed. There are several case studies.

Neubert, D., Kavlock, R. J., Merker, H. J., and Klein, J. (Eds.) (1992)
Risk Assessment of Prenatally-Induced Adverse Health Effects
Springer-Verlag, Berlin

Derives from a symposium concerning risk assessment of prenatally induced health effects. The goal is to discuss the scientific prerequisites for a risk assessment in reproductive toxicity and to discuss the possibilities for quantitative assessment. End points for analysis, terminology, problems created by use of high doses, and problems of interfering maternal toxicity are discussed.

Neumann, D. A., and Kimmel, C. A. (Eds.) (1998)
Human Variability in Response to Chemical Exposures: Measures, Modeling and Risk Assessment
CRC Press, Boca Raton, FL

Recognizes that understanding of variability in response is critical in accounting for interindividual variability in susceptibility. This is needed for the regulatory community that is expected to characterize human health risks associated with exposure to chemicals.

Newman, M. C., and Strojan, C. L. (1998)
Risk Assessment: Logic and Measurement
Ann Arbor Press, Chelsea, MI

Covers areas such as the historical perspective of exposure assessment, simulation models, canonical modeling, dyanamic measures for ecotoxicity, and radiation exposure.

Noji, E. K. (1997)
The Public Health Consequences of Disasters
Oxford Univ. Press, New York

Though only tangentially related to toxicology, from a risk assessment perspective, this book provides a fascinating account of disaster emergency planning, preparedness, and response. The examples concern geophysical events, weather-related problems, and human-generated problems (including air pollution, fires, nuclear reactor incidents, and industrial disasters).

Paustenbach, D. J. (Ed.) (1989)
The Risk Assessment of Environmental and Human Health Hazards: A Textbook of Case Studies
Wiley, New York

Series of instructive case histories describing both cause and effect issues arising in the workplace. These examples are useful to industrial hygienists as examples of situations and solutions to commonly occurring workplace problems.

Presidential/Congressional Commission on Risk Assessment and Risk Management (1997)
Final Reports
U.S. Government Printing Office, Washington, DC

Volume 1, *Framework for Environmental Health Risk Management,* and Vol. 2, *Risk Assessment and Risk Management in Regulatory Decision-Making*. Volume 1 is a reader-friendly report that focuses on the commission's comprehensive new Risk Management Framework, providing principles for making good risk management decisions and for actively engaging stakeholders in the process. Volume 2 addresses many technical and policy issues related to health and environmental risk-based decisions. Available at the Riskworld Web site (*http://www.riskworld.com*).

Richardson, M. L. (Ed.) (1992)
Risk Management of Chemicals
Royal Society of Chemistry, Cambridge, UK

Reviews the current status of the management of the risk entailed in the synthesis, handling, use, and particularly disposal of chemicals. There are five areas covered: setting the scene, introduction to the management of risk, managing risk in manufacture, risk management from waste, and managing risk during chemical use.

Rodericks, J. V. (1992)
Calculated Risks
Cambridge Univ. Press, Cambridge, UK

Focuses on the methods and principles of toxicology and risk assessment. This volume describes and clarifies the reasons for our current concerns about chemicals in the environment, the strengths and weaknesses of our scientific understanding, and the interplay between science and public policy.

Roloff, M. V., and Wilson, A. G. E. (Eds.) (1987)
Human Risk Assessment—The Role of Animal Selection and Extrapolation
Taylor & Francis, London

Explores the current understanding of the factors which are critical in the selection of an appropriate animal species for toxicology studies and the subsequent extrapolation of the data to man. The aim is to use this information to reduce the uncertainty that exists in switching from animal data to human.

Smith, C. M., Christiani, D. C., and Kelsey, K. T. (Eds.) (1994)
Chemical Risk Assessment and Occupational Health
Auburn House, Westport, CT

Discusses scientific, social, and regulatory issues affecting risk assessment. It includes methods and strategies for use of epidemiological studies, animal bioassay data, toxicokinetics, and biomarkers to assess occupational risks.

Stara, J. F., and Erdreich, L. S. (1985)
Advances in Health Risk Assessment for Systemic Toxicants and Chemical Mixtures
Princeton Scientific, Princeton, NJ

Presents papers from a symposium that reviewed risk assessment procedures for systemic toxicants and presents new topics such as dealing with chemical mixtures. The book places emphasis on current research being conducted or sponsored by the EPA. Following a review of this program, the remaining areas covered in detail include using human data, applying pharmacokinetics and pharmacogenetics to risk assessment, risk assessment for mixtures, dealing with uncertainty, and new and applied areas for future research. This is one of the few texts which deals with the issue of mixture assessment and testing.

Swanson, M. B., and Socha, A. C. (Eds.) (1997)
Chemical Ranking and Scoring: Guidelines for Relative Assessments of Chemicals
SETAC, Pensacola, FL

Presents the outcome of a workshop discussing ways of raning chemicals for relative risks. The workshop developed a framework and guidelines and principles to promote consistency in the development and application of such systems. Working group reports cover framework issues, methods for assessing exposure, human health effects, and ecological effects. A series of 17 principles were proposed as guidelines for use in ranking systems.

Van Leeuwen, C. J., and Hermens, J. L. M. (Eds.) (1995)
Risk Assessment of Chemicals: An Introduction
Kluwer, Dordrecht

Contains basic background information on sources, emissions, distribution, and fate processes for exposure estimation. Also included are dose–effect estimations for both human health-related toxicology and ecotoxicology as well as information on estimation methodologies. The basic principles and methods of risk assessment in their broadest, including legislative aspects, are covered in this book.

Vincoli, J. W. (1997)
Risk Management for Hazardous Chemicals
CRC Press, Boca Raton, FL

This book/CD-ROM set provides as MSDS for each of many industrial chemicals. Information concerning risks to health, risks to the environment, and risks to business operations is covered in this set. This book compiles data from groups such as NIOSH, ACGIH, and EPA.

Wang, R. G. M., Knaak, J. B., and Maibach, H. I. (Eds.) (1993)
Health Risk Assessment: Dermal and Inhalation Exposure and Absorption of Toxicants
CRC Press, Boca Raton, FL

Aspects of dermal exposure to toxicants are emphasized with respect to skin metabolism, absorption, and pharmacokinetic modeling. This text attempts to link dermal exposures to the specific agent end points which can be affected. Addresses the issue of delivered versus applied dose.

Zervos, C. (Ed.) (1991)
Risk Analysis: Prospects and Opportunities
Plenum, New York

Covers the spectrum on risk analysis. Both cancer and noncancer health risks are examined. The public's perception of risk and the correlation between that perception and the acceptance of nonacceptance of certain risks is also addressed. The progress on predicting and quantifying specific risks is reported

See Also:

Aldrich: *Environmental Epidemiology and Risk Assessment* (Epidemiology)

Brusick: *Methods for Genetic Risk Assessment* (Genetic Toxicology)

Calabrese: *Air Toxics and Risk Assessment* (Environmental—Atmospheric)

Calabrese: *Principles of Animal Extrapolation* (Miscellaneous)

Chengelis: *Regulatory Toxicology* (Regulatory Toxicology)

ECETOC: *Monograph No. 21: Immunotoxicity: Hazard Identification and Risk Characterization* (Testing Methods and Toxicity Assessment)

ECETOC: *Technical Report No. 40: Hazard Assessment of Chemical Contaminants in Soil* (Environmental Toxicology—Terrestrial)

ECETOC: *Technical Report No. 51: Environmental Hazard. Assessment of Substances* (Environmental Toxicology—Aquatic)

Eisenberg: *Risk Assessment and Indoor Air Quality* (Environmental Toxicology—Atmospheric)

Federal Focus: *Principles for Evaluating Epidemiologic Data* (Epidemiology)

Graham: *The Role of Epidemiology in Regulatory Risk Assessment* (Epidemiology)

Gratt: *Air: Toxic Risk Assessment and Management* (Environmental Toxicology: Air)

Guzelain: *Similarities and Differences between Children and Adults* (Miscellaneous)

Hrudey: *Bioavailability in Environmental Risk Assessment* (Pharmacokinetics and Metabolism)

Ingersoll: *Ecological Risk Assessments of Contaminated Sediments* (Environmental Toxicology—Terrestrial)

Jenkins: *Respiratory Toxicology and Risk Assessment* (Target Sites—Respiratory)

Korting: *The Benefit/Risk Ratio* (Chemicals—Drugs)

Landis: *Environmental Toxicology and Risk Assessment* (Environmental—General)

Lawson: *Disease Mapping and Risk Assessment for Public Health* (Epidemiology)

Lipsky: *Mechanistic Basis and Relevance of Kidney Tumors in Male Rats for Use in Risk Assessment* (Target Sites—Kidney)

Lu, F. C.: *Basic Toxicology Fundamentals, Target Organs, and Risk Assessment*, 3rd ed. (General Texts)

Miller: *Fundamentals of Extrapolation Modeling of Inhaled Toxicants* (Target Sites—Respiratory)

Olin: *Exposure to Contaminants in Drinking Water* (Environmental Toxicology—Aquatic)

Olin: *Low-Dose Extrapolation of Cancer Risks: Issues and Perspectives* (Cancer)

Pearson: *Aquatic Toxicology and Hazard Assessment* (Environmental—Aquatic)

Rappaport: *Exposure Assessment for Epidemiology and Hazard Control* (Epidemiology)

Richardson: *Risk Assessment of Chemicals in the Environment* (Environmental—General)

Sadhra: *Occupational Health: Risk Assessment and Management* (Occupational Health)

Snyder: *Biological Reactive Intermediates: Basic Mechanistic Research in Toxicology and Human Risk Assessment* (Pharmacokinetics and Metabolism)

Suter: *Ecological Risk Assessment* (Environmental—Aquatic)

WHO: *Biomarkers and Risk Assessment: Concepts and Principles* (Biomonitoring/Biomarkers)

Zervos: *Oncogene and Transgenics Correlates of Cancer Risk Assessments* (Cancer)

Journals

Human and Ecological Risk Assessment

Regulatory Toxicology and Pharmacology

Risk Analysis

Risk: Health, Safety, and Environment

Journal Articles

Acquavella, J. F., *et al.* (1994). Interpretation of low to moderate relative risks in environmental epidemiologic studies. ***Annu. Rev. Public Health* 15,** 179–201.

Albert, R. E. (1994). Carcinogen risk assessment in the U.S. Environmental Protection Agency. ***Crit. Rev. Toxicol.* 24,** 75–86.

Anonymous (1996). **Proposed guidelines for carcinogen risk assessment,** NTIS/PB96-157500.

Babich, M. A. (1998). Risk assessment of low-level chemical exposures from consumer products under the U.S. Consumer Product Safety Commission chronic hazard guidelines. ***Environ. Health Perspect.* 106**(Suppl. 1), 387–390.

Bailer, A. J., and Dankovic, D. A. (1997). An introduction to the use of physiologically based pharmacokinetic models in risk assessment. ***Stat. Methods Med. Res.* 6**(4), 341–358.

Becher, H., and Wahrendorf, J. (1995). Epidemiological risk assessment for chemical substances. ***Zentralblatt Hygiene Umweltmedizin* 197,** 188–195.

Beck, B. D., *et al.* (1993). Improvements in quantitative noncancer risk assessment. ***Fundam. Appl. Toxicol.* 20,** 1–15.

Becking, G. C. (1996). International harmonization of approaches to risk assessment: Will resolution of scientific issues alone lead to success. ***Drug Metab. Rev.* 28**(1/2), 269–283.

Birnbaum, L. S., and DeVito, M. J. (1995). Use of toxic equivalency factors for risk assessment for dioxin and related compounds. ***Toxicology* 105,** 391–401.

Blair, A., *et al.* (1995). Guidelines for application of meta-analysis in environmental epidemiology. ILSI

Risk Science Institute. ***Regul. Toxicol. Pharmacol.*** **22**(2), 189–197.

Bond, J. A., and Medinsky, M. A. (1995). Health risk assessment of chemical mixtures from a research perspective. ***Toxicol. Lett.*** **82,** 521–525.

Boyes, W. K., Dourson, M. L., Patterson, J., Tilson, H. A., Sette, W. F., MacPhail, R. C., Li, A. A., and O'Donoghue, J. L. (1997). EPA's neurotoxicity risk assessment guidelines. ***Fundam. Appl. Toxicol.*** **40**(2), 175–184.

Bucher, J. R., *et al.* (1996). National Toxicology Program studies: Principles of dose selection and applications to mechanistic based risk assessment. ***Fundam. Appl. Toxicol.*** **31,** 1–8.

Cassee, F. R., Groten, J. P., van Bladeren, P. J., and Feron, V. J. (1998). Toxicological evaluation and risk assessment of chemical mixtures. ***Crit. Rev. Toxicol.*** **28,** 1–33.

Clayson, D. B., and Iverson, F. (1996). Cancer risk assessment at the crossroads: The need to turn to a biological approach. ***Regul. Toxicol. Pharmacol.*** **24**(10), 45–59.

De Rosa, C. T., Stevens, Y. W., and Johnson, B. L. (1998). Role of risk assessment in public health practice. ***Toxicol. Ind. Health*** **14**(3), 389–412.

Doull, J., *et al.* (1995). Hazard evaluation in risk assessment: Whatever happened to sound scientific judgement and weight of evidence? ***Drug Metab. Rev.*** **28**(1/2):285–99, 1996.

Dourson, M. L., *et al.* (1996). Evolution of science-based uncertainty factors in noncancer risk assessment. ***Regul. Toxicol. Pharmacol.*** **24**(2 Part 1), 108–120. [Also see comment on p. 107]

Fan, A., *et al.* (1995). Risk assessment of environmental chemicals. ***Annu. Rev. Pharmacol. Toxicol.*** **35,** 341–368.

Fedra, K. (1998). Integrated risk assessment and management: Overview and state of the art. ***J. Hazardous Materials*** **61**(1–3), 5–22.

Gaylor, D. W., Bolger, P. M., and Schwetz, B. A. (1998). U.S. Food and Drug Administration perspective of the inclusion of effects of low-level exposures in safety and risk assessment. ***Environ. Health Perspect.*** **106**(Suppl. 1), 391–394.

Goddard, M. J., and Krewski, D. (1995). The future of mechanistic research in risk assessment: Where are we going and can we get there from here? ***Toxicology*** **102**(1/2), 53–70.

Groopman, J. D., *et al.* (1995). Molecular epidemiology and human risk monitoring. ***Toxicol. Lett.*** **82,** 763–769.

Hard, G. C., and Whysner, J. (1994). Risk assessment of d-limonene: An example of male rat-specific renal tumorigen. ***Crit. Rev. Toxicol.*** **24,** 231–254.

Jarvholm, B. (1997). Relative risk and excess rate models in exposure-response analysis. ***Am. J. Indust. Med.*** **31,** 399–402.

Kakkar, P., *et al.* (1996). Specific molecular probes for mechanistic studies in toxicology and molecular epidemiology for risk assessment. ***J. Environ. Sci. Health Part C Environ. Carcinog. Ecotoxicol. Rev.*** **14**(2), 105–137.

Kamrin, M. A. (1997). Environmental risk harmonization: Federal/state approaches to risk assessment and management. ***Regul. Toxicol. Pharmacol.*** **25**(2), 158–165.

Kodell, R. L. (1996). Bioassay designs for validating biologically based mathematical models of carcinogenesis for risk assessment. ***Drug Metab. Rev.*** **28**(1/2), 219–223.

Kreps, S. E., Banzet, N., Christiani, D. C., and Polla, B. S. (1997). Molecular biomarkers of early responses to environmental stressors: Implications for risk assessment and public health. ***Rev. Environ. Health*** **12**(4), 261–280.

Links, J. M. (1995). Biomarkers and mechanistic approaches in environmental epidemiology. ***Annu. Rev. Public Health*** **16,** 83–103.

Lovell, D. P., and Thomas, G. (1996). Quantitative risk assessment and the limitations of the linearized multistage model. ***Hum. Exp. Toxicol.*** **15,** 87–104.

Mattie, D. R. (1997). An overview of the risk assessment of hazardous materials and the role of toxicology. ***Ann. Clin. Lab. Sci.*** **27**(3), 173–178.

McClellan, R. O. (1995). Risk assessment and biological mechanisms: Lessons learned, future opportunities. ***Toxicology*** **102,** 239–258.

Mumtaz, M. M. (1995). Risk assessment of chemical mixtures from a public health perspective. ***Toxicol. Lett.*** **82,** 527–532.

Mumtaz, M. M., *et al.* (1993). Risk assessment of chemical mixtures: Biologic and toxicologic issues. ***Fundam. Appl. Toxicol.*** **21,** 258–269.

Ohanian, E. V., *et al.* (1997). Risk characterization: A bridge to informed decision making. ***Toxicol. Appl. Pharmacol.*** **39,** 81–88.

Olin, S. S., *et al.* (1997). Topics in cancer risk assessment. ***Environ. Health Perspect.*** **105**(Suppl. 1), 117–126.

Perera, F. P., *et al.* (1995, July 26). Molecular epidemiology in environmental carcinogenesis. ***Environ. Health Perspect.*** **104**(Suppl. 3), 441–443.

Portier, C., and el Masri, H. (1997). Statistical research needs in mechanistic modelling for carcinogenic risk assessment. ***Stat. Methods Med. Res.*** **6**(4), 305–315.

Schaffer, D. J., and Bailey, M. (1996). Chemical codes: A methodology for generic risk assessment of wastes. ***J. Hazardous Materials*** **45,** 245–258.

Scheuplein, R. J. (1995). Information needed to support hazard identification and risk assessment of toxic substances. ***Toxicol. Lett.*** **79,** 23–28.

Schulte, P. A., and Talaska, G. (1995, July 26). Validity criteria for the use of biological markers of exposure to chemical agents in environmental epidemiology. ***Toxicology*** **101**(1/2), 73–88.

Sielken, R. L., Jr., and Stevenson, D. E. (1998). Some implications for quantitative risk assessment if hormesis exists. ***Hum. Exp. Toxicol.*** **17**(5), 259–262.

Simmons, J. E. (1995). Chemical mixtures: Challenge for toxicology and risk assessment. ***Toxicology*** **105,** 111–119.

Slikker, W., Jr., *et al.* (1996). Biologically based, quantitative risk assessment of neurotoxicants. ***Fundam. Appl. Toxicol.*** **29,** 18–30.

Stohrer, G. (1995). Realistic risk assessment. ***Regul. Toxicol. Pharmacol.*** **22,** 118–121.

Teuschler, L. K., and Hertzberg, R. C. (1995). Current and future risk assessment guidelines, policy, and methods development for chemical mixtures. ***Toxicology*** **105,** 137–144.

Thomas, P. T. (1998). Immunotoxicology: Hazard identification and risk assessment. ***Nutr. Rev.*** **56**(1, Pt. 2), 131–134.

Velazquez, S. F., *et al.* (1996). Cancer risk assessment: Historical perspectives, current issues, and future directions. ***Drug Chem. Toxicol.*** **19**(3), 161–185.

Zemba, S. G., *et al.* (1996). Quantitative risk assessment of stack emissions from municipal waste combustors. ***J. Hazardous Materials*** **47,** 229–275.

TARGET SITES—GENERAL

Brown, S. S., and Davies, D. S., (Eds.) (1981)
Organ-Directed Toxicity: Chemical Indices and Mechanisms
Pergamon, Oxford

Based on a symposium held in Barcelona in 1981. Animal models, renal toxicity, hepatotoxicity, neurotoxicity, and toxicity in other systems are covered. Particular emphasis is placed on both parameters needed to detect chemically induced damage and the biochemical mechanism for that damage.

Cohen, G. M. (Ed.) (1986)
Target Organ Toxicity, Vols. 1 and 2
CRC Press, Boca Raton, FL

Sets a basis for the in-depth study of target organ toxicity. General principles such as pharmacokinetics and species differences are covered and illustrated by selected examples. Emphasis is placed on long-term health risks, with many chapters dedicated to chemical carcinogens.

Kroemer, K. H. F., Kroemer, H. J., and Kroemer-Elbert, K. E. (1997)
Engineering Physiology, 3rd ed.
Van Nostrand–Reinhold, New York

Contains information on the size, build, and functioning of the human body without necessitating in-depth knowledge of physiology, biology, or medicine on the part of the reader. The book is best viewed as a collection of ideas, an introduction to the interrelationships of the human body and machines, and a guide for problem solving regarding ergonomics.

See Also:
Turton: *Target Organ Pathology* (Pathology)

Journal Articles

Cohen, S. D., *et al.* (1997). Selective protein covalent binding and target organ toxicity. ***Toxicol. Appl. Pharmacol.*** **143,** 1–12.

Lock, E. A. (1994). The role of mechanistic studies in understanding target organ toxicity. ***Arch. Toxicol. Suppl.*** **16,** 151–160.

Lock, E. A. (1995). Mechanisms underlying species-specificity in target organ toxicity. ***Arch. Toxicol. Suppl.*** **17,** 367–374.

TARGET SITES—CARDIOVASCULAR

Acosta, D., Jr. (Ed.) (1992)
Cardiovascular Toxicology, 2nd ed.
Raven Press, New York

Following an introduction to cardiovascular toxicology, this book discusses methods for investigating the acute and chronic toxicity of drugs to the cardiovascu-

lar system. The third section focuses on mechanisms and hypotheses by which myocardial cells may be injured by xenobiotics or ischemic/hypoxic conditions. The final two sections present major reviews on the toxicity of drugs and chemicals to the myocardium and to the vascular system.

Balazs, T. (1981)
Cardiac Toxicology
CRC Press, Boca Raton, FL

Three volumes: The first volume provides background information on cardiac pathophysiology and molecular pathology, the second volume describes cardiotoxic effects of drugs and other chemicals, and the third volume discusses methods for toxicity studies. The first volume includes chapters regarding biochemical and ionic mechanisms of cardiotoxic agents; myocardial function and drug actions; effects of cardiotoxic agents on electrical properties of myocardial cells; mechanism of chemically induced cardiac arrhythmias; pathophysiology of the heart in shock; the role of coronary no-flow, reflow phenomenon to myocardial injury; the role of calcium in reversible and irreversible injury; and the heart as a target organ in immune–hypersensitivity reactions.

Baskin, S. I. (1991)
Principles of Cardiac Toxicology
CRC Press, Boca Raton, FL

Introduces the principles of cardiovascular toxicology to students and clinicians attempting to gain an understanding of drugs and chemicals that may introduce undesired effects by interfering with cardiac or vascular tissues.

See Also:
Jones: *Monographs on Pathology of Laboratory Animals Series* (Pathology)

Journal Articles

Boor, P. J., *et al.* (1995). Chemical-induced vasculature injury. ***Toxicol. Appl. Pharmacol.* 132,** 177–195.

Braun, F. L., *et al.* (1997, April). Lifetime cocaine use and cardiovascular characteristics among young adults: The CARDIA study. ***Am. J. Public Health* 87**(4), 629–634.

Criqui, M. H. (1996). Alcohol and coronary heart disease: Consistent relationship and public health implications. ***Clin. Chim. Acta* 246,** 51–57.

Dogterom, P., *et al.* (1992). Cardiotoxicity of vasodilators and positive inotropic/vasodilating drugs in dogs: An overview. ***Crit. Rev. Toxicol.* 22,** 203–242.

Doig, J. C. (1997). Drug-induced cardiac arrhythmias: Incidence, prevention and management. ***Drug Safety* 17,** 265–275.

Friedman, P. L., and Stevenson, W. G. (1998). Proarrhythmia. ***Am. J. Cardiol.* 82,** 50N–58N.

Keller, D. A., *et al.* (1996). Fluoroacetate-mediated toxicity of fluorinated ethanes. ***Fundam. Appl. Toxicol.* 30,** 213–219.

Khedun, S. M., *et al.* (1996). Hexane cardiotoxicity: An experimental study. ***Israel J. Med. Sci.* 32,** 123–128.

Koyama, S., *et al.* (1995). Experimental rat model representing both acute and chronic heart failure related to autoimmune myocarditis. ***Cardiovasc. Drugs Ther.* 9,** 701–707.

Lewis, M. A. (1998). Myocardial infarction and stroke in young women: What is the impact of oral contraceptives? ***Am. J. Obstet. Gynecol.* 179,** 68–77.

Neely, J. L. (1998). Tonic clonic seizures and tachycardia induced by fluoxetine (Prozac) overdose. ***W. Virginia Med. J.* 94,** 283–285.

Preedy, V. R., *et al.* (1996). Alcohol and the heart: Biochemical alterations. ***Cardiovasc. Res.* 31,** 139–147.

Sullivan, M. L., *et al.* (1998). The cardiac toxicity of anabolic steroids. ***Prog. Cardiovas. Dis.* 41,** 1–15.

Szekeres, L. (1996). On the mechanism and possible therapeutic application of delayed cardiac adaptation to stress. ***Can. J. Cardiol.* 12,** 177–185.

TARGET SITES—ENDOCRINE

Atterwill, C. K., and Flack, J. D. (Eds.) (1992)
Endocrine Toxicology
Cambridge Univ. Press, New York

Describes the anatomy and physiology of the major endocrine glands so that a toxicologic response to xenobiotics can be defined in mechanistic terms. It includes hypothalamic and pituitary toxicology, thyroid and parathyroid toxicology, adrenal toxicology, and reproductive toxicology.

Guillette, L. J., Jr. (Ed.) (1999)
Environmental Endocrine Disrupters
Taylor & Francis, Philadelphia

Deals with the latest research in endocrine disruption by environmentally encountered substances in humans, mammals, and other vertebrates. This book examines the role of contaminants as endocrine disrupters. After laying the technical groundwork, the book

covers specific effects on the immune and nervous system as well as effects on the liver and thyroid.

Harvey, P. W. (1997)
The Adrenal in Toxicology: Target Organ and Modulator of Toxicity
Taylor & Francis, London

Takes the approach of the adrenal as a major modulator of whole body response to toxic insult. Includes many chapters on the adrenal as a target organ for toxicity and describes in detail various forms of adrenal gland pathology. Specific classes of chemicals such as drugs and pesticidal agents are highlighted.

Jones, T. C., Capen, C. C., and Mohr, U. (Eds.) (1996)
Endocrine System, 2nd ed.
Springer, Berlin

Part of the series *Monographs on Pathology of Laboratory Animals.* Designed for multidisciplinary use and covers the subject in an attempt to harmonize evaluation of endocrine function in toxicity testing. The main thrust is to present a uniform nomenclature around tissue/cellular findings regarding cells of the endocrine system. The reader will gain a clearer concept of the significance of some pathologic lesions in the endocrine system and their relation to human health.

Keith, L. H., Keith, V., and Johnson, T. (Eds.) (1997)
Environmental Endocrine Disruptors: A Handbook of Property Data
Wiley, New York.

Uses a standard format to provide a single source for physical and hazardous properties of 67 known or suspected environmental endocrine disrupters. Each chapter includes an introduction followed by a brief summary of why the chemical is included, environmental reference materials, toxicologic information, and overexposure symptoms. A searchable CD-ROM version is available.

Lechago, J., and Gould, V. E. (Eds.) (1997)
Bloodworth's Endocrine Pathology, 3rd ed.
Williams & Wilkins, Baltimore

Thorough review of the endocrine system pathology covering such aspects as mechanisms of hormone action, molecular and cellular basics of endocrine neoplasia, neurohypophysis, hypothalamus, the pineal gland, and endocrine aspects of the male and female reproductive systems.

McLachlan, J. A. (Ed.) (1985)
Estrogens in the Environment II: Influences on Development
Elsevier, New York

Relevant to today's concern about this subject, this book covers structure–activity relationships of estrogenic chemicals and analysis of estrogenic xenobiotics. The role of metabolism and the effect on the developing organism, particularly those involved in sexual development, are well discussed.

National Research Council, Committee on Hormonally Active Agents in the Environment (1999)
Hormonally Active Agents in the Environment
National Academy Press, Washington, DC

Critically evaluates the literature on hormonally active agents in the environment and identifies known and suspected toxicologic mechanisms and effects in fish, wildlife, and humans.

Norris, D. O. (1996)
Vertebrate Endocrinology, 3rd ed.
Academic Press, San Diego

Aimed at the advanced undergraduate student and assumes a basic background in cellular and organismic physiology. The subjects include the traditional and also recent important interfaces, such as neurobiology, immunology, cellular biology, and molecular biology. This basic text does a fine job of updating and covering an emerging field of importance to the toxicologist.

Thomas, J. A. (Ed.) (1996)
Endocrine Methods
Academic Press, New York

Contains descriptions of contemporary methodologies in various areas of endocrinology including receptor theory and immunologic techniques. The book provides a wide spectrum of assays, both *in vivo* and *in vitro,* important to several areas of hormone research. This book is intended for hands-on toxicologists and medical researchers.

Thomas, J. A. (Ed.) (1996)
Endocrine Toxicology
Taylor & Francis, Philadelphia

Each chapter begins with the basic physiology of the endocrine organ involved and provides a description of what occurs when it is under attack by toxins.

Thomas, J. A. (Ed.) (1997)
Endocrine Toxicology, 2nd ed.
Taylor & Francis, Washington, DC

Presents a range of topics from the molecular events surrounding hormone actions to epidemiologic studies of the effects of environmental and occupational chemicals on reproductive organs. The endocrine systems covered include the adrenal cortex, the thyroid and parathyroid, the gonads, and the endocrine pancreas.

The monograph also describes some of the underlying toxic mechanisms involving pancreatic B cells and metal-induced changes in male sex assessory glands.

Woodman, D. D. (1997)
Laboratory Animal Endocrinology
Wiley, New York

Aimed at providing a source of information covering the major laboratory species, particularly rodents, dogs, and monkeys, and to provide a comparison of their endocrine system with that of man. The focus of this book is to provide the reader with the many species differences in hormonal structure, metabolism, and interaction.

See Also:
Bolander: *Molecular Endocrinology,* 2nd ed. (Molecular, Cellular, and Biochemical Toxicology)

Danish Environmental Protection Agency: *Male Reproductive Health and Environmental Chemicals with Estrogenic Effects* (Developmental and Reproductive Toxicology)

Kendall: *Principles and Processes for Evaluating Endocrine Disruption in Wildlife* (Environmental Toxicology—Wildlife)

Li: *Hormonal carcinogenesis* (Cancer)

Naz: *Endocrine Disruptors* (Developmental and Reproductive Toxicology)

Yen: *Neuroendocrine Regulation of Reproduction* (Developmental and Reproductive Toxicology)

Journal Articles

Ashby, J., *et al.* (1997). The challenge posed by endocrine-disrupting chemicals. ***Environ. Health Perspect.*** **105**(2), 164–169.

Barton, H. A., and Andersen, M. E. (1998). Endocrine active compounds: From biology to dose response assessment. ***Crit. Rev. Toxicol.*** **28,** 363–423.

Calabrese, E. J., *et al* (1997). A toxicologically based weight-of-evidence methodology for the relative ranking of chemicals of endocrine disruption potential. ***Reg. Toxicol. Pharmacol.*** **26,** 36–40.

Capen, C. C. (1998). Correlation of mechanistic data and histopathology in the evaluation of selected toxic endpoints of the endocrine systme. ***Toxicol. Lett.*** **102–103,** 405–409.

Chapin, R. E., *et al.* (1996). Endocrine modulation of reproduction. ***Fundam. Appl. Toxicol.*** **29,** 1–17.

Cheek, A. O., Vonier, P. M., Oberdorster, E., Burow, B. C., and McLachlan, J. A. (1998). Environmental signaling: A biological context for endocrine disruption. ***Environ. Health Perspect.*** **106**(Suppl. 1), 5–10.

Cooper, R. L., and Kavlock, R. J. (1997). Endocrine disruptors and reproductive development: A weight-of-evidence overview. ***J. Endocrinol.*** **152**(2), 159–166.

Crisp, T. M., Clegg, E. D., Cooper, R. L., Wood, W. P., Anderson, D. G., Baetcke, K. P., Hoffmann, J. L., Morrow, M. S., Rodier, D. J., Schaeffer, J. E., Touart, L. W., Zeeman, M. G., and Patel, Y. M. (1998). Environmental endocrine disruption: An effects assessment and analysis ***Environ. Health Perspect.*** **106**(Suppl. 1), 11–56.

Eubanks, M. W. (1997, May). Hormones and health. ***Environ. Health Perspect.*** **105**(5), 482–486.

Golden, R. J., Noller, K. L. Titus-Ernstoff, L., Kaufman, R. H. Mittendorf, R., Stillman, R., and Reese, E. A. (1998). Environmental endocrine modulators and human health: An assessment of the biological evidence. ***Crit. Rev. Toxicol.*** **28,** 109–227.

Heufelder, A. E., and Hofbauer, L. C. (1996). Environmental endocrinology: Hidden, but potent ways of activating the estrogen receptor. ***Eur. J. Endocrinol.*** **135**(6), 653–654.

Kavlock, R. J., *et al.* (1996). Research needs for the risk assessment of health and environmental effects of endocrine dissruptors: A report of the U.S. EPA-sponsored workshop. ***Environ. Health Perspect.*** **104**(Suppl. 4), 715–740.

Lech, J. J., *et al.* (1996). *In vivo* estrogenic activity of nonylphenol in rainbow trout. ***Fundam. Appl. Toxicol.*** **30,** 229–232.

Olea, N. (1996, December). Oestrogens and the environment. ***Eur. J. Cancer Prevention*** **5**(6), 491–496.

Nimrod, A. C., and Benson, W. H. (1996). Environmental estrogenic effects of alkylphenol ethoxylates. ***Crit. Rev. Toxicol.*** **26,** 335–364.

Tyler, C. R., Jobling, S., and Sumpter, J. P. (1998). Endocrine disruption in wildlife: A critical review of the evidence. ***Crit. Rev. Toxicol.*** **28**(4), 319–361.

Van Os, W. A., *et al.* (1997, March). Oral contraceptives and breast cancer risk. ***Adv. Contraception*** **13,** 63–69.

Wilks, M. F., *et al.* (1996). Environmental endocrine modulators—where toxicology meets epidemiology. ***Hum. Exp. Toxicol.*** **15,** 692–693.

TARGET SITES—GASTROINTESTINAL

Hill, M. J. (Ed.) (1995)
Role of Gut Bacteria in Human Toxicology and Pharmacology
Taylor & Francis, London

Presents an indication of the breadth and depth of the subject and applies the current state of awareness to selected issues. The first section deals with background data on the normal gut and then nitrogen, carbohydrate, fat and fat substitute, sulfur compound, and xenobiotic metabolism. The last section covers biliary excretion and enterohepatic circulation of xenobiotics.

Preedy, V. R., and Watson, R. R. (Eds.) (1996)
Alcohol and the Gastrointestinal Tract
CRC Press, Boca Raton, FL

Covers the epidemiology of alcohol misuse and general pathological mechanisms, the biochemistry and physiology of the intestinal tissues, and organ-specific reactions.

Rozman, K., and Hanninen, O. (Eds.) (1986)
Gastrointestinal Toxicology
Elsevier, Amsterdam

Examines the functional, biochemical, and structural characteristics of the alimentary canal along with methodologies for studying aspects of gastrointestinal toxicology. Known effects of important classes of xenobiotics and issues in gastrointestinal toxicology encountered by practicing physicians and veterinarians are presented in this text.

See Also:
ECETOC: *Technical Report No. 57: Polypropylene Production and Colorectal Cancer* (Cancer)

Jones: *Monographs on Pathology of Laboratory Animals Series* (Pathology)

Journal Articles

Davies, N. M. (1995). Toxicity of nonsteroidal antiinflammatory drugs in the large intestine. ***Dis. Colon Rectum*** **38**(12), 1311–1321.

Davies, N. M. (1998). Review article: non-steroidal antiinflammatory drug-induced gastrointestinal permeability. ***Alimentary Pharmacol. Therapeutics*** **12,** 303–320.

Fosslien, E. (1998). Adverse effects of nonsteroidal antiinflammatory drugs on the gastrointestinal system. ***Ann. Clin. Lab. Sci.*** **28,** 67–81.

Gore, R. M., *et al.* (1999). Drug-induced disorders of the stomach and duodenum. ***Abdom. Imaging*** **24,** 9–16.

Kaminsky, L. S., and Fasco, M. J. (1991). Small intestinal cytochromes P450. ***Crit. Rev. Toxicol.*** **21,** 407–422.

Morise, Z., and Grisham, M. B. (1998). Molecular mechanisms involved in NSAID-induced gastropathy. ***J. Clin. Gastroenterol.*** **27,** (Suppl. 1), S87–S90.

Naylor, G. P. L., and Harrison, J. D. (1995). Gastrointestinal iron and cobalt absorption and iron status in young rats and guinea pigs. ***Hum. Exp. Toxicol.*** **14,** 949–954.

Scheiman, J. M. (1996). NSAIDs, gastrointestinal injury, and cytopretection. ***Gastroenterol. Clin. North Am.*** **25**(2), 279–298.

Smalley, W. E., and Griffin, M. R. (1996). The risks and costs of upper gastrointestinal disease attributable to NSAIDs. ***Gastroenterol. Clin. North Am.*** **25**(2), 373–396.

Subramanian, U., and Ahmed, A. E. (1995). Intestinal toxicity of acrylonitrile: *In vitro* metabolism by intestinal cytochrome P450 2E1. ***Toxicol. Appl. Pharmacol.*** **135,** 1–8.

Sugimura, T., and Terada, M. (1998). Experimental chemical carcinogenesis in the stomach and colon. ***Jap. J. Clin. Oncol.*** **28,** 163–167.

Zwas, F. T., and Lyon, D. T. (1996). Occult GI bleeding in the alcoholic. ***Am. J. Gastroenterol.*** **91,** 551–553.

TARGET SITES—HEMATOPOIETIC

Evans, G. O. (Ed.) (1996)
Animal Clinical Chemistry: A Primer for Toxicologists
Taylor & Francis, Philadelphia.

Provides background information on the selection and application of biochemical tests in safty assessment studies.

Freshney, R. I., Pragnell, I. B., and Freshney, M. G. (Eds.) (1994)
Culture of Hematopoietic Cells
Wiley–Liss, New York

Provides an accessible comprehensive synthesis of proven methods for the culture and experimental use of hematopoietic cells. The text covers a range of human and mouse cell types and features the latest experimental information, both the how-to and whats.

Irons, R. D. (Ed.) (1985)
Toxicology of the Blood and Bone Marrow
Raven Press, New York

Provides an overview of hematology and a summary of current methods and approaches to the study of

blood and bone marrow toxicity. Subject areas include the development, structure, and function of the bone marrow, regulation of hemopoiesis, toxicology of the erythrocyte and granulocyte, the use of stem cell assays, flow cytofluorometry, and cytogenetic techniques for assessing bone marrow damage.

Joseph, M. (Ed.) (1995)
Immunopharmacology of Platelets
Academic Press, San Diego

Covers a wide range of topics relating to the immune response characteristics of platelets. Contents include discussion of platelets and their role as immune cells, animal models for investigating the properties of platelets, platelet activation, platelets in infections, biochemistry of platelets, and long-term consequences of platelet therapy.

Loeb, W. F., and Quimby, F. W. (Eds.) (1999)
Clinical Chemistry of Laboratory Animals, 2nd ed.
Taylor & Francis, Philadelphia

A comprehensive reference of the clinical chemistry of laboratory animals. Expanded coverage in this new edition has been given to urine chemistry, hormones including melatonin, and the control mechanisms of analytes.

See Also:
Hendry: *Radiation Toxicology: Bone Marrow and Leukaemia* (Radiation)

Jones: *Monographs on Pathology of Laboratory Animals Series* (Pathology)

Journal Articles

Chan, T. Y. (1996, March). Food-borne nitrates and nitrites as a cause of methemoglobinemia. ***Southeast Asian J. Trop. Med. Public Health*** **27,**189–192.

Greenberger, J. S. (1991). Toxic effects on the hematopoietic microenvironment. ***Exp. Hematol.*** **19**(11), 1101–1109.

Hatake, K., *et al.* (1998). Apoptosis-gene expression in hematopoietic system: Normal and pathological conditions. ***Int. J. Mol. Med.*** **1,** 121–129.

Kibbe, M. R., and Rhee, R. Y. (1996, December). Heparin-induced thrombocytopenia: Pathophysiology. ***Sem. Vascular Surg.*** **9**(4), 284–291.

Ogilvie, G. K. (1995). Hematopoietic growth factors: Frontiers for cure. ***Vet. Clin. North Am. Small Anim. Practice*** **25,** 1441–1456.

Savitz, D. A., and Anddrews, K. W., (1997, March). Review of epidemiologic evidence on benzene and lymphatic and hematopoietic cancers. ***Am. J. Ind. Med.*** **31**(3), 287–295.

Thompson, D. F., and Gales, M. A., (1996, November/December). Drug-induced pure red cell aplasia. ***Pharmacotherapy*** **16**(6), 1002–1008.

Uetrecht, J. (1990). Drug metabolism by leukocytes and its role in drug-induced lupus and other idiosyncratic drug reactions. ***Crit. Rev. Toxicol.*** **20,** 213–236.

Wohl, J. S., and Cotter, S. M., (1995), Blood substitutes: Oxygen-carrying acellular fluids. ***Vet. Clin. North Am. Small Anim. Practice*** **25,** 1417–1440.

TARGET SITES—IMMUNE

Burleson, G. R., Dean, J. H., and Munson, A. E. (Eds.) (1995)
Methods in Immunotoxicology
Wiley–Liss, New York

Presents the standard immunological methods used to assess immune function and potential immunotoxicity. The goal is to provide both a practical bench guide as well as an in-depth reference. This 56-chapter, 2-volume set accomplishes that goal.

Burrell, R., Flaherty, D. K., and Sauers, L. J. (1992)
Toxicology of the Immune System: A Human Approach
Van Nostrand–Reinhold, New York

Emphasizes the human. Principles of basic immunology are presented, then not only damage to but damage by the immune system is presented. The 12 chapters present the subject to the intended audience of toxicologists and health professionals desiring a perspective of the interface between laboratory studies and practice.

Coligan, J. E., Margulies, D. H., Shevach, E. M., Strober, W., Coico, R., and Kruisbeek, A. M. (Eds.) (1991)
Current Protocols in Immunology
Wiley, New York

Provides coverage of immunological methods from classic to cutting edge, including antibody detection and preparation, assays for functional activities of mouse and human cells involved in immune responses, assays for cytokines and their receptors, isolation and analysis of proteins and peptides, biochemistry of cell activation, molecular immunology, and animal models of autoimmune and inflammatory diseases.

Colvin, R. B., Bhan, A. K., and McCluskey, R. T. (Eds.) (1995)
Diagnostic Immunopathology, 2nd ed.
Raven Press, New York

Provides a basic overview of the immune system, adhesion molecules, and the complement system. Chapters include the liver, lung, and nervous system as targets of the immune response as well as a comprehensive review of vasculitis, dysproteinemias, immunodeficiencies, infections, and neoplasias. Transplantation is covered and the techniques currently applied to diagnosis and research are presented.

Dean, J. H., Luster, M. I., Munson, A. E., and Kimber, I. (Eds.) (1994)
Immunotoxicology and Immunopharmacology, 2nd ed.
Raven Press, New York

Divided into three major sections: immunosuppression, autoimmunity, and hypersensitivity. These are treated comprehensively with attention to test methods, theoretical considerations, and clinical significance. The volume contains 42 separate chapters prepared by experts and is a valuable resource.

Descotes, J. (1999)
An Introduction to Immunotoxicology
Taylor & Francis, Philadelphia.

Provides a concise but broad-ranging introduction to key immunological issues. The first section explores the health consequences of immunotoxicity. The book next describes the latest methods used to detect and evaluate, preclinically and clinically, the unexpected immunotoxic effects of xenobiotics.

European Chemical Industry Ecology and Toxicology Centre (ECETOC) (1987)
Monograph No. 10: Identification of Immunotoxic Effects of Chemicals and Assessment of Their Relevance to Man
ECETOC, Brussels

A critical review of potential immunotoxic effects of chemicals. It includes a strategy for assessing immunotoxicity in experimental models and in exposed human populations. A number of recommendations for further research are made.

European Centre for Ectoxicology and Toxicology of Chemicals (ECETOC) (1994).
Monograph No. 21: Immunotoxicity: Hazard Identification and Risk Characterization
ECETOC, Brussels.

Treats immunotoxicity and sensitization separately. The monograph examines the suitability of immunotoxicity parameters for inclusion in routine 28-day studies and comments on methods that have been proposed for incorporation within guidelines issued by the U.S. FDA, U.S. EPA, and the OECD.

Frankel, A. E. (Ed.) (1998)
Clinical Application of Immunotoxins
Springer-Verlag, Berlin

A reference source for review of results seen with immunotoxins in patients. Covers targeted toxins, ribosome inactivating proteins, bacterial toxins, and clinical trials. Volume 234 of *Current Topics in Microbiology and Immunology.*

Gregory, C. D. (Ed.) (1994)
Apoptosis and the Immune Response
Wiley–Liss, New York

Offers a close look at programmed cell death and its role in the development, function, and maintenance of the immune system. The book presents a current picture of the various aspects and consequences of this action and probes its role in carcinogenesis and HIV-induced pathogenesis.

Haber, E., and Pfitzer, E. A. (Eds.) (1982)
Immunological Aspects of Toxicology
Williams & Wilkins, Baltimore

Covers fundamental immunology (basis for potential application to toxicology), application of immunology to clinical problems with implications for drug safety evaluation, immunotoxicology and safety evaluation, current status, and future directions. Although an older text, the principles and approach presented make this a useful resource.

Herbert, W. J., Wilkinson, P. C., and Stott, D. I. (1995)
The Dictionary of Immunology, 4th ed.
Academic Press, New York

Designed to meet needs of any biologist, clinician, or biochemist who requires easy reference to current immunological usage. This serves as a handy reference, a companion to other reference texts, or a spelling and fact checker for the student.

Kammuller, M. E., Bloksma, N., and Seinen, W. (1989)
Autoimmunity and Toxicology: Immune Disregulation Induced by Drugs and Chemicals
Elsevier, New York

Considers the experimental approach to preclinically identify the potential of drugs and chemicals to produce autoimmune diseases. Comprehensive reviews of drugs that have caused autoimmune reactions are provided. Experimental approaches are also covered.

Kimber, I., and Selgrade, M. J. (Eds.) (1998)
T Lymphocytes in Immunotoxicology
Wiley, Chichester, UK

For graduate students and professionals specializing in immunotoxicology, immunopharmacology, and

clinical allergy. Provides a review of research into functional subpopulations of T lymphocytes.

Miller, K., Turk, J. L., and Nicklin, S. (Eds.) (1992)
Principles and Practice of Immuntoxicology
Blackwell, London

Describes the cellular constituents, their pharmacological responses, homeostatic controls, and concepts regarding the immune organ system. Includes examples of effects in humans and approaches to evaluating hypersensitivity changes, histomorphometric changes, changes in immune function assays, and molecular biology and cell culture approaches.

National Research Council (1992)
Biologic Markers in Immunotoxicology
National Academy Press, Washington, DC

Provides a technical overview of how the monitoring of biologic markers such as lymphocytes in the blood (called T cells) can be used to determine the effects of potentially harmful environmental toxicants; types of disease resulting from immune suppression; hypersensitivity, autoimmunity, and immunodeficiency; and other characteristics of the immune system.

Newcombe, D. S., Rose, N. R., and Bloom, J. C. (1992)
Clinical Immunotoxicology
Raven Press, New York

Provides an overview of the principles of immunotoxicology and xenobiotic metabolism. Includes well-characterized immunological dysfunctions associated with exposure to pharmacologic agents and environmental pollutants. Attention is given to the inaccurate predictions that may be associated with extrapolation from animal to man and the possible role of low-dose exposures, chronic immunosuppression, and cancer.

Repetto, R. C. (1996)
Pesticides and the Immune System
World Resource Institute, Washington, DC

Considers pesticides' effects on the immune system as an emerging issue imperfectly understood by those evaluating health risks of chemical exposures. The evidence assembled in this report underscores the need to continue improving our understanding of such risks.

Roitt, I. (1997)
Essential Immunology, 9th ed.
Blackwell, London

Primary guide to the science written in an easily understandable fashion. The major sections of the text include the basis of immunology, the recognition of antigen, technology, the acquired immune response, immunity to infection, and clinical immunology. This edition also includes quickly developing issues and should serve both the novice and the expert well.

Schook, L. B., and Laskin, D.L. (Eds.) (1994)
Xenobiotics and Inflammation
Academic Press, New York

Collects current information on how chemicals can modulate the immune system. The book focuses on the process of inflammation. It provides a single-source reference for researchers investigating the mechanisms responsible for altered host resistance following exposure to xenobiotics.

Smialowicz, R. J., and Holsapple, M. P. (Eds.) (1996)
Experimental Immunotoxicology
CRC Press, Boca Raton, FL

Provides information on recent advances in experimental immunotoxicology and serves as a reference source for policymakers and regulators. The major sections include definitions and approaches, target organ specificity in immuntoxicology, chemical-induced immunosuppression, and chemical-induced immunoenhancement. Each chapter contains up-to-date research information.

World Health Organization (WHO) (1996)
Principles and Methods for Assessing Direct Immunotoxicity Associated with Exposure to Chemicals
WHO, Geneva.

Volume 180 of the monographic series *Environmental Health Criteria*. Offers a thorough look at immunotoxicology, health impacts of selected immunotoxic agents, strategies for testing the immunotoxicity of chemicals in animals, methods of immunotoxicology in experimental animals, essentials of immunotoxicity assessment in humans, and risk assessment.

See Also:

ECETOC: *Monograph No 14: Skin Sensitization Testing* (Testing Methods and Toxicity Assessment)

ECETOC: *Monograph No. 21: Immunotoxicity: Hazard Identification and Risk Characterization* (Testing Methods and Toxicity Assessment)

Joseph: *Immunopharmacology of Platelets* (Target Sites—Hematopoietic)

Kimball: *Immunopharmaceuticals* (Chemicals—Drugs)

Kimber: *Toxicology of Chemical Respiratory Hypersensitivity* (Target Sites—Respiratory)

Kimber: *Toxicology of contact Hypersensitivity* (Target Sites—Skin)

Krutmann: *Photoimmunology* (Target Sites—Skin)

Zelikoff: *Immunotoxicology of Environmental and Occupational Metals* (Chemicals—Metals)

Journal

Immunopharmacology and Immunotoxicology

Journal Articles

Ben-Eliyahu, S., *et al.* (1996). Acute alcohol intoxication suppresses natural killer cell activity and promotes tumor metastasis. ***Nature Med.* 2,** 457–460.

Biagini, R. E. (1998) Epidemiology studies in immunotoxicity evaluations. ***Toxicology* 129,** 37–54.

Bloksma, N., *et al.* (1995). Predictive immunotoxicological test systems: Suitability of the popliteal lymph node assay in mice and rats. ***Crit. Rev. Toxicol.* 25,** 369.

Briatico-Vangosa, G., *et al.* (1994). Respiratory allergy: Hazard identification and risk assessment. ***Fundam. Appl. Toxicol.* 23,** 145–158.

Dean, J. H. (1997). Issues with introducing new immunotoxicology methods into the safety assessment of pharmaceuticals. ***Toxicology* 119,** 95–101.

Dean, J. H., Hincks, J., Luster, M. I., Gerberick, G. F., Neumann, D. A., and Hastings, K. L. (1998). Safety evaluation and risk assessment using immunotoxicology methods ***Int. J. Toxicol.* 17**(3), 277–296.

Farine, J. C. (1997). Animal models in autoimmune disease in immunotoxicity assessment. ***Toxicology* 119,** 29–35.

Fuchs, B. A., and Sanders, V. M. (1994). The role of brain–immune interactions in immunotoxicology. ***Crit. Rev. Toxicol.* 24,** 151–171.

Harling, R. J. (1996). Perspectives on immunotoxicity regulatory guidelines. ***Inflammation Res.* 45**(Suppl. 2), PS69–PS73.

Holsapple, M. P., *et al.* (1996). Molecular mechanisms of toxicant-induced immunosuppression: Role of second messengers. *Annu. Rev. Pharmacol. Toxicol.* **36,** 131–160.

Kawabata, T. T., *et al.* (1995). Immunotoxicology of regional lymphoid tissue: The respiratory and gastrointestinal tracts and skin. ***Fundam. Appl. Toxicol.* 26,** 5–19.

Kimber, I., and Cumberbatch, M. (1992). Dendritic cells and cutaneous immune responses to chemical allergens. *Toxicol. Appl. Pharmacol.* **117,** 137–146.

Kimber, I., *et al.* (1992). Chemical allergy: Molecular mechanisms and practical applications. ***Fundam. Appl. Toxicol.* 19,** 479–483.

Kimber, I., *et al.* (1996). Identification of respiratory allergens. ***Fundam. Appl. Toxicol.* 33,** 1–10.

Krzystyniak, K., *et al.* (1995). Approaches to the evaluation of chemical-induced immunotoxicity. ***Environ. Health Perspect.* 103,** 17–22.

Lokik, M. (1997). Mutant and transgenic mice in immunotoxicology: An introduction. ***Toxicology* 119,** 65–76.

Luster, M. I. (1996). Immunotoxicology: Clinical consequences. ***Toxicol. Ind. Health* 12**(34), 533–534.

Madsen, C., *et al.* (1996). Immunotoxicity of the pyrethroid insecticides deltametrin and alpha-cypermetrin. ***Toxicology* 107,** 219–227.

Meyer zum Buschenfelde, K. H. (1995). Immunopathology of chronic liver diseases. ***Verhandlungen Deutschen Gesellschaft Pathol.* 79,** 186–197.

Morris, R. E. (1995). Mechanisms of action of new immunosuppressive drugs. ***Ther. Drug Monitoring* 17,** 564–569.

Pallardy, M., Kerdine, S., and Lebrec, H. (1998). Testing strategies in immunotoxicology. ***Toxicol. Lett.* 102,** 257–260.

Rodgers, K., *et al.* (1997). Immunotoxicity of medical devices. ***Fundam. Appl. Toxicol.* 36,** 1–14.

Ross, P. S., De Swart, R. L., Van Loveren, H., Osterhaus, A. D. M. E. and Vos, J. G. (1996) The immunotoxicity of environmental contaminants to marine wildlife: A review. ***Annu. Rev. Fish Dis.* 6,** 151–165.

Selgrade, M. K., *et al.* (1995). Immunotoxicity—Bridging the gap between animal research and human health effects. ***Fundam. Appl. Toxicol.* 24,** 13–21.

Selgrade, M. J. K., *et al.* (1997). Modulation of T-helper cell populations: Potential mechanisms of respiratory hypersensitivity and immune suppression. ***Toxicol. Appl. Pharmacol.* 145,** 218–229.

Thomas, P. T. (1998). Immunotoxicology: Hazard identification and risk assessment. ***Nutr. Rev.* 56,** (1 Part 2), PS131–134.

Thrush, G. R., *et al.* (1996). Immunotoxins: An update. ***Annu. Rev. Immunol.* 14,** 49–71.

Vandebriel, R. J., *et al.* (1996). Early indicators of immunotoxicity: Development of molecular biological

test batteries. ***Hum. Exp. Toxicol.*** **15**(Suppl. 1), S2–S10.

Van Loveren, H., *et al.* (1998). Risk assessment and immunotoxicology. ***Toxicol. Lett.*** **102–103,** 261–265.

Vohr, H. W. (1995). Experiences with an advanced screening procedure for the identification of chemicals with an immunotoxic potential in routine toxicology. ***Toxicology*** **104,** 149–158.

Vos, J. G., and van Loveren, H. (1995). Markers for immunotoxic effects in rodents and man. ***Toxicol. Lett.*** **82,** 385–394.

Wu, M. (1997). Enhancement of immunotoxin activity using chemical and biological reagents. ***Br. J. Cancer*** **73,** 1347–1355.

Zelikoff, JT. (1998). Biomarkers of immunotoxicity in fish and other non-mammalian sentinel species: Predictive value for mammals? ***Toxicology*** **129,** 63–71.

[Note: The journal *Toxicology* has a special section devoted to immunotoxicology.]

TARGET SITES—KIDNEY

Anders, M. W., Dekant, W., Henschler, D., Oberleithner, H., and Silbernagl, S. (1993)
Renal Disposition and Nephrotoxicity of Xenobiotics
Academic Press, San Diego

Summarizes current knowledge about the mechanisms of renal handling of xenobiotics and their metabolites and the mechanisms by which they produce nephropathy. The volume focuses on assessment of xenobiotic-induced nephropathy, renal disposition of xenobiotics, and bioactivation and nephrotoxicity of xenobiotics.

Bach, P. H. (Ed.) (1991)
Nephrotoxicity: Mechanisms, Early Diagnosis, and Therapeutic Management
Dekker, New York

Covers areas such as renal physiology and function, acute renal failure, natural toxic compounds, analgesics and papillary necrosis, antibiotics, halogenated compounds, organic solvents, heavy metals, and markers of nephrotoxicity.

Bach, P. H., and Lock, E. A. (Eds.) (1987)
Nephrotoxicity in the Experimental and Clinical Situation
Nijhoff, Dordrecht

Two volumes cover the different methods that are used to assess renal function in health and disease. The biology of many model nephropathies that are directly relevant to the clinical situation and a broader appreciation of the different types of clinical nephrotoxicity are factors that may affect their diagnosis and progression.

Bach P. H., and Loch, E. A. (Eds.) (1989)
Nephrotoxicity: In Vitro to in Vivo: Animals to Man
Plenum, New York

Based on a symposium, the objectives of which were to establish where animal nephrotoxicity data are relevant to the clinical situation. The symposium placed an emphasis on heavy metal toxicity and also explored aminoglycosides, lithium, cyclosporin, platinum anticancer drugs, radiological contrast media, hydrocarbon nephropathy, and halogenated molecules.

De Broe, M.E., *et al.* (Eds.) (1998)
Clinical Nephrotoxins: Renal Injury from Drugs and Chemicals
Kluwer, Dordrecht

A handbook on all aspects of adverse effects by drugs, chemical substances, and radiation on the kidneys. Covers clinical relevance and clinical syndromes of nephrotoxicity, renal handling of drugs, and pathological expression of nephrotoxicity as well as early markers, principles of drug dosage in renal failure, and practical dosage.

Goldstein, R. S. (Ed.) (1994)
Mechanisms of Injury in Renal Disease and Toxicity
CRC Press, Boca Raton, FL

Attempts to integrate recent mechanistic concepts of renal injury in both disease and chemically induced nephrotoxicity. It covers mechanisms of acute and chronic renal failure, including pathophysiologic mechanisms, cellular/molecular mechanisms, and immunologic mechanisms. Additionally, it reviews drug-induced nephropathies.

Heptinstall, R. H. (1992)
Pathology of the Kidney, 4th ed., Vols. 1–3
Little, Brown, Boston

Covers the human conditions in which altered kidney function is observed. The content includes anatomy, development, descriptions of various types of glomerulonephritis, hypertension, renal failure, urinary tract infections, diabetes, and a section on miscellaneous diseases.

Hook, J. B., and Goldstein, R. S. (Eds.) (1993)
Toxicology of the Kidney, 2nd ed.
Lippincott–Raven Press, New York

Focuses on an understanding of the correlation between anatomy, biochemistry, and physiology of the

kidney, how this is related to normal renal function, and how this is assessed. A major theme is the correlation between work in experimental animals and what would be expected in man.

Lipsky, M. M. (1994)
Mechanistic Basis and Relevance of Kidney Tumors in Male Rats for Use in Risk Assessment
American Water Works Association, Denver

Describes the relationships between chloroform- and bromodichloromethane-induced toxicity and cell replication in male rat kidneys after acute exposure. It provides an understanding of potential mechanisms for renal tumorigenicity after chronic exposure.

Mignone, L. (Ed.) (1978)
Toxic Nephropathies
Karger, Basel

Papers from the 6th International Congress on Toxic Nephropathies held in Parma in 1977; contributions on nephropathies induced by agents such as gentamicin, D-penicillamine, analgesics, and cadmium. Although an older text, the examples and basic data presented make it useful.

National Research Council (1995)
Biologic Markers in Urinary Toxicology
National Academy Press, Washington, DC

Reviews the research on known biologic markers and identifies and evaluates promising new technologies to find markers, research opportunities in the field, and subjects in which interdisciplinary research is needed. The major sections include toxic exposure to the urinary tract, markers of susceptibility and exposure, markers of effect, extrapolation, new technologies, conclusions, and recommendations.

Porter, G. A. (Ed.) (1982)
Nephrotoxic Mechanisms of Drugs and Environmental Toxins
Plenum, New York

Reviews the effects of various toxins on the kidney. Sections on pathophysiology of acute renal failure, renal failure due to antimicrobial agents, tubulointerstitial nephropathy due to drugs and environmental toxicants, pathophysiologic mechanisms of toxicity induced by environmental toxins, and immunologic mechanisms and toxic nephropathies are included.

World Health Organization (WHO), United Nations Environment Programme, (1991)
Principles and Methods for the Assessment of Nephrotoxicity Associated with Exposure to Chemicals
WHO, Geneva

Volume 119 of the series *Environmental Health Criteria.* This monograph, prepared by a joint WHO/CEC task group, contains chapters on the scope and significance of nephrotoxicity, principles of nephrotoxicity, kidney structure and function, mechanistic basis for chemical-induced renal injury, therapeutic agents and chemicals that cause kidney damage, renal cancer, assessment of nephrotoxicity, and detection of nephrotoxicity in humans.

Zalups, R. K., and Lash, L. H. (Eds.) (1996)
Methods in Renal Toxicology
CRC Press, Boca Raton, FL

Presents approaches and methods for the study of renal cellular, glomerular, and tubular structure, function, and biochemistry under physiological, toxicological, and pathological conditions. It ranges from noninvasive measurements of renal function in the whole animal to a variety of *in vitro* preparations utilizing the intact kidney, portions of the kidney, isolated renal epithelial cells, and subcellular and molecular approaches. Each chapter contains a detailed description of methods and techniques and also offers historical perspectives, applications, procedural details, and advantages and disadvantages of these methods.

See Also:
Jones: *Monographs on Pathology of Laboratory Animals* (Pathology)

Journal Articles

Baliga, R., *et al.* (1997). Oxidant mechanisms in toxic acute renal failure. ***Am. J. Kidney Dis.*** **29**(3), 465–467.

Bernard, A., and Lauwerys, R. R. (1991). Proteinuria: Changes and mechanisms in toxic nephropathies. ***Crit. Rev. Toxicol.*** **21,** 373–406.

Berndt, W. O. (1998). The role of transport in chemical nephrotoxicity. ***Toxicol. Pathol.*** **26,** 52–57.

Blowey, D. L., *et al.* (1995). Interactions of drugs with the developing kidney. ***Pediatr. Clin. North Am.*** **42,** 1415–1431.

Borghoff, S. J., *et al.* (1990). Biochemical mechanisms and pathobiology of alpha 2μ-globulin nephropathology. ***Annu. Rev. Pharmacol. Toxicol.*** **30,** 349–367.

Choudhury, D., and Ahmed, Z. (1997). Drug-induced nephrotoxicity. ***Med. Clin. North Am.*** **81**(3), 705–717.

Commandeur, J. N. M., and Vermeulen, N. P. E. (1992). Molecular and biochemical mechanisms of chemically induced nephrotoxicity: A review. In ***Frontiers***

in Molecular Toxicology L. J. Marnett, (Ed.), pp. 73–96. American Chemical Society, Washington, DC.

Current Opinion in Nephrology and Hypertension **5**(2) (1996). This issue contains articles on topics such as analgesics and chronic renal disease, drugs of abuse and renal disease, and occupational renal disease.

Dekant, W., and Vamvakas, S. (1996). Biotransformation and membrane transport in nephrotoxicity. ***Crit. Rev. Toxicol.*** **26,** 309–334.

Endou, H. (1998). Recent advances in molecular mechanisms of nephrotoxicity. ***Toxicol. Lett.*** **102–103,** 29–33.

Farrugia, E. (1998). Drug-induced renal toxicity: Diagnosis and prevention. ***Hosp. Med.*** **59,** 140–144.

Guignard, J. P. (1993). Effect of drugs on the immature kidney. ***Adv. Nephrol. Necker Hosp.*** **22,** 193–211.

Lau, C. S. and Kavlock, R. J. (1994). Functional toxicity in the developing heart, lung, and kidney. ***Dev. Toxicol.*** (***Target Organ Toxicology*** series), 119–88.

Lock, E. A. and Reed, C. J. (1998). Xenobiotic metabolizing enzymes of the kidney. ***Toxicol. Pathol.*** **26,** 18–25.

Maines, M. D. (1991). Effect of *cis*-platinum on heme, drug, and steroid metabolism pathways: Possible involvement in nephrotoxicity and infertility. ***Crit. Rev. Toxicol.*** **21,** 1–20.

Murray, M. D. and Brater, D. C. Effects of NSAIDs on the kidney. ***Prog. Drug Res.*** **49,** 155–71.

Pfaller, W., and Gstraunthaler, G. (1998). Nephrotoxicity testing *in vitro*—what we know and what we need to know. ***Environ. Health Perspect.*** **106,** (Suppl. 2), 559–569.

Seminars in Nephrology **17** (1997). This issue contains articles on such topics as renal toxicities of antineoplastic and immunosuppressive drugs, occupational and renal disease, and pathogenetic mechanisms in nephrotoxic acute renal failure.

Springate, J. E. (1997). Toxic nephropathies. ***Curr. Opin. Pediat.*** **9,** 166–169.

Witzmann, F. A., *et al.* (1996). Toxicant-induced alterations in two-dimensional electrophoretic patterns of hepatic and renal stress proteins. ***Electrophoresis*** **17,** 198–202.

TARGET SITES—LIVER

Cameron, R. G., Feuer, G., and De La Iglesia, F. A. (Eds.) (1996)
Drug-Induced Hepatotoxicity
Springer, Berlin

Volume 121 of the *Handbook of Experimental Pharmacology*. Presents information on hepatic reactions to drugs. Recent advances, including development of better animal models, definition of *in vitro* models, and molecular aspects of drug metabolism mechanisms, are covered. The information is presented in 26 well-written chapters.

Csomos, G., and Feher, J. (Eds.) (1992)
Free Radicals and the Liver
Springer-Verlag, Berlin

Explores in detail the role of free radical reaction in liver disease. The book refers to the many observations, experiences, and evaluations that have been made both clinically and experimentally.

Farber, E., and Fisher, M. M. (Eds.) (1979)
Toxic Injury of the Liver, 2 vols.
Dekker, New York

Covers the effects of xenobiotic and therapeutic agents on the liver. The book is comprehensive, with the emphasis on mechanisms rather than phenomena. This remains a classic textbook in the area of effects of agents on the liver.

Farrell, G. C. (1994)
Drug-Induced Liver Disease
Livingstone, Edinburgh, UK

Presents a catalog-like listing of interactions between various drugs and drug classes and liver damage in man. The main thesis is that the liver is almost always a target of drug interaction by virtue of its metabolic capability and it is this function that makes the organ a target for damage.

Gibson, G. G. (Ed.) (1993)
Peroxisomes: Biology and Importance in Toxicology and Medicine
Taylor & Francis, Washington, DC

Discusses in great detail the function of these organelles in both animals and man. A thorough review of the experimental information showing modification following exposure to a wide variety of xenobiotics is provided. The significance of these findings in various animal models to man is covered.

MacSween, R. N., Anthony, P. P., and Scheuer, P. J. (1994)
Pathology of the Liver, 3rd ed.
Churchill Livingstone, Edinburgh, UK

Intended for the clinician, enabling him or her to better understand the effects of exogenous agents on the function of the liver. An extensive look at liver pathology

with discussions of anatomy, pathophysiology, metabolic error, iron storage disease, and other topics.

Meeks, R. G., Harrison, S. D., and Bull, R. J. (Eds.) (1991)
Hepatotoxicology
CRC Press, Boca Raton, FL

Source book for those dealing with all aspects of chemical-induced damage to the liver. The first section deals with histological organization classification of chemically induced damage and stages of cellular injury. The second section deals with xenobiotic metabolism and biochemical means to diagnose liver damage. The last section presents chemical-specific information on liver damage and discusses hepatocarcinogenicity.

Plaa, G. L., and Hewitt, W. R. (Eds.) (1998)
Toxicology of the Liver, 2nd ed.
Taylor & Francis, Washington, DC

This second edition of the classic 1982 text presents state-of-the-art reviews by recognized experts in selected areas of hepatotoxicity. Perspectives include clinical characterization of chemical hepatotoxicity, microscopic characteristics of the different manifestations of liver responses to toxic insult, examples of mechanisms by which chemicals can produce liver injury, and experimental models useful for the study of liver dysfunction.

Stricker, B. H. (1992)
Drug-Induced Hepatic Injury, 2nd ed.
Elsevier, Amsterdam

Characterizes the various forms of hepatic injury and their association drugs, based on many individual reports. Focuses on the characterization of clinical features and the circumstances of development of injury. Sections include diagnosis and causality assessment, epidemiology mechanisms and pathology of drug-induced hepatic injury, and individual agents (drugs).

Zimmerman, H. J. (1978)
Hepatotoxicity: The Adverse Effects of Drugs and Other Chemicals on the Liver
Appleton-Crofts, New York

Divided into four sections dealing with the interface between chemicals and the liver, experimental hepatotoxicity, theoretical risk with environmental chemicals, and drug-induced liver damage. This book is a classic on chemically induced hepatic injury.

See Also:

Bock: *Hepatic Metabolism and Disposition of Endo- and Xenobiotics* (Pharmacokinetics and Metabolism)

ECETOC: *Monograph No. 4: Hepatocarcinogenesis in Laboratory Rodents: Relevance for Man* (Cancer)

Jones: *Monograph on Pathology of Laboratory Animal* (Pathology)

Lee: *Drug-Induced Hepatotoxicity* (Chemicals—Drugs)

Journal Articles

***Annals of the New York Academy of Sciences* 804** (1996). This volume contains articles on such issues as nongenotoxic hepatocarcinogenesis and hepatocarcinogenesis of peroxisome proliferators.

Ballet, F. (1997). Hepatotoxicity in drug development: Detection, significance and solutions. ***J. Hepatol.* 26** (Suppl. 2), 26–36.

Boelsterli, U. A., *et al.* (1995). Idiosyncratic liver toxicity of nonsteroidal antiinflammatory drugs: Molecular mechanisms and pathology. ***Crit. Rev. Toxicol.* 25,** 207–236.

Bradham, C. A., Plumpe, J., Manns, MP., Brenner, D. A., and Trautwein, C. (1998). Mechanisms of hepatic toxicity. I. TNF-induced liver injury. ***Am. J. Physiol.* 275,** (3, Pt, 1), 387–392.

Carmichael, N. G., Enzmann, H., Pate, I., and Waechter, F. (1997). The significance of mouse liver tumor formation for carcinogenic risk assessment: Results and conclusions from a survey of ten years of testing by the agrochemical industry. ***Environ. Health Perspect.* 105**(11), 1196–1203.

Castell, J. V., *et al.* (1997). *In vitro* investigation of the molecular mechanisms of hepatotoxicity. ***Arch. Toxicol. Suppl.* 19,** 313–321.

Corcoran, G. B., and Sidhartha, D. R. (1992). The role of the nucleus and other compartments in toxic cell death produced by alkylating hepatotoxicants. ***Toxicol. Appl. Pharmacol.* 113,** 167–183.

Farrell, G. C. (1997). Drug-induced hepatic injury. ***J. Gastroenterol. Hepatol.* 12,** S242–250.

***Gastroenterology Clinics of North America* 24** (1995). This volume contains articles on subjects such as genetic predisposition to drug-induced liver disease, mechanisms of drug-induced liver disease, and the morphologic spectrum of drug-induced hepatic disease.

George, D. K., and Crawford, D. H. (1996). Antibacterial-induced hepatotoxicity. Incidence, prevention and management. ***Drug Safety* 15,** 79–85.

Graudal, N., *et al.* (1996). Distribution of liver haemosiderin iron in 187 patients with various types of hepatic diseases. ***APMIS* 104,** 220–226.

Guillouzo, A. (1998). Liver cell models in *in vitro* toxicology. ***Environ. Health Perspect.* 106**(Suppl. 2), 511–532.

Hakkola, J., Tanaka, E., and Pelkonen, O. (1998). Developmental expression of cytochrome P450 enzymes in human liver. ***Pharmacol. Toxicol.* 82**(5), 209–217.

Jaeschke, H., *et al.* (1996). Mechanisms of inflammatory liver injury: Adhesion molecules and cytotoxicity of neutrophils. ***Toxicol. Appl. Pharmacol.* 139,** 213–226.

Larrey, D. (1997). Hepatotoxicity of herbal remedies. ***J. Hepatol.* 26**(Suppl. 1), 47–51.

Larrey, D., and Pageaux, G. P. (1997). Genetic predisposition to drug-induced hepatotoxicity. ***J. Hepatol.* 26** (Suppl. 2), 12–21.

Manoukian, A. V., and Carson, J. L. (1996). Nonsteroidal anti-inflammatory drug-induced hepatic disorders. Incidence and prevention. ***Drug Safety* 15,** 64–71.

Nanji, A. A. (1998). Apoptosis and alcoholic liver disease. ***Sem. Liver Dis.* 18**(2), 187–190.

Roach, J. A., and Stacey, B. (1997). Acetaminophen toxicity. ***Orthoped. Nursing* 16,** 39–53.

Sauer, J. M., *et al.* (1997). The liver as a target for chemical-chemical interactions. ***Adv. Pharmacol.* 43,** 37–63.

Tolman, K. G. (1998). Hepatotoxicity of non-narcotic analgesics. ***Am. J. Med.* 105,** 13S–19S.

Walker, A. M. (1997). Quantitative studies of the risk of serious hepatic injury in persons using nonsteroidal antiinflammatory durgs. ***Arthritis Rheum.* 40**(2), 201–208.

Williams, G. M. (1997). Chemicals with carcinogenic activity in the rodent liver; mechanistic evaluation of human risk. ***Cancer Lett.* 117,** 175–188.

TARGET SITES—NERVOUS SYSTEM

Annau, Z. (Ed.) (1986)
Neurobehavioral Toxicology
Johns Hopkins Univ. Press, Baltimore.

Addresses research strategies for evaluating behavioral effects of neurotoxic chemicals, examines the effects of exposure to neurotoxic chemicals during critical periods in the development of the nervous system, considers mechanism of toxicity at the neurobehavioral level, and deals with epidemiological and experimental approaches to neurobehavioral toxicity.

Araki, S. (Ed.) (1994)
Neurobehavioral Methods and Effects in Occupational and Environmental Health
Academic Press, New York.

Covers the techniques used in both animals and man to detect changes in the nervous system from gross to subtle. The book makes liberal use of examples, mainly in the field of metal toxicology in the case of human effects, to detail the applications of the method covered.

Arlien-Soborg, P. (1992)
Solvent Neurotoxicity
CRC Press, Boca Raton, FL

A comprehensive look at solvent neurotoxicity. The first chapter describes methods for assessing human neurological effects. The remaining chapters present research and epidemiological data regarding classic neurotoxins such as toluene, xylene, styrene, hexane, methyl *n*-butyl ketone, methyl ethyl ketone, 2,5-hexanedione, methylene chloride, methyl chloride, trichloroethylene, 1,1,1-trichloroethane, white spirit, and solvent mixtures.

Aschner, M., and Kimelberg, H. K. (1996)
The Role of Glia in Neurotoxicity
CRC Press, Boca Raton, FL

Identified as an essential and modifiable component of the nervous system, this book is concerned with the reciprocal relationships between neurons and glia that are vital for mutual differentiation, development, and optimal functioning of the CNS.

Bleecker, M. L., and Hansen, J. A. (Eds.) (1994)
Occupational Neurology and Clinical Neurotoxicology
Williams & Wilkins, Baltimore

Defines the multidisciplinary components of occupational neurology, including study design, exposure assessment, methods for quantifying dysfunction, outcomes associated with exposure to neurotoxins, and ergonomic stressors. The text offers several perspectives on the issues in the field and specifically does not present classical animal experimentation.

Brust, J. C. (1996)
Handbook of Neurotoxic Side Effects of Prescription Drugs
Butterworth-Heinemann, Boston

Presents in a concise manner the reports from the literature that deal with the unwanted nervous system effects of prescription drugs. The arrangement allows easy access to specifics on either a drug or a drug class. Supporting information from animal studies is often included for reference purposes.

Chang, L. W. (1994)
Principles of Neurotoxicology
Dekker, New York

Presents the basics of neurotoxicology. Covers neurotoxicology of the central and peripheral nervous systems, behaviorial aspects of laboratory assessment and modeling, and biochemical and molecular neurotoxicology.

Chang, L. W., and Dyer, R. S. (1995)
Handbook of Neurotoxicology
Dekker, New York

Volume 36 of ***Neurological Disease and Therapy.*** Focuses on the effects and mechanisms of major categories of neurotoxicants. Part I covers the traditional neurotoxicants—metals, organic solvents, and agricultural chemicals. Part II covers the nontraditional neurotoxicants—natural neurotoxins, drugs of abuse, and narcotics/environmental agents.

Chang, L. W., and Slikker, W. (Eds.) (1995)
Neurotoxicology: Approaches and Methods
Academic Press, San Diego

Covers in-depth basic principles of neurotoxicity, current concepts on the effects and mechanisms of various classes of neurotoxicants, and state-of-the-art approaches and methods in toxicologic research and testing. The first sections consider whole animal integrated responses, followed by detailed methods for teasing out the mechanisms of damage, the descriptions of the specific agents, and targets within the nervous system.

Cooper, J. R., Bloom, F. E., and Roth, R. H. (1996)
The Biochemical Basis of Neuropharmacology, 7th ed.
Oxford Univ. Press, New York

Concentrates on the biochemistry and physiology of nervous tissue, with an emphasis on neurotransmitters. Also discusses neuropharmacology agents and their actions.

Crawley, J. (Ed.) (1997)
Current Protocols in Neuroscience
Wiley, New York

Up-to-date collection of neuroscience methods. The publication draws from techniques in neurophysiology, neuroanatomy, neuropharmacology, and behavioral neuroscience to meet the specific needs of researchers in the full range of disciplines that are involved in studying the brain, nervous system, and corresponding behaviors.

Davis, R. L., and Robertson, D. M. (Eds.) (1997)
Textbook of Neuropathology, 3rd ed.
Williams & Wilkins, Baltimore

A detailed account of all aspects of the pathology of the nervous system, from neurons and astrocytes to the pathology of epilepsy, demyelinating diseases, neurological infections due to bacteria, fungi, and parasites, cerebrospinal trauma, etc.

Eaton, R. C. (Ed.) (1984)
Neural Mechanisms of Startle Behavior
Plenum, New York

Startle has been a model end point because of the reliability of the behavioral act in laboratory studies and because of the accessibility of the underlying neural circuitry. This book presents approaches based on a broad background of animal groups ranging from the earliest nervous systems to advanced systems in mammals. The book is primarily oriented toward neural networks and behavior.

European Centre for Ectoxicology and Toxicology of Chemicals (ECETOC) (1992)
Monograph No. 18: Evaluation of the Neurotoxic Potential of Chemicals
ECETOC, Brussels

Examines the current test methods for the evaluation of the neurotoxic potential of chemicals in order to provide adequate safeguards for human health. A tiered testing strategy is recommended for this evaluation.

Feldman, R. G. (1998)
Occupational and Environmental Neurotoxicology
Lippincott Williams & Wilkins, Philadelphia

Presents clinically relevant information on 20 major neurotoxicants. Describes chemical structure, sources of exposure, recommended exposure limits, metabolism, symptoms, and therapeutic measures.

Gali, C. L., Manzo, L., and Spencer, P. S. (Eds.) (1988)
Recent Advances in Nervous System Toxicology
Plenum, New York

Divided into three main sections dealing with neurotoxic effects of prolonged exposure to toxic materials, neurotoxic agents, and experimental models for assessment of neurotoxic mechanisms.

Harry, G. J. (Ed.) (1994)
Developmental Neurotoxicology
CRC Press, Boca Raton, FL

Addresses the basic principles of development in structure and functional components and presents information covering the various methodological approaches. Evidence for the value of examination of the developing nervous system for environmentally induced perturbations is well covered. Chemical effects in the system as well as methods to assess such end points are discussed.

Hartman, D. E. (1995)
Neuropsychological Toxicology, 2nd ed.
Plenum, New York

Intended as a reference for clinical practitioners who must evaluate the history, symptoms, behavior, and neuropsychological functioning of individuals exposed to neurotoxic substances. The book focuses on human psychological applications of toxicology research. The book contains a basic overview, an evaluation of neurotoxic syndromes, and it discusses the effects of metals, solvents, alcohol, drugs, pesticides, and other neurotoxins. Helpful concluding chapters include psychosomatic disorders and forensic issues.

Herken, H., and Hucho, F. (1992)
Selective Neurotoxicity
Springer-Verlag, New York,

Focuses on the molecular mechanisms of action of various neurotoxins. It discusses recent research on their targets at the nerve cell and its subcellular components. Special emphasis is placed on vulnerable sites in the nervous system.

Jain, K. K. (1996)
Drug-Induced Neurological Disorders
Hogrefe & Huber, Seattle

Covers the wide range of central nervous system disorders which have been related to use of drugs and drug families. The information is clearly presented and well organized.

Kilburn, K. H. (1998)
Chemical Brain Injury
Van Nostrand Reinhold, New York.

Focuses on how common and abundant chemicals affect the brain. Included are effects of chlorine, hydrogen sulfide, chlordane, arsenic, trichloroethylene, PCBs, hydrochloric acid, and diesel exhaust. Considers mechanisms of brain damage, prognosis, and therapy.

Kostrzewa, R. M. (Ed.) (1998)
Highly Selective Neurotoxins: Basic and Clinical Applications
Humana Press, Totowa, NJ

Critically reviews and evaluates the most common and important neurotoxins used today to precisely destroy selected neurons. Describes the mechanisms of action plus the limits on the use and clinical applicability of these neurotoxins.

Lowndes, H. E. (1987)
Electrophysiology in Neurotoxicology
CRC Press, Boca Raton, FL

A good basic text regarding the major techniques of electrophysiology. The first volume contains four chapters which include the structure, function, and pharmacology of acetylcholine and sodium channel receptors; the effects of toxic agents on neural membranes; physiology of synaptic transmission; and clinically used electrophysiological end points.

Mitchell, C. L. (1982)
Nervous System Toxicology
Raven Press, New York

Deals with an interdisciplinary approach to nervous system toxicology. The focus is on animal test procedures for the assessment of toxic effects. The chapters include background on behavioral principles; advantages and disadvantages of examining naturally occurring behaviors versus conditioned behaviors; the assessment of toxic effects on specific sensory modalities and learning and memory; screening for behavioral toxicity; neuropathological methods; electrophysiological methods; neurochemical methods; tissue culture; and the use of changes in vascular permeability in response to neurotoxic effects.

Moser, A. (Ed.) (1998)
Pharmacology of Endogenous Neurotoxins: A Handbook
Birkhauser, Boston

Surveys some of the important areas of neurotoxicological research and the impact of endogenously synthesized heterocyclic neurotoxins on normal and pathophysiological regulation in the central nervous system.

Mutti, A., Costa, L. G., Manzo, L., and Cranmer, J. M. (Eds.) (1992)
Current Issues in Neurotoxicology
INTOX, Little Rock, AK

Presents the proceedings of the 3rd Meeting of the International Neurotoxicology Association in July 1991. Topics include screening for neurotoxicity in humans, developmental neurotoxicity, neurotoxicity relative to aging, cellular and subcellular mechanisms of neurotoxicity, *in vitro* techniques, neurotoxicity observed in sensory organs, neurobehavioral effects, effects of chemicals during occupational exposure, kinetics, and metabolism.

National Research Council (1992)
Environmental Neurotoxicology
National Academy Press, Washington, DC

Covers the work of an academy panel charged with assessing the biological basis of neurotoxicity, reviewing existing models and indicators of neurotoxic action, and developing critical hypotheses for future research. The sections presented include an introduction, biological basis of neurotoxicity, biologic markers, testing methods, surveillance to prevent, and risk assessment.

Niesink, R. J. M (1998)
Introduction to Neurobehavioral Toxicology: Food and Environment
CRC Press, Boca Raton, FL

Examines the effects of chemicals on the central and peripheral nervous system and the subsequent changes in behavior, with a focus on the toxicity of food components and behavioral effects of environmental toxicants.

Office of Technology Assessment, Congress of the United States (1990, April)
Neurotoxicity: Identifying and Controlling Poisons of the Nervous System
U.S. Government Printing Office, Washington, DC

Covers a congressional panel review to conclude that considerably more research and testing are necessary to determine which substances have neurotoxic potential. Included in this book are fundamentals of neurotoxicity; research and education programs; testing and monitoring; regulatory responses; case studies on lead, pesticides, and organic solvents; and some very useful specific appendices.

Pentreath, V. (Ed.) (1999)
Experimental in Vitro Neurotoxicology
Taylor & Francis, Philadelphia

Covers the accelerating field of *in vitro* replacement tests for whole animal models. The main impetus for this shift comes from the increased understanding of the behavior and properties of different types of nerve cells *in vitro.* Many of the cellular responses to neurotoxicants are retained in culture.

Prasad, K. N., and Vernadakis, A. (1982)
Mechanisms of Actions of Neurotoxic Substances
Raven Press, New York

Discusses the effects of selected agents on nervous tissue at the molecular, cellular, and organism levels. The chemicals selected for this book are categorized into two classes—heavy metals and pharmaceuticals.

Rosenberg, N. L. (1995)
Occupational and Environmental Neurology
Butterworth-Heinemann, Newton, MA

Covers the field in easily understood terms. The focus is on specific examples of chemically induced neurologic changes. A few of the specific chemicals included are ethanol, cyanide, carbon disulfide, toluene, and acrylamide.

Shaw, C. (Ed.) (1997)
Glutathione in the Nervous System
Taylor & Francis, Washington, DC

Captures the emerging role that glutathione may play in the nervous system. The book describes the history and chemistry of glutathione in relation to antioxidant defenses and oxidative stress. This book provides an in-depth look at this molecule and its known and foreseen roles.

Sherman, J. D. (1994)
Chemical Exposure and Disease
Princeton Publishing, Princeton, NJ

Subtitled ''Diagnostic and Investigative Techniques''; includes guidelines for obtaining a work or environmental history, along with case reports and bibliographies for 14 major groups of chemicals (arsenic, asbestos, pesticides, chromium compounds, and plastics).

Slikker, W., and Chang, L. W. (Eds.) (1998)
Handbook of Developmental Neurotoxicology
Academic Press, San Diego

Provides a comprehensive account of the impacts, mechanisms, and clinical relevances of chemicals on the development of the nervous system.

Spencer, P. S., Schaumburg, H. H., and Ludolph, A. C. (Eds.) (1999)
Experimental and Clinical Neurotoxicology, 2nd ed.
Oxford Univ. Press, New York

The first edition of the book laid the groundwork for the field of neurotoxicology. Perhaps the premiere work in the field, this second edition is an essential reference for anyone concerned with the neurotoxic potential of drugs, experimental agents, environmental pollutants, and other substances. The second edition has been reorganized and completely rewritten and covers nearly 450 chemical compounds.

Tilson, H. A., and Harry, G. J. (1999)
Neurotoxicology, 2nd ed.
Taylor & Francis, Philadelphia

Provides the basis for an understanding of the sites and mechanisms of neurotoxicity as well as the adverse

effects of chemicals on the nervous system. Recent advances in neurotoxicological research are reviewed.

Tipton, K. F., and Dajas, F. (Eds.) (1994)
Neurotoxins in Neurobiology: Their Actions and Applications
Ellis Horwood, New York

Includes information on how toxins are obtained and fractionated; tabulation of toxin sources and their nature and actions; and synthetic toxins and their possible relationship to CNS diseases.

Vinken, P. J., and Bruyn, G. W. (Eds.) (1994)
Intoxications of the Nervous System
Elsevier, Amsterdam

A broad-ranging group of papers covering all aspects of clinical neurotoxicology. Papers deal with topics such as carbon disulfide, organic solvents and the nervous system, lithium, manganese, plumbism, water intoxication, cycad toxicity, ergot alkaloids, Jamaican vomiting sickness, microbial toxins, and vitamin toxicity. This is an accomplished undertaking.

Weiss, B., and O'Donoghue, J. L. (Eds.) (1994)
Neurobehavioral Toxicity: Analysis and Interpretation
Raven Press, New York

Covers many current issues in the field of neurobehavioral toxicology. The sections covered are instructional and include criteria for determining neurotoxic potential, developmental neurotoxicity, activity and observational data, schedule-controlled operant behavior, and case studies. This text focuses on issues using good examples and is a valuable resource in the field.

Woodruff, M. L., and Nonneman, A. J. (Eds.) (1994)
Toxin-Induced Models of Neurological Disorders
Plenum, New York

Discusses and evaluates the use of neurotoxins to produce animal models of human neurodegenerative diseases. The text considers the utility, validity, generalizability, and limitations of the models presented.

Zbinden, G. (1992)
The Brain in Bits and Pieces
M.T.C. Verlag, Zollikon, Switzerland

Presents methods, mainly *in vitro*, that can be used to study the function of the brain. The seven invited chapters discuss topics such as the place for *in vitro* methods, monolayer cultures, aggregate cultures, tiered systems for testing, development studies, electron microscopic analysis, and organotypic slice cultures.

See Also:
Section on Chemicals—Metals

Section on Chemicals—Pesticides

Arlien-Soborg: *Solvent Neurotoxicity* (Chemicals—Solvents)

Brust: *Neurotoxic Side Effects of Prescription Drugs* (Chemicals—Drugs)

Ciraulo: *Drug Interactions in Psychiatry* (Chemicals—Drugs)

Connor: *Metals and Oxidative Damage in Neurological Disorders* (Chemicals—Metals)

Costa: *Occuaptional Neurotoxicology* (Occupational Health)

Ecobichon: *Pesticides and Neurological Diseases,* 2nd ed. (Chemicals—Pesticides)

el-Mallakh: *Lithium: Actions and Mechanisms* (Chemicals—Drugs)

Johnson: *Occupational Neurotoxicity: Critical Document for Evaluation of Existing Data* (Occupational Health)

Jones: *Monographs on Pathology of Laboratory Animals* (Pathology)

Niesink: *Drugs of Abuse and Addiction* (Chemicals—Drugs)

Valciukas: *Foundations of Environmental and Occupational Neurotoxicology* (Occupational Health)

Yasui: *Mineral and Metal Neurotoxicity* (Chemicals—Metals)

Yen: *Neuroendocrine Regulation of Reproduction* (Developmental)

Yokel: *Research Issues in Aluminum Toxicity* (Chemicals—Metals)

Journals

Neurotoxicology

Neurotoxicology and Teratology

Journal Articles

Anger, W. K., *et al.* (1996). Symposium on computerized behavioral testing of humans in neurotoxicology research: Overview of the proceedings. ***Neurotoxicol. Teratol.* 18,** 347–350.

Ben-Avi, I., *et al.* (1998). Malingering assessment in behavioral toxicology: What, why, and how. ***Am. J. Indust. Med.* 34,** 325–330.

Boyes, W. K., *et al.* (1997). EPA's neurotoxicity risk assessment guidelines. ***Toxicol. Appl. Pharmacol.*** **40,** 175–184.

Costa, L. G. (1998). Signal transduction in environmental neurotoxicity. ***Annu. Rev. Pharmacol. Toxicol.*** **38,** 21–43.

Costa, L. G., and Manzo, L. (1995). Biochemical markers of neurotoxicity: Research strategies and epidemiological applications. ***Toxicol. Lett.*** **77**(1–3), 147–144.

Costa, L. G. (1996). Biomarker research in neurotoxicology: The role of mechanistic studies to bridge the gap between the laboratory and epidemiological investigations. ***Environ. Health Perspect.*** **104,** (Suppl. 1), 55–67.

Costa, L. G. (1998). Biochemical and molecular neurotoxicology: Relevance to biomarker development, neurotoxicity testing and risk assessment. ***Toxicol. Lett.*** **102–103,** 417–421.

Crofton, K. M. (1996). A structure–activity relationship for the neurotoxicity of triazole fungicides. ***Toxicol. Lett.*** **84,** 155–159.

Dawson, R., Jr., *et al.* (1995). Excitotoxins, aging, and environmental neurotoxins: Implications for understanding human neurodegenerative diseases. ***Toxicol. Appl. Pharmacol.*** **134,** 1–17.

ECETOC working group (1996). Chronic neurotoxicity of solvents. ***ECETOC Tech. Rep.*** **70.**

Environmental Health Perspectives **104**(Suppl. 2) (1996). This supplement contains a variety of relevant articles on topics such as neurobehavioral epidemiology, behavioral toxicology, behavioral effects of lead, clinical neurologic indices of toxicity in animals, and the SGOMSEC joint report.

Harry, G. J., *et al.* (1998). *In vitro* techniques for the assessment of neurotoxicity. ***Environ. Health Perspect.*** **106** (Suppl. 1), 131–158.

Hoerauf, K., *et al.* (1996). Occupational exposure to enflurane and nitrous oxide in operating rooms. ***Zentralblatt Hygiene Umweltmedizin*** **198,** 265–274.

Jacobson, J. L., and Jacobson, S. W. (1996, April). Prospective, longitudinal assessment of developmental neurotoxicity. ***Environ. Health Perspect.*** **104**(SuppL 2), 275–283.

LoPachin, R. M., Jr., and Aschner, M. (1993). Glial–neuronal interactions: Relevance to neurotoxic mechanisms. ***Toxicol. Appl. Pharmacol.*** **118,** 141–158.

LoPachin, R. M., Jr., and Lehning, E. J. (1997). Mechanism of calcium entry during axon injury and degeneration. ***Toxicol. Appl. Pharmacol.*** **143,** 233–244.

Manzo, L., *et al.* (1996). Biochemical markers of neurotoxicity. A review of mechanistic studies and applications. ***Hum. Exp. Toxicol.*** **15,** S20–S35.

Moser, V. C., *et al.* (1997). The IPCS collaborative study on neurobehaviorial screening methods. ***Fundam. Appl. Toxicol.*** **35,** 143–151.

Rice, D. C., *et al.* (1996). Lessons for neurotoxicology from selected model compounds: SGOMSEC report. ***Environ. Health Perspect.*** **104** (Suppl. 2), 205–215.

Slikker, W., Jr., *et al.* (1998). Biologically based dose–response model for neurotoxicity risk assessment. ***Toxicol. Lett.*** **102–103,** 429–433.

Tilson, H. A., and Kodavanti, P. R. (1998). The neurotoxicity of polychlorinated biphenyls. ***Neurotoxicology*** **19,** 517–525.

Viviani, B., and Marinovich, M. (1998). Neurotoxicity: An Active role for glia? ***Neurosci. Res. Commun.*** **23,** 1–12.

TARGET SITES—RESPIRATORY

Barrow, C. S. (Ed.) (1986)
Toxicology of the Nasal Passages
Hemisphere, Washington, DC

Summarizes current knowledge on the anatomy, physiology, and biochemistry of the nasal passages in relation to chemical injury, assesses the relevance of data from experimental animals to human risk estimation, and identifies areas of research needing to be initiated or expanded.

Bernstein, I. L., Chan-Yeung, M., Malo, J. L., and Bernstein, D. I. (Eds.) (1993)
Asthma in the Workplace
Dekker, New York

Due to rapid advances in the field, many interdisciplinary presentations are given to inform the reader of the current state of knowledge. The book contains three main sections dealing with general considerations (historical background), specific disease entities (chemical agents and reactive airway dysfunction syndrome and cotton and grain dusts), and compendiums with specific tabular information.

Churg, A., and Green, F. H. Y. (1998)
Pathology of Occupational Lung Disease, 2nd ed.
Williams & Wilkins, Baltimore

Useful for researching a wide array of occupational lung conditions. Covers topics such as silicons, pneumoconiosis, asbestos-related diseases, beryllions, and hard-metal disease. Includes sections on cancer and occupational asthma.

Cordasco, E. M., Demeter, S. L., and Zenz, C. (1997)
Environmental Respiratory Disease
Van Nostrand–Reinhold, New York

The relationship between occupational and environmental health problems is the major theme. Topics include sources of contamination and respiratory reactions, epidemiological aspects, lung defense mechanisms, toxic inhalation, routine pulmonary function tests, toxic pulmonary edema, respiratory health risks in agriculture and the aerospace industry, environmental allergens, and reactive airways dysfunctional syndrome.

Dail, D. H., and Hammar, S. P. (Eds.) (1994)
Pulmonary Pathology, 2nd ed.
Springer-Verlag, New York

An authoritative text in the field of pulmonary pathology. Chapters on assorted diseases, congenital and pediatric diseases, infections, allergic reactions, therapeutic injuries, effects of dust inhalation, vascular diseases, and neoplasms are included.

European Centre for Ecotoxicology and Toxicology of Chemicals (ECETOC) (1993)
Monograph No. 19: Respiratory Allergy
ECETOC, Brussels

Describes the clinical syndromes, the mechanisms associated with occupational respiratory hypersensitivity, the clinical criteria used for diagnosis, and methods available currently for the prospective identification of potential respiratory allergens.

Gardner, D. E. (1999)
Toxicology of the Lung, 3rd ed.
Taylor & Francis, Philadelphia

This revised monograph addresses the target organ toxicology of the lungs. Provides an overview of both *in vivo* and *in vitro* methods and models that can be used to predict and evaluate the host response to inhaled substances.

Jenkins, P. G., Kayser, D., Muhle, H., Rosner, G., and Smith, E. M. (Eds.) (1994)
Respiratory Toxicology and Risk Assessment
Wissenschaftliche Verlagsgesellschaft, Stuttgart

Based on a symposium held in Hanover, Germany, focusing on issues such as study design, interpretation of data, extrapolation from experimental animal species to humans, correlation with epidemiological findings, and the implications for risk assessment.

Kimber, I., and Dearman, R. J. (Eds.) (1996)
Toxicology of Chemical Respiratory Hypersensitivity
Taylor & Francis, Washington, DC

Draws together toxicological aspects of occupational allergic respiratory sensitization. Included are an overview of respiratory allergy, analysis of the clinical aspects of respiratory sensitization and occupational asthma, and a consideration of safety measures and risk management.

Leong, B. K. J. (1981)
Inhalation Toxicology and Technology
Ann Arbor Science, Ann Arbor, MI

Contains basic information on exposure technology, aerosol technology, and inhalation toxicology from those who are the leaders in this field. Although an older text, the chapters include currently useful approaches that have formed the basis for the experimental work which has followed. Particularly useful are the sections outlining the special needs which need to be considered in separating the effects of inhaled gases from aerosols.

Mauderly, J. J., and McCunney, R. J. (Eds.) (1996)
Particle Overload in the Rat Lung and Lung Cancer
Taylor & Francis, Washington, DC

Covers a broad spectrum of issues regarding the effects of particle deposition in the animal lung. Included are mechanisms of overload-associated responses, interspecies differences, approaches to modeling responses, the usefulness of extrapolations to human risk, epidemiology, and regulatory issues. The issue regarding the usefulness of rodent bioassay results following high-level exposures to predict human health effects at lower exposures is clearly presented.

McClellan, R. O., and Henderson, R. E. (Eds.) (1995)
Concepts in Inhalation Toxicology, 2nd ed.
Taylor & Francis, Washington, DC

Covers the basic concepts and quantitative approaches in the study of health effects of airborne materials. Topics include generation and measurement, biology of the respiratory tract, deposition and disposition of agents, dose dependence, cancer and noncancer end points, and risk assessment involving integration of this information.

Miller, F. J., and Menzel, D. B. (Eds.) (1984)
Fundamentals of Extrapolation Modeling of Inhaled Toxicants: Ozone and Nitrogen Dioxide
Hemisphere, Washington, DC

Describes the feasibility of dosimetry modeling and the integration of species sensitivity data based on physical, physiological, anatomical, and toxicological information. The methodology for estimating regional lung doses and analogies between animals and man that permit this are well covered. This is a unique approach in extrapolation modeling and the information presented here has served as a basis for this activity.

Mohr, U. (Ed.) (1992)
International Classification of Rodent Tumours, Part I: The Rat Respiratory System
IARC, Lyon

Presents a classification of rodent tumor nomenclature and diagnosis for purposes of standardization. The long-term intent is to understand the correlation between experimental results in animals and human extrapolation without involving subjective bias.

Mohr, U., *et al.* (Eds.) (1989)
Assessment of Inhalation Hazards
ILSI Press, Washington, DC

Covers information on inhalation hazards, including cell biological and molecular biological approaches, animal experiments, and epidemiology. Includes asbestos, acrolein, formaldehyde, and nitrosamines as examples.

Mohr, U., Dungworth, D. L., Mauderly, J. L., and Oberdorster, G. (Eds.) (1994)
Toxic and Carcinogenic Effects of Solid Particles in the Respiratory Tract
ILSI Press, Washington, DC

Papers presented at the fourth biennial International Inhalation Symposium in Hannover examine the relationship between particulate and biological outcomes with special emphasis on cancer. The major areas covered include introductions, overview of chronic animal studies, particle–cell interactions, mechanisms of pulmonary carcinogenesis and fibrosis, human exposure and effects, risk assessment, and conclusions. Special topic areas include some very interesting papers covering *in vitro* effects of solid particles, *in vivo* effects, fiber effects, different approaches, and particles and tobacco smoke.

Mohr, U., Dungworth, D. L., Adler, K. B., Harris, C. C., and Plopper, C. G. (Eds.) (1997)
Correlations between in Vitro and in Vivo Investigations in Inhalation Toxicology
ILSI Press, Washington, DC

Explores improvements in techniques for *in vitro* studies and presents insights into mechanisms responsible for toxic injury. The book examines the validity of *in vitro* data for *in vivo* situations and applies the data to quantitation of human risk. A major focus is on airborne toxicants.

Morgan, W. K. C., and Seaton, A. (1995)
Occupational Lung Disorders, 3rd ed.
Saunders, Philadelphia

A comprehensive review of occupational lung diseases. It covers pulmonary physiology, pathological reactions of the lungs, deposition and clearance mechanisms as well as specific diseases. It includes chapters on prevention, biotrauma, and the measurement of aerosols.

National Research Council (1989)
Biologic Markers in Pulmonary Toxicology
National Academy Press, Washington, DC

A comprehensive study of the use of biologic markers. Focusing on the respiratory tract as an entryway for airborne pollutants, this volume reviews new ways of measuring markers, the need for markers to indicate exposure and toxic response, noninvasive respiratory function tests, and approaches to evaluating markers from functional down to the cellular and biochemical levels.

Parkes, W. R. (Ed.) (1994)
Occupational Lung Disorders, 3rd ed.
Butterworth-Heinemann, Boston

Presents a description and discussion of pathogenesis, pathology, physiology, and clinical features of occupational pulmonary disorders. It identifies the sources of agents in the workplace environment that have potentially deleterious respiratory effects. It emphasizes the question of personal susceptibility or resistance to the development of the diseases.

Phalen, R. F. (1984)
Inhalation Studies: Foundations and Techniques
CRC Press, Boca Raton, FL

This is a valuable text despite its age. It covers basic scientific foundations of inhalation research which are directly applicable to the practical design and conduct of toxicologic studies. Basic and applied aerosol science, comparative respiratory tract anatomy and physiology, generation and characterization of atmospheres, inhalation exposure techniques, selection of end points, design of studies, animal models, facilities requirements, and applicable regulations and guidelines are all included in an easily understandable format.

Phalen, R. F. (Ed.) (1997)
Methods in Inhalation Toxicology
CRC Press, Boca Raton, FL

Details of conducting inhalation toxicology experiments are clearly presented in a series of well-written chapters. Major topics include the use of animal subjects and related quality control and ethical considerations, air purification methodology, exposure atmosphere generation and characterization, inhalation exposure systems, and real-time and postexposure biological assessments.

Salem, H. (Ed.) (1986)
Inhalation Toxicology: Research Methods, Applications, and Evaluation
Dekker, New York

This classic text considers characteristics of inhalation exposure equipment and test article administration, examines physiological responses to inhalation of toxic substances, discusses stages of movement of toxic matter through the body, outlines methods of evaluating inhalants' pulmonary responses and immunotoxicology, and identifies issues concerning regulatory requirements for inhalation toxicity testing. Each section has been prepared by carefully selected experts.

Sanders, C. L., Cross, F. T., Dagle, G. E., and Mahaffey, J. A. (Eds.) (1980)
Pulmonary Toxicology of Respirable Particles
U. S. Department of Energy, Washington, DC

Proceedings of the 19th Annual Hanford Life Sciences Symposium, October 22–24, 1979 (DOE Symposium Series No. 53). Includes more than 40 papers on the pulmonary toxicology of energy sources. The papers are divided between studies on nuclear fuel radionuclides and studies on toxicants associated with the production and combustion of fossil fuels. The symposium emphasized aerosol physics, dosimetry, mutagenicity and *in vitro* assays, the pulmonary alveolar macrophage, immunocompetency, histopathology, and cocarcinogenesis with cigarette smoking.

Thomassen, D. G., and Nettesheim, P. (Eds.) (1990)
Biology, Toxicology, and Carcinogenesis of Respiratory Epithelium
Hemisphere, New York

Examines the relationship between exposure to potential toxicants and carcinogens and the mechanism of lung cancer development. Particularly stressed are the roles of growth and differentiation, injury and repair, and carcinogenesis of the respiratory epithelium.

Willeke, K. (Ed.) (1980)
Generation of Aerosols and Facilities for Exposure Experiments
Ann Arbor Science, Ann Arbor, MI

Focuses more on instrumentation and facilities than on specific health effects. Sections include basic concepts of aerosol generation and health effects, methods of aerosol generation, and exposure facilities utilizing models for humans and animals. The text goes into considerable mathematical detail (aerosol physics).

Willeke, K., and Baron, P. A. (Eds.) (1993)
Aerosol Measurement: Principles, Techniques, and Applications
Van Nostrand–Reinhold, New York

Provides a solid grasp of measurement fundamentals and practices in a variety of aerosol applications. It focuses on a thorough understanding of aerosols, covers specific instrumental techniques, and explains specific applications in various fields. The book uses examples liberally and has a series of useful appendices such as a glossary of terms and an index of abbreviations.

Witschi, H., and Brain, J. D. (Eds.) (1985)
Toxicology of Inhaled Materials
Springer-Verlag, Berlin

Volume 75 of the *Handbook of Experimental Pharmacology.* Examines inhalation toxicological exposure techniques, general assessment of toxic effects, morphologic techniques, and biological and biochemical analysis.

Witschi, H., and Nettesheim, P. (1982)
Mechanisms in Respiratory Toxicology, 2 vols.
CRC Press, Boca Raton, FL

Classic text covering the cellular and biochemical mechanisms of lung tissue response to chemical injury. The first volume discusses the access that toxic agents have to the lung, including the anatomy, kinetics of delivery, and how the sequence of lung responses is initiated. The second volume deals with pulmonary defense mechanisms and endogenous factors modulating the biological response.

See Also:
Section on Environmental Toxicology—Atmospheric

Section on Chemicals—Dusts and Fibers

Castranova: *Silica and Silica-Induced Lung Diseases* (Chemicals—Dusts and Fibers)

Gad: *Combustion Toxicology* (Miscellaneous)

Harber: *Occupational and Environmental Respiratory Disease* (Occupational Health)

Hinds: *Aerosol Technology* (Environmental Toxicology—Atmospheric)

Jones: *Monographs on Pathology of Laboratory Animals* (Pathology)

Kayser: *Natural and Synthetic Mineral Fibers Affecting Man* (Chemicals—Dusts and Fibers)

Miller: *Nasal Toxicity and Dosimetry* (Target Sites—Sensory)

National Research Council: *Biologic Markers in Pulmonary Toxicology* (Biomonitoring/Biomarkers)

Thomasen: *Biology, Toxicology and Carcinogenesis of Respiratory Epithelium* (Cancer)

Wang: *Health Risk Assessment: Dermal and Inhalation Exposure and Absorption of Toxicants* (Risk Assessment)

Warheit: *Fiber Toxicology* (Chemicals—Dusts and Fibers)

Journal Articles

Bhalla, D. K. (1999). Ozone-induced lung inflammation and mucosal barrier disruption: toxicology, mechanisms, and implications. ***J. Toxicol. Environ. Health B. Crit. Rev.*** **2,** 31–86.

Copper, J. A., Jr. (1997). Drug-induced lung disease. ***Adv. Internal Med.*** **42,** 231–268.

Dahl, A. R. and Hadley, W. M. (1991). Nasal cavity enzymes involved in xenobiotic metabolism: Effects on the toxicity of inhalants. ***Crit. Rev. Toxicol.*** **21,** 345–372.

Dahl, A. R., and Lewis, J. L. (1993). Respiratory tract uptake of inhalants and metabolism of xenobiotics. ***Annu. Rev. Pharmacol. Toxicol.*** **33,** 383–408.

Farley, J. M. (1992). Inhaled toxicants and airway hyperresponsiveness. ***Annu. Rev. Pharmacol. Toxicol.*** **32,** 67–88.

Foth, H. (1995). Role of the lung in accumulation and metabolism of xenobiotic compounds: Implications for chemically induced toxicity. ***Crit. Rev. Toxicol.*** **25,** 165–206.

Hubal, E. A. C., *et al.* (1996). Mass-transport models to predict toxicity of inhaled gases in the upper respiratory tract. ***J. Appl. Physiol.*** **80,** 1415–1427.

Kennedy, A. L., and Brown, W. E. (1992). Isocyanates and lung disease: Experimental approaches to molecular mechanisms. ***Occup. Med.*** **7**(2),301–329.

Kimber, I., *et al.* (1996). Identification of respiratory allergens. ***Fundam. Appl. Toxicol.*** **33,** 1–10.

Kjuus, H., *et al.* (1996). Work-related lung disorders: An epidemiological approach to the assessment of causal relationships. ***Tidsskrift Norske Laegeforening*** **116,** 736–738.

Libby, D., and White, D. A. (1998). Pulmonary toxicity of drugs used to treat systemic autoimmune diseases. ***Clin. Chest Med.*** **19,** 809–821.

Medinsky, M. A. *et al.* (1993). Advances in biologically based models for respiratory tract uptake of inhaled volatiles. ***Fundam. Appl. Toxicol.*** **20,** 265–272.

Morrow, P. E. (1992). Dust overloading of the lungs: Update and appraisal. ***Toxicol. Appl. Pharmacol.*** **113,** 1–12.

Morrow, P. E., *et al.* (1996). The maximum tolerated dose for inhalation bioassays: Toxicity vs. overload. ***Fundam. Appl. Toxicol.*** **29,** 155–167.

Nilsson, R. (1996). Environmental tobacco smoke and lung cancer: A reappraisal. ***Ecotoxicol. Environ. Safety*** **34,** 2–17.

Schlesinger, R. B. (1990). The interaction of inhaled toxicants with respiratory tract clearance mechanisms. ***Crit. Rev. Toxicol.*** **20,** 257–286.

Schwade, L. S., and Thompson, D. C. (1998). Interspecies comparison of pulmonary toxicants using precision-cut mouse and rat lung slices. ***In Vitro Mol. Toxicol.*** **11,** 243–253.

Schwarze, P. E., *et al.* (1996). The use of isolated lung cells in in vitro pulmonary toxicology: Studies of DNA damage, apoptosis and alteration of gene expression. ***Centr. Eur. J. Public Health*** **4** (Suppl.), 6–10.

Steenland, K., *et al.* (1996). Review of occupational lung carcinogens. ***Am. J. Ind. Med.*** **29,** 474–490.

Stöber, W., and McClellan, R. O. (1997). Pulmonary retention and clearance of inhaled biopersistent aerosol particles: Data-reducing interpolation models and models of physiologically based systems: A review of recent progress and remaining problems. ***Crit. Rev. Toxicol.*** **27,** 539–598.

Talaska, G., *et al.* (1996). Molecular biomarkers of occupational lung cancer. ***Yonsei Med. J.*** **37,** 1–18.

Weiss, W. (1999). Asbestosis: A marker for the increased risk of lung cancer among workers exposed to asbestos. ***Chest*** **115,** 536–549.

TARGET SITES—SENSORY

Chiou, G. (Ed.) (1999)
Ophthalmic Toxicology, 2nd ed.
Taylor & Francis, Philadelphia

Covers a variety of areas related to the target organ toxicology for the eye and associated tissue. Contains additional material on molecular toxicology.

Esfandabad, H. S. (1993)
Odor and Irritation Detection of Formaldehyde by Human Observers
Stockholm Univ. Press, Stockholm

Covers human experimentation to separate the effects of irritation from those of sensation. The report is part of a series of reports from the Department of Psychology covering areas interfacing between toxicology and psychology.

European Chemical Industry Ecology and Toxicology Centre (ECETOC) (1988)
Monograph No. 11: Eye Irritation Testing
ECETOC, Brussels

Assesses the current status of the Draize rabbit eye test and examines modified *in vivo* tests and alternative *in vitro* techniques in relation to their relevance to man, to the humane use of animals, and to their utility for legislatory classification.

European Chemical Industry Ecology and Toxicology Centre (ECETOC) (1992)
Technical Report No. 48: Eye Irritation: Reference Chemicals Data Bank
ECETOC, Brussels

A compilation of comprehensive *in vivo* rabbit eye irritation data on 55 chemicals. The 55 chemicals represent a range of chemical classes and different degrees of irritancy. These chemicals are ranked for eye irritation potential on the basis of a ''modified maximum average score.''

European Centre for Ectoxicology and Toxicology of Chemicals (ECETOC) (1994)
Monograph No. 22: Evaluation of Chemicals for Oculotoxicity
ECETOC, Brussels

Reviews the available evidence on the assessment of oculotoxicity and recommends a practical testing strategy for evaluating the oculotoxic potential of chemicals.

Frazier, J. M., Gad, S. C., Goldberg, A. M., and McCulley, J. P. (1987)
A Critical Evaluation of Alternatives to Acute Ocular Irritation Testing
Liebert, New York

Examines critically the information relevant to the use of alternative testing methods, other than traditional animal tests, for the purpose of determining the extent of ocular damage following chemical exposure. Included in this book are an historical perspective, current *in vivo* testing methods, a critical review of these methods, approaches to developing *in vitro* alternatives, and a critical evaluation of these alternatives. Validation is the important last step and is discussed thoughtfully.

Grant, W. M., and Schuman, J. S. (Eds.) (1993)
Toxicology of the Eye, 4th ed.
Thomas, Springfield, IL

A classic regarding the effects of chemicals on the eye. The book presents a synopsis of what is known regarding substances which have toxic properties injurious to the eyes. The information is presented in a chemical by chemical format. Also included is a section providing an outline of toxic effects systematized according to signs, symptoms, and sites of action.

Hayes, A. W. (Ed.) (1985)
Toxicology of the Eye, Ear, and Other Special Senses
Raven Press, New York

Deals with an interdisciplinary approach to the toxicology of the eye, ear, and other special senses. The normal morphology, physiology, and biochemistry of these organs are discussed. The focus then is on animal test procedures for the assessment of toxic effects. Conceptual and methodologic problems are discussed to show their usefulness and their limitations.

Hobson, D. W. (1991)
Dermal and Ocular Toxicology: Fundamentals and Methods
CRC Press, Boca Raton, FL

Divided into two general sections, ocular and dermal toxicology. Each section includes a discussion of the toxicologically relevant anatomical and pathologic characteristics of each organ system. In addition, *in vitro* and *in vivo* techniques to evaluate toxicity, toxicokinetics, statistical considerations, and research needs are presented and discussed.

Hockwin, O., Green, K., and Rubin, L. F. (Eds.) (1992)
Manual of Oculotoxicity Testing of Drugs
Fischer, Stuttgart

Provides a collection of methods for the practical solution of questions that arise in connection with the oculotoxic effects of medications. The major section headings include General Introduction and Routine Methods, Systems, Models, Methods to Test Drug Toxicity, and Prospective Models for *in Vitro/in Vivo* Testing.

Langston, D. P. (1991)
Handbook of Ocular Drug Therapy and Ocular Side Effects of Systemic Drugs
Little, Brown, Boston

First examines pharmacologic agents used in fighting ocular infections and diseases including the major side effects. The second part of this book presents 20 chapters on ocular effects caused by pharmacologic agents used in treating systemic disease.

Lerman, S., and Tripathi, R. C. (1990)
Ocular Toxicology
Dekker, New York

Proceedings of the First Congress of the International Society of Ocular Toxicology. Examines drug-related ocular side effects and methods to monitor for them and presents *in vivo* and *in vitro* models. The book also illustrated the importance of correlating morphologic changes with biochemical and biophysical parameters.

Miller, F. J. (1995)
Nasal Toxicity and Dosimetry of Inhaled Xenobiotics: Implications for Human Health
Taylor & Francis, Washington, DC

Serves as a well-designed study of the nose as an entry point for noxious chemicals.

Miller, J. (1985)
CRC Handbook of Ototoxicity
CRC Press, Boca Raton, FL

Only available text which deals exclusively with the ear as the target for chemical insult. It emphasizes clinical occurrence of drug-induced ototoxic reactions and appropriate animal research indicating morphological, electrophysiological, and biochemical events in the toxic reaction.

Weisse, I. (Ed.) (1995)
Ocular Toxicology
Plenum, New York

Reviews the methods and techniques in ocular toxicology. It covers ocular electrophysiology, ocular pharmacokinetics, *in vitro* methods, and lens/cataracts. It also reviews regulatory issues.

Yanoff, M., and Fine, B. S. (1989)
Ocular Pathology: A Text and Color Atlas, 3rd ed.
Lippincott–Raven Press, Philadelphia

Presents ocular pathology in a simplified, systematic manner to both the student and the practitioner. Facets for examination include congenital anomalies, corneal and sclera changes, lens, retina, vitreous, optic nerve, orbit, diabetes mellitus, glaucoma, and tumors.

See Also:
Barrow: *Toxicology of the Nasal Passages* (Target Sites—Respiratory)

Jones: *Monographs on Pathology of Laboratory Animals* (Pathology)

Journal

Journal of Toxicology. Cutaneous and Ocular Toxicology

Journal Articles

al-Tweigeri, T., *et al.* (1996). Ocular toxicity and cancer chemotherapy. A review. ***Cancer* 78,** 1359–1373.

Bos, P. M. J., *et al.* (1991). Evaluation of the sensory irritation test for the assessment of occupational health risk. ***Crit. Rev. Toxicol.* 21,** 423–450.

Casterton, P. L., *et al.* (1996). A novel approach to assessing eye irritation potential using the bovine corneal opacity and permeability assay. ***J. Toxicol. Cutaneous Ocular Toxicol.* 15,** 147–163.

Chamberlain, M., *et al.* (1997). IRAG working group 1. Organotypic models for the assessment/prediction of ocular irritation. Interagency Regulatory Alternatives Group. ***Food Chem. Toxicol.* 35,** 23–37.

Estlander, T., *et al.* (1996). Occupational conjunctivitis associated with type IV allergy to methacrylates. ***Allergy* 51,** 56–59.

Herzinger, T., *et al.* (1995). Assessment of cutaneous and ocular irritancy: A decade of research on alternatives to animal experimentation. ***Fundam. Appl. Toxicol.* 24,** 29–41.

Huang, M. Y., and Schacht, J. (1989). Drug-induced ototoxicity. Pathogenesis and prevention. ***Med. Toxicol. Adverse Drug Experience* 4**(6), 452–467.

Hurley, P. M., *et al.* (1993). Screening procedures for eye irritation. ***Food Chem. Toxicol.* 31**(2), 87–94.

Kuhweide, R. (1995). Experimental evidence of ototoxicity of ear drops. A review of the literature. ***Acta Otorhinolaryngol. Belgica* 49**(3), 293–298.

Lin, G. H., and Hemming, M. (1996). Ocular and dermal irritation studies of some quaternary ammonium compounds. ***Food Chem. Toxicol.* 34,** 177–182.

Nayfield, S. G., and Gorin, M. B. (1996). Tamoxifen-associated eye disease. A review. ***J. Clin. Oncol.* 14**(3), 1018–1026.

Nielsen, G. D. (1991). Mechanisms of activation of the sensory irritant receptor by airborne chemicals. ***Crit. Rev. Toxicol.* 21,** 183–208.

O'Sullivan, E. P., and Kennard, C. (1998). Ocular manifestations of neurological disease. ***Curr. Opin. Neurol.* 11,** 25–29.

Rennie, I. G. (1993). Clinically important ocular reactions to systemic drug therapy. ***Drug Safety* 9**(3), 196–211.

Scott, P. M., and Griffiths, M. V. (1994). A clinical review of ototoxicity. ***Clin. Otolaryngol.* 19,** 3–8.

Wagoner, M. D. (1997). Chemical injuries of the eye: Current concepts in pathophysiology and therapy. ***Surv. Ophthalmol.* 41,** 275–313.

Weisse, I. (1995). Changes in the aging rat retina. ***Ophthal. Res.* 27,** 154–163.

Wersall, J. (1995). Ototoxic antibiotics: A review. ***Acta Otolaryngol. Suppl.*** *(Stockholm)* **519,** 26–29.

York, M., and Steiling, W. (1998). A critical review of the assessment of eye irritation potential using the Draize rabbit eye test. ***J. Appl. Toxicol.* 18,** 233–240.

TARGET SITES—SKIN

Adams, R. M. (1999)
Occupational Skin Disease, 3rd ed.
Saunders, Philadelphia

Over 40 clinician contributors suggest practical management solutions for a variety of occupational skin diseases. This new edition includes extensive information on the new and easy method of patch testing and an expanded section on irritants and allergens associated with various jobs.

Amin, S., *et al.* (Eds.) (1997)
Contact Urticaria Syndrome
CRC Press, Boca Raton, FL

Discusses reactions caused by chemicals, animal products, antibiotics, cosmetics, and many other materials. Special issues such as childhood atopic dermatitis, protein contact dermatitis, paronychia, and the oral allergy syndrome are also discussed.

Breathnach, S. M., and Hinter, H. (1992)
Adverse Drug Reactions and the Skin
Blackwell, Oxford

The types of skin injury are classified by response and include copious illustrations for easy reference. The major sections are epidemiology and pathomechanisms, patterns of clinical disease, widely prescribed drugs and skin reactions, and the management of drug reactions.

DeGroot, A. C., Weyland, J. W., and Nater, J. P. (1994)
Unwanted Effects of Cosmetics and Drugs Used in Dermatology, 3rd ed.
Elsevier, Amsterdam

Designed as a reference source for the practicing physician who is confronted with an adverse reaction to a cosmetic or a drug. The 30 chapters include discussions on contact and allergic dermatitis, photoeffects, discoloration, absorption of agents, side effects of agents, and cosmetic action and effect by system (hair, face, etc.).

Drill, V. A., and Lazar, P. (Eds.) (1984)
Cutaneous Toxicity
Raven Press, New York

Covers percutaneous absorption, dermatoxicology test techniques, allergic contact dermatitis in laboratory animals, the eye, cutaneous DNA repair mechanisms, the immune system, cutaneous phototoxicity, adverse reactions to cosmetics and other topical agents, retinoids, and occupational dermatoses.

Elsner, P., Lachapelle, J. M., Wahlberg, J. E., and Maibach, H. I. (Eds.) (1996)
Prevention of Contact Dermatitis
Karger, Basel

Extensive coverage of both irritant and allergic contact dermatitis prevention. This book examines the epidemiological basis of the disease, prediction of irritancy and allergenicity by modern techniques, and prevention of cutaneous penetration. Intended for use by dermatologists, occupational physicians, toxicologists, and cosmetologists.

European Chemical Industry Ecology and Toxicology Centre (ECETOC) (1990)
Monograph No. 14: Skin Sensitization Testing
ECETOC, Brussels

Assesses the current status of skin sensitization (or allergic contact dermatitis) testing using the guinea pig as the experimental model and examines how the assessment of skin sensitization potential could be changed to allow improved risk assessment both by modifying current test methods and by introducing well-validated, alternative test methods. The role of predictive patch testing using human volunteers is also considered.

European Chemical Industry Ecology and Toxicology Centre (ECETOC) (1990)
Monograph No. 15: Skin Irritation
ECETOC, Brussels

Describes the various aspects of the assessment of skin irritation/corrosive potential of substances and preparations including the use of alternative testing procedures. It also discusses how skin irritation test results can be interpreted in terms of hazard to man.

European Centre for Ectoxicology and Toxicology of Chemicals (ECETOC) (1995)
Technical Report No. 66: Skin Irritation and Corrosion: Reference Chemicals Data Bank
ECETOC, Brussels

This report is the data bank of 176 chemicals for which comprehensive rabbit skin irritation/corrosion data are available. The chemicals are ranked for skin irritation potential on the basis of a ''primary irritation index.'' Classification schemes are included.

Goldstein, S. M., and Wintroub, B. U. (1996)
Adverse Cutaneous Reactions to Medication
Williams & Wilkins, Baltimore

Presents the dermal adverse reactions to drugs using minimal text and liberal photographs. This book will be used primarily by the dermatologist dealing with drug-induced skin lesions. Types of eruptions, diagnosis, drugs of particular interest, and special situations are discussed.

Guin, J. D. (1995)
Practical Contact Dermatitis: A Handbook for the Practitioner
McGraw-Hill, New York

Immediate source of information for patients known to be allergic to standard contact allergens. The intent of the book is to provide practical information to the physician and through the physician to the patient.

Hogan, D. J. (1994)
Occupational Skin Disorders
Igaku-Shoin, New York

The most common occupational dermatoses are covered in this text. The book deals with methods for basic patch testing, skin diseases of occupational origin, and practical guidance for treatment. Many color plates are included for easy diagnostic reference.

Hotchkiss, S. (1999)
Introduction to Skin Toxicology
Taylor & Francis, Washington, DC

Provides a comprehensive introduction to skin toxicology and covers the general structure and function of skin. Chapters discuss aspects such as pathology, toxicants, absorption and metabolism, corrosion, irritation, sensitization, phototoxicity, and cancer. Case studies are used to elaborate the principles discussed.

Kauppinen, K., *et al.* (Eds.) (1998)
Skin Reactions to Drugs
CRC Press, Boca Raton, FL

Part of the CRC Series in Dermatology. Emphasizes the mechanisms and clinical laboratory proof of a cause and effect relationship between drugs and adverse reactions. Discusses ''drug challenge,'' as developed in Finland.

Kimber, I. (Ed.) (1996)
Toxicology of Contact Hypersensitivity
Taylor & Francis, Washington, DC

Provides a concise reference to all aspects of contact hypersensitivity. The contributors illustrate well recent advances aiding in the identification of hazard and risk assessment associated with skin sensitization.

Krutmann, J., and Elmets, C. A. (Eds.) (1995)
Photoimmunology
Blackwell, Oxford

Provides an overview of the principles of photobiology and immunology as they relate to the skin and summarizes the effects of UV radiation on immunological processes. Current applications of UV radiation as a means of achieving specific immunosuppression and its use in the therapy of cutaneous diseases is covered.

Lookingbill, D. P., and Marks, J. G., Jr. (1993)
Principles of Dermatology, 2nd ed.
Saunders, Philadelphia

Aimed at facilitating dermatologic diagnosis through a clinicopathologic approach to skin disease. Each chapter is based on the appearance of the primary skin process rather than the etiology. This method has been found useful in that this is how most patients present in the clinical setting. A 3rd edition is projected for 2000.

Lovell, C. R. (1993).
Plants and the Skin
Blackwell, Boston

Practical illustrated account of value to the dermatologist, practitioner, or nurse confronted with an eruption from contact with a plant or a plant product. The major types of eruptions are discussed along with the plants that cause them. Occupational contacts in food handling, perfumes, and cosmetics are discussed.

Maibach, H. I. (Ed.) (1987)
Occupational and Industrial Dermatology, 2nd ed.
Year Book Med. Publ., Chicago

Presents 41 chapters covering the basics of dermatotoxicology and specific industrial problems. Each chapter focuses on a specific aspect of occupational dermatol-

ogy. Emphasis is placed on basic mechanisms and etiologic agents of occupational skin disorders.

Marks, J. G., and DeLeo, V. A. (1997)
Contact and Occupational Dermatology, 2nd ed.
Mosby/Year Book, St. Louis

An introductory textbook for clinicans involved in evaluating patients with contact and occupational dermatoses. Covers allergic and irritant contact dermatitis, patch testing, regional contact dermatitis, occupational skin disease, and a variety of agents (e.g., preservatives and vehicles, cosmetics and fragrances, medicaments, photoallergens, and plants).

Marks, R., and Plewig, G. (Eds.) (1992)
The Environmental Threat to the Skin
M. Dunitz, London

Recognizes that environmental agents can have a profound effect on the skin, which serves as a barrier between internal and external. The major sections cover the type of contact challenge and include solar radiation and other climactic influences, chemical hazards, and the microbial threat.

Marzulli, F. N., and Maibach, H. I. (Eds.) (1996)
Dermatotoxicology, 5th ed.
Taylor & Francis, Washington, DC

A highly regarded text in a new edition with some revised and many new chapters. Discusses mechanisms of action and practical information on the large array of responses of skin to various toxicants. Includes approaches to evaluating dermal toxicity.

Marzulli, F., and Maibach, H. I. (Eds.) (1998)
Dermatotoxicology Methods: The Laboratory Worker's Vade Mecum
Taylor & Francis, Washington, DC

Evaluates methods currently employed to identify the potential of certain types of chemicals to adversely affect the skin. The book is written specifically to meet the needs of the laboratory worker. The manual includes sections on standardization of tests as well as the development of alternative testing strategies.

Mukhtar, H. (Ed.) (1992)
Pharmacology of the Skin
CRC Press, Boca Raton, FL

Assembles a summary of pharmacology as it relates to the skin. The major sections in this text are instructive: skin and its barrier function, skin model systems, drug metabolism in skin, skin pharmacology in health and in disease, oxidants and antioxidants in skin, immunopharmacology of skin, and skin carcinogenesis. This book brings together excellent reviews and gives the reader a solid grounding for the skin as an active tissue.

Reitschel, R. L., and Fowler, J. F., (Eds.) (1995)
Fisher's Contact Dermatitis, 4th ed.
Williams & Wilkins, Baltimore

Classic text in the field and encyclopedic in scope. The 37 chapters clearly characterize the disease state, the agents and occupations affected, natural products with these properties, diagnosis and treatment, and prevention. Agent-specific findings are easy to locate.

Roberts, M. S., and Walters, K. A. (Eds.) (1998)
Dermal Absorption and Toxicity Assessment
Dekker, New York

Volume 91 of the series *Drugs and the Pharmaceutical Sciences*. Examines the dermal absorption process with emphasis on determining the toxicity arising from exposure to pharmaceuticals, cosmetics, and other substances. This text serves as an excellent bench reference for scientists seeking effective and efficient means of estimating risks from chemicals following dermal contact.

Rycroft, R. J. G., Menne, T., and Frosch, P. J. (Eds.) (1995)
Textbook of Contact Dermatitis, 2nd ed
Springer-Verlag, Berlin

Presents information on how to study patients, patch test them, and interpret the results with accuracy and precision. The 22 chapters in this book cover every aspect of contact dermatitis, including historical aspects, basic features, diagnostic tests, and allergens related to specific exposures. A most useful text for those dealing with dermal irritation and sensitization.

Surber, C., Elsner, P., and Bircher, A. J. (1995)
Exogenous Dermatology
Karger, Basel

Advances in skin-related allergy, bioengineering, pharmacology, and toxicology of the skin are presented in 33 chapters. The central theme follows the continuing attempts to explain local and systemic effects onto the skin with compelling biological mechanistic explanations.

U.S. Environmental Protection Agency (1996)
Occupational Dermal Exposure Assessment—A Review of Methodologies and Field Data. Final Report, September 30, 1996.
Science Applications, US. EPA, Washington, DC

Covers various methods to assess and estimate dermal exposures. The book also includes skin surface area and published dermal exposure data.

Van der Valk, P. G. M., and Maibach, H. I. (Eds.) (1996) ***The Irritant Contact Dermatitis Syndrome*** CRC Press, Boca Raton, FL

Provides information on theoretical, epidemiological, and clinical aspects of irritant contact dermatitis. The book also describes important irritants, contributing factors, and issues related to sensitive skin. Included is a discussion of the tools that may be useful in diagnosing and treating the problem.

Walters, K. A., and Hadgraft, J. (Eds.) (1997) ***Pharmaceutical Skin Penetration Enhancement*** Dekker, New York

Blends theory and practice of penetration enhancement in one text. Topics include chapters on the following enhancers: water, alkyl esters, phospholipids, terpenes, and more complex molecules. Also included is mechanistic and regulatory information.

See Also:

Draelos: *Cosmetics in Dermatology*, 2nd ed. (Chemicals—Cosmetics and Other Consumer Products)

ECETOC: *Technical Report No. 45: Nickell, Cobalt and Chromium in Consumer Products: Allergic Contact Dermatitis* (Chemicals—Metals)

Frosch: *Fragrances* (Chemicals—Cosmetics and Other Consumer Products)

Guy: *Metals and the Skin* (Chemicals—Metals)

Hobson: *Dermal and Ocular Toxicology* (Target Sites—Sensory)

Homburger: *Skin Painting Techniques and in Vivo Carcinogenesis Bioassays* (Cancer)

Jones: *Monographs on Pathology of Laboratory Animals* (Pathology)

Ness: *Surface and Dermal Monitoring for Toxic Exposures* (Occupational Health)

Wang: *Health Risk Assessment: Dermal and Inhalation Exposure and Absorption to Toxicants* (Risk Assessment)

Journals

Contact Dermatitis

Cutis

Environmental Dermatology

Journal of Toxicology. Cutaneous and Ocular Toxicology

Journal Articles

Agency for Toxic Substances and Disease Registry (1996). Skin lesions and environmental exposures. An overview for the occupational health nurse. ***AAOHN J.*** **44**(11), 529–540.

Bagley, D. M., *et al.* (1996). Skin irritation: Reference chemicals data bank. ***Toxicol. in Vitro*** **10,** 1–6.

De Gruijl, F. R. (1996). Photobiology of photocarcinogenesis. ***Photochem. Photobiol.*** **63,** 372–375.

Draelos, Z. D. (1997). Sensitive skin: Perceptions, evaluation, and treatment. ***Am. J. Contact Dermatitis*** **8**(2), 67–78.

Goldberg, A. M., and Maibach, H. I. (1998). Dermal toxicity: Alternative methods for risk assessment. ***Environ. Health Perspect.*** **106** (Suppl. 2), 493–496.

Greenhalgh, D. A., *et al.* (1995). Multistage skin carcinogenesis in transgenic mice. ***Proc. Assoc. Am. Physicians*** **107,** 258–275.

Herzinger, T., *et al.* (1995). Assessment of cutaneous and ocular irritancy: A decade of research on alternatives to animal experimentation. ***Fundam. Appl. Toxicol.*** **24,** 29–41.

Hostynek, J. J. (1998). Toxic potential from metals absorbed through the skin. ***Cosmetics Toiletries*** **113,** 33–34, 37–40.

Lansdown, A. B. G., (1995). Physiological and toxicological changes in the skin resulting from the action and interaction of metal ions. ***Crit. Rev. Toxicol.*** **25,** 397–462.

Mukhtar, H., and Elmets, C. A. (1996). Photocarcinogenesis mechanisms models and human health implications introduction. ***Photochem. Photobiol.*** **63,** 356–357.

Ponec, M. (1992). *In vitro* cultured human skin cells as alternatives to animals for skin irritancy screening. ***Int. J. Cosmetic Sci.*** **14,** 245–264.

Rietschel, R. L. (1996). Reproducibility of patch-test results. ***Lancet*** **347,** 1202–1207.

Riviere, J. E., and Monteiro-Riviere, N. A. (1991). The isolated perfused porcine skin flap as an *in vitro* model for percutaneous absorption and cutaneous toxicology. ***Crit. Rev. Toxicol.*** **21,** 329–344.

Walker, A. P., *et al.* Test guidelines for the assessment of skin tolerance of potentially irritant cosmetic ingredients in man. European Cosmetic, Toiletry and Perfumery Association. ***Food Chem. Toxicol.*** **35,** 1099–1106.

Wolkenstein, P., and Revuz, J. (1995). Drug-induced severe skin reactions. Incidence, management and prevention. ***Drug Safety* 13,** 56–68.

Zhang, Z., and Monteiro-Riviere, N. A. (1997). Comparison of integrins in human skin, pig skin, and perfused skin: An *in vitro* skin toxicology model. ***J. Appl. Toxicol.* 17,** 247–253.

TESTING METHODS AND TOXICITY ASSESSMENT (INCLUDING ALTERNATIVES)

Adams, A., Gottschling, D. E., Kaiser, C.A., and Stearns, T. (1998)
Methods in Yeast Genetics
Cold Spring Harbor Laboratory Press, Plainville, NY

Updates and incorporates significant portions of previous manuals—all designed to give the laboratorian a hands-on guide to conducting experiments using yeasts as the experimental unit.

Alternative Methods in Toxicology and the Life Sciences (1983–)
Liebert, New York

A monographic series focusing on alternative methods. Volume 10 was titled *In Vitro Toxicology: Irritation, Phototoxicity, Sensitization,* and Volume 11 (1995) *The World Congress on Alternatives in Animal Use in the Life Sciences* (A. M. Goldberg and L. F. M. van Zutphen, Eds.).

Anderson, D., and Russel, T. (1995)
The Status of Alternative Methods in Toxicology
Royal Society of Chemistry, Cambridge, UK

Covers cytotoxicity testing and other *in vitro* methods for evaluating acute toxicity, eye and skin irritation, target organ toxicity, target system toxicity, and dermal absorption. A general discussion of structure–activity relationships and the application of this approach to various toxicological end points is included.

Arnold, D. L., *et al.* (Eds.) (1990)
Handbook of in Vivo Toxicity Testing
Academic Press, San Diego

Outlines broad objectives of toxicity testing and general considerations in protocol development. Attention is paid to the selection and quality control aspects of the test species. Acute, subchronic, and chronic study principles are covered in which the test agent is administered orally, dermally, or by inhalation. Developmental toxicity testing, pharmacokinetic disposition of test chemicals, behavioral toxicity, and immunotoxicity are also covered.

Bailer, J., *et al.* (1998)
Statistics for Environmental Biology and Toxicology
Chapman & Hall, London

Presents and illustrates statistical methods appropriate for the analysis of environmental data obtained in biological or toxicological experiments. Begins with basic probability and statistical inferences and progresses through nonlinear and generalized linear models, trend testing, time-to-event data, and analysis of cross-classified tabular and categorical data. Includes examples and exercises.

Balls, M., Bridges, J., and Southee, J. (Eds.) (1991)
Animals and Alternatives in Toxicology: Present Status and Future Prospects
VCH, New York

For toxicologists to examine their current procedures using animals to compare with possible alternative methods. Chapters include testing for acute oral effects, skin and eye irritation, chronic toxicity, genotoxicity, neurotoxicity, immunotoxicity, reproductive toxicity, and ecotoxicity.

Barile, F. A. (1994)
Introduction to in Vitro Cytotoxicology: Mechanisms and Methods
CRC Press, Boca Raton, FL

Introduces *in vitro* cytotoxicology to toxicologists and other professionals. These general tests are often empirically based quantitative tests of cell injury due to a host of various undefined mechanisms. Prevailing mechanisms which underlie *in vitro* cytotoxicology and cellular toxicity are presented in 12 chapters.

Bonifacino, J. S., Dasso, M., and Lippincott-Schwartz, J. (Eds.) (1998)
Current Protocols in Cell Biology
Wiley, New York

Provides investigators with both the basic methods, such as cell culturing, and the most cutting-edge techniques such as green fluorescent protein-based methods. The manual will become a standard reference for all researchers who need to understand the relationship between specific genes and molecules and their location, function, and structure at the cellular level.

Brown, V. K. (1980)
Acute Toxicity in Theory and Practice
Wiley, Chichester, UK

Based primarily on experience and examples from chemical pesticides, this remains a major reference in

the area of acute toxicity testing. The author carefully blends theory and examples to make the desired toxicologic points. The structure of this concisely written book includes reasons for needing the information, responses to be measured, test models for generating these answers, dose and dosage to be considered, and the overall perspective of acute toxicity in the total safety evaluation. From a how-to-do-it point of view, this book remains a valuable resource.

Castell, J. V., and Comez-Lechon, M. J. (1997)
In Vitro Methods in Pharmaceutical Research
Academic Press, San Diego

Composed of five parts containing chapters on general aspects of *in vitro* testing, *in vitro* models of target organs, *in vitro* testing of irritancy, *in vitro* testing of teratogenicity and genotoxicity, and drug metabolism.

Chanda, V. (Ed.) (1996)
Current Protocols in Protein Science
Wiley, New York

Developed in response to revitalized interest in the power of protein. It provides a comprehensive and practical compilation of protein methods available. Coverage includes procedures for the expression, characterization, and purification of recombinant proteins and posttranslational modification and structural characterization.

Chen, F., and Schuurmann, G. (Eds.) (1997)
Quantitative Structure–Activity Relationships in Environmental Sciences—VII
SETAC, Pensacola, FL

Presents information on recent developments relating to QSAR in environmental chemistry and toxicology. The first section covers molecular modeling and computerization techniques, the next discusses QSAR applications for chemicals regarding physicochemical properties. Applications to acute toxicity and mutagenicity are then presented and model statistical validation is discussed. SETAC will publish *Quantitative Structure–Activity Relationships and Endocrine Disruption* in 1999.

Chow, S. C., and Liu, J. P. (Eds.) (1998)
Design and Analysis of Animal Studies in Pharmaceutical Development
Dekker, New York

Provides comprehensive and unified presentations of statistical designs and analyses of important applications in biostatistics. The sections include design principles for studies on pharmaceutical development, interval estimates for median dosages, principles for randomization, subchronic toxicity test statistics, and proof of safety versus hazard in safety assessment.

Devillers, J. (Ed.) (1998)
Comparative QSAR
Taylor & Francis, Bristol, PA

Highlights the multifaceted aspect of the term comparative QSAR by bringing together experts to offer their views. The biologies covered in this text include fish bioconcentration, mutagenicity, transdermal penetration, odors, key enzyme systems, and a concluding section on generalized approaches.

Ecobichon, D. J. (1998)
The Basis of Toxicity Testing, 2nd ed.
CRC Press, Boca Raton, FL

Includes the principles and concepts behind various types of *in vivo* and *in vitro* toxicological studies; the design, conduct, and interpreteation of studies; the latest developments in alternatives to animal studies; the types of studies required by regulatory agencies; and sections on various risk assessment-related topics.

European Chemical Industry Ecology and Toxicology Centre (ECETOC) (1985)
Monograph No. 6: Acute Toxicity Tests, LD50 (LC50) Determinations and Alternatives
ECETOC, Brussels

Examines the use of animals in assessing the acute toxicity of chemicals. It includes the OECD requirements for acute testing as well as suggested alternative protocols.

European Chemical Industry Ecology and Toxicology Centre (ECETOC) (1986)
Monograph No. 8: Structure–Activity Relationships in Toxicology and Ecotoxicology: An Assessment
ECETOC, Brussels

A critical assessment of QSARs (qualitative or quantitative structure–activity relationships) that are used in predicting the toxicity and ecotoxicity of chemicals. It includes a description of the components of a QSAR, the techniques for establishing QSARs, and an analysis and discussion of QSARs.

European Chemical Industry Ecology and Toxicology Centre (ECETOC) (1990)
Technical Report No. 38: A Guide to the Classification of Preparations Containing Carcinogens, Mutagens and Teratogens
ECETOC, Brussels

Describes a mechanism for determining the ''specific concentration limits'' which should be applied to carcinogenic, mutagenic, and teratogenic substances

in determining the classification of preparations; outlines indicative criteria for the choice of limits; and recommends that toxicological test data on preparations should be allowed to contribute to this classification.

Evans, E. O. (1996)
Animal Clinical Chemistry: A Primer for Toxicologists
Taylor & Francis, London

Provides background information on the selection and application of biochemical tests in safety assessment studies. Covers specific organ toxicity, preanalytical variables, regulatory requirements, and statistical approaches.

Foran, J. A. (Ed.) (1997)
Principles for the Selection of Doses in Chronic Rodent Bioassays
ILSI Press, Washington, DC

Analyzes existing dose selection procedures in regulatory arenas and presents a series of case studies. The principles for dose selection represent a consensus of 30 scientists and regulators.

Frazier, J. M. (Ed.) (1992)
In Vitro Toxicity Testing
Dekker, New York

Reviews the status of *in vitro* toxicity testing methods in the context of chemical safety evaluation. The focus is to put *in vitro* testing in the proper perspective. The following are the basic questions asked (and to some extent answered): What are the responses that need to be evaluated? What current systems are available? and What are the technology limitations?

Freshney, R. I. (Ed.) (1992)
Culture of Epithelial Cells
Wiley–Liss, New York

Designed as a practical source for laboratory practitioners. This book presents proven methods that have been refined by established investigators. The text includes discussion of the culture environment conditions most suitable for the survival and growth of particular cells of interest and stepwise culture procedures in an easy to use format.

Freshney, R. I. (1993)
Culture of Animal Cells, 3rd ed.
Wiley–Liss, New York

Provides an accessible, comprehensive synthesis of proven methods for the culture and experimental manipulation of animal cells. The text includes step-by-step laboratory procedures, detailed reagent preparation, and the latest information on equipment and supplies. New technologies covered include DNA fingerprinting, fluorescent *in situ* hybridization, and chromosome painting.

Gad, S. C. (Ed.) (1988)
Product Safety Evaluation Handbook
Dekker, New York

Presents details of the procedures involved in product safety testing. The sections developed include the design of the appropriate experiment(s), the conduct of the study, and the scientific and administrative details needed to accomplish the study. Specific endpoint biologies or target tissues, such as the sensory, immune, respiratory, and reproductive systems, and methods for determining the impact of specific agents are covered. This book is a good hands-on guide with practice, not theory, in mind.

Gad, S. C. (1998)
Statistics and Experimental Design for Toxicologists, 3rd ed.
CRC Press, Boca Raton, FL

Completely updated with new chapters on trend analysis and risk assessment and epidemiology. The book provides revised sections on analysis of covariance with new examples. Instruction provided on SAS software.

Gad, S. C., and Chengelis, C. P. (Eds.) (1992)
Animal Models in Toxicology
Dekker, New York

The goal of this book is to provide a single-source reference for the use of animal models in toxicology. For each of eight animal species commonly used in laboratory settings, the toxicology, pathology, and metabolism is reviewed. Obvious emphasis is placed on the use of the species as a model to predict the appropriate human biology. Associated areas such as alternatives to animals in testing programs, modeling and scaling, and regulatory considerations are also discussed in separate sections.

Gad, S. C., and Chengelis, C. P. (1998)
Acute Toxicology Testing, 2nd ed.
Academic Press, San Diego

This completely revised edition of a classic text offers a broad-ranging look at testing in areas such as dermal and ocular irritation, dermal sensitization, lethality, systemic acute toxicity testing, routes, formulations, and vehicles and considerations specific to animal test models, statistical analysis, and acute inhalation.

Gad, S. C., and Taulbee, S. (1996)
Handbook of Data Recording, Maintenance, and Management for the Biomedical Sciences
CRC Press, Boca Raton, FL

Explains how to maintain a scientific log that will withstand peer, federal, and other reviewing agencies' scrutiny. It covers data monitoring, recording, and maintenance; quality assurance; and printed forms and the laws and regulations that impact their design and use.

Gad, S., and Weil, C. S. (1986)
Statistics and Experimental Design for Toxicologists
Telford, Caldwell, NJ

Designed as a source and textbook for both practicing and student toxicologists with the central objective of equipping them for regular statistical analysis of experimental data. The sections develop basic principles, present actual techniques, review possible data analysis applications, and discuss current areas needing research. The careful reader should be able not only to put the information to practice but also to critically review statistical applications such that misuse can be minimized.

Gralla, E. J. (1981)
Scientific Considerations in Monitoring and Evaluating Toxicological Research
Hemisphere, Washington, DC

Serves as a sentinel reference in the area of toxicologic testing. The book looks beyond the regulatory requirements of Good Laboratory Practice to the scientific considerations that need to characterize the conduct, supervision, monitoring, and evaluation of toxicology testing. A total of 12 chapters are presented which focus on the quality assurance aspects of a wide variety of toxicologic testing programs.

Greaves, P. (1990)
Histopathology of Preclinical Toxicity Studies
Elsevier, Amsterdam

Describes histopathological changes which relate to toxicity testing of therapeutic agents in the usual test species—the rat, mouse, dog, and nonhuman primate. Particularly useful are the discussions which concern the relevance of the specific lesions to drug safety evaluation.

Grice, H. C. (1984)
Interpretation and Extrapolation of Chemical and Biological Carcinogenicity Data to Establish Human Safety Standards; The Use of Short-Term Tests for Mutagenicity and Carcinogenicity in Chemical Hazard Evaluation
Springer-Verlag, New York

Provides an accurate snap-shot of the state-of-the-art chronic and short-term tests, pharmacokinetics, synergism and antagonism, and mechanism of action, and establishing human exposure guidelines. The second volume reviews development of test strategies, batteries of short-term tests, and approaches to the interpretation of short-term test results. Although old, the information presented applies today.

Grice, H. C. (1984)
The Selection of Doses in Chronic Toxicity/Carcinogenicity Studies; Age-Associated (Geriatric) Pathology: Its Impact on Long-Term Toxicity Studies
Springer-Verlag, New York

Practical orientation for information relating to factors involved in dose selection, principles for dose selection, and recommendations for future research in dose selection, factors related to the aging process, age-associated diseases, duration of long-term studies, and areas in need of future research for age-associated studies.

Grothe, D. R., Dickson, K. L., and Reed-Judkins, D. K. (Eds.) (1996)
Whole Effluent Toxicity Testing: An Evaluation of Methods and Prediction of Receiving System Impacts
SETAC, Pensacola, FL

Presents current assessments of the end points used in whole effluent toxicity (WET) testing, including routine methods, degree and causes of WET test method variability, biotic and abiotic factors that can influence measured field responses to effluents, and relationships among effluent toxicity, ambient toxicity, and receiving system impacts.

Hart, R. W., Neumann, D., and Robertson, R. (Eds.) (1995)
Dietary Restriction: Implications for the Design and Interpretation of Toxicity and Carcinogenicity
ILSI Press, Washington, DC

Examines the current state of scientific research on dietary restriction as it applies to toxicity testing. The book includes discussions on animal metabolism, physiology, health, genetics, and pathology. The contributors identify and address fundamental biological questions about the feasibility and practical implications of dietary restriction during long-term toxicity and carcinogenicity studies for safety assessment.

Jolles, G., and Cordier, A. (1992)
In Vitro Methods in Toxicology
Academic Press, London

This book resulted from an international meeting on the proper uses of *in vitro* technology. It provides a rational assessment of the current potential of the alternatives to animal experimentation. After an extensive introductory section, a pragmatic summary of the ex-

isting techniques and methods currently used and relating to the most important target organs is presented. This book provides a technical overview and attempts to define the border between *in vitro* and whole animal needs.

Krewski, D., and Franklin, C. (Eds.) (1991)
Statistics in Toxicology
Gordon & Breach, New York

Provides a reasonably comprehensive treatment of statistical methods for many of the toxicological tests currently in use. With the practicing toxicologist in mind, the emphasis is on statistical methods taking into account features of the data derived from particular studies. Main topic areas include acute and subacute toxicology, pharmacokinetics, and genetic, developmental, behavioral, and chronic toxicity which cover most of the toxicologic tests being employed in safety evaluation.

Liansky, S., *et al.* (1996)
Alternatives to Animal Testing
CPL Press, Newbury, UK

Contains the proceedings of a 1995 conference organized by the European Cosmetic, Toiletry and Perfumery Association (COLIPA). Includes the text of keynote addresses, round-table discussions, and other presentations.

Lloyd, E. W. (Ed.) (1986)
Safety Evaluation of Drugs and Chemicals
Hemisphere, Washington, DC

Provides a thorough compilation of basic toxicological considerations, testing procedures, and interpretation of safety tests. Chapters include toxicokinetics, species-specific toxicoses, animal studies, dosing laboratory animals, screening approaches for acute and subacute studies, microbial and mammalian cell systems for detecting mutagens, whole animal systems for detecting mutations, carcinogenicity testing, skin and eye toxicity testing, and data management systems for complying with good laboratory procedures.

Maines, M. (Ed.) (1998)
Current Protocols in Toxicology
Wiley, New York

Provides step-by-step laboratory procedures for the assessment of toxicity at the level of whole organisms, organs and tissues, cells, and biochemical pathways. It covers a broad range of techniques from the disciplines of molecular biology, cell biology, biochemistry, and genetics, highlighting both standard and sophisticated toxicological procedures.

Mehlman, M. A. (Ed.) (1989)
Benchmarks: Alternative Methods in Toxicology
Princeton Scientific, Princeton, NJ

Presents alternative methods for toxicology that replace the use of animals, reduce the number of animals used, or refine the existing procedures.

National Research Council (1977)
Principles and Procedures for Evaluating the Toxicity of Household Substances: A Report Prepared by the Committee for the Revision of NAS Publication 1138
National Academy of Sciences, Washington, DC

Updates an earlier report, incorporates the methodological advancements in toxicology, and expands the area of interest from acute to chronic effects. Focuses on methology for assessment of toxicity of chemicals used in the household.

National Research Council (1988)
Complex Mixtures: Methods for in Vivo Toxicity Testing
National Academic Press, Washington, DC

This publication, representing work of a scientific committee convened by the National Institute of Environmental Health Sciences, covers the difficult topic of toxicity testing. The committee recommended that new methods needed to be developed since those currently available were too limited. The main sections include analyzing human exposure to mixtures, testing strategies and methods, sampling and chemical characterization, and interpretation and modeling of toxicity test results.

Nohynek, G. J. (Ed.) (1996)
Presenting Toxicology Results: How to Evaluate Data and Write Reports
Taylor & Francis, Washington, DC

Designed for technical writers from the amateur to the professional. The 13 chapters are written in an easy to follow style. The structure of toxicological reports, issues regarding regulatory matters, as well as suggestions for writing clinical and anatomic pathology reports are covered.

O'Hare, S., and Atterwill, C. K. (1995)
In Vitro Toxicity Testing Protocols
Humana Press, Totowa, NJ

Discusses *in vitro* toxicity testing and validation criteria. Chapters cover target organ toxicity, general and topical toxicity, irritancy testing, immunotoxicity, carcinogenesis, and submammalian and subvertebrate models.

Organisation for Economic Co-Operation and Development (OECD) (1993)
OECD Guidelines for Testing of Chemicals, 2 vols.
OECD, Paris

Reports on formulated procedures for the laboratory testing of a property or effect deemed important for the evaluation of health and environmental hazards of a chemical. It includes all the essential elements which, assuming good laboratory practice, should enable an operator to carry out the required test.

Paget, G. E. (1977)
Quality Control in Toxicology
University Park Press, Baltimore

Deals with regulatory criteria, quality control systems in industrial laboratories and settings, experimental design, and quality in contract laboratories.

Paget, G. E., and Thomson, R. (1979)
Standard Operating Procedures in Toxicology
MTP Press, Lancaster, UK

A valuable resource to those practicing in the field of toxicology. Standard operating procedures for the multiplicity of functions that need to be performed in a standard toxicology test are outlined in detail. Included in the book are procedures for record keeping, test substances, general toxicology, rodent-specific handling procedures, etc. and the A to Z of experimental use of rabbits, dogs, and primates.

Reinhardt, C. A. (Ed.) (1994)
Alternatives to Animal Testing: New Ways in the Biomedical Sciences, Trends and Progress
Weinheim, New York

Presents papers from a symposium which examined refining, replacing, and reducing the number of animals used in safety evaluation testing. The 20 chapters included give the reader the basis for the concern, programs that have made progress and those that have not, and regulatory comments on the use of this data.

Robinson, J. P. (Ed.) (1997)
Current Protocols in Cytometry
Wiley, New York

Represents the combined efforts of leading cytometry laboratories from around the world to provide the reader with carefully prepared, clearly presented, and finely tuned methods in the fields of flow and image cytometry. It covers the complete range of techniques employed in flow cytometry from instrumentation to interpretation, from fluorescence to antigen density, and from research to clinical applications. Microscopy and image analysis are also covered extensively, from in-depth descriptions of objectives to commentaries on image interpretation, confocal microscopy, and illumination sources.

Rogiers, V., Sonck, W., Shephard, E., and Vercruysse, A. (Eds.) (1993)
Human Cells in in Vitro Pharmaco-Toxicology: Present Status within Europe
Vubpress, Brussels

Presents the information currently available on the use of *in vitro* techniques to predict *in vivo* responses. A series of 20 papers examine various end points and try to develop correlated between whole animal and cell/tissue/organ culture results. An interesting group of papers discuss the use and interpretation of data developed from human tissues.

Salem, H., and Katz, S. (Eds.) (1997)
Advances in Animal Alternatives for Safety and Efficacy Testing
Taylor & Francis, Washington, DC

Addresses some of the important ramifications of the National Institutes of Health (NIH) Revitalization Act of 1993 which instructs the NIH to fund Replacement, Reduction, and Refinement alternatives. In addition, it addresses the ramifications of the European Union's Cosmetic Directive, which bans marketing of animal-tested cosmetics in Europe after 1997 if alternatives are available. Nearly 50 contributions from over 150 international experts are grouped into five categories: dermal toxicity, developmental toxicity, immunotoxicity, neurotoxicity, and oral/dermal/ocular validation.

Sword, I. P., and Thomson, R. (1980)
Standard Operating Procedures in Vitro Toxicology
University Park Press, Baltimore

Presents in great detail the how-to's of *in vitro* toxicology testing. In particular, this blends international efforts to standardize testing and testing methodologies so that meaningful data comparisons can be made. Areas covered in this book include analytical chemistry, genetic testing, and cell culture testing for both cytotoxicity and genotoxicity.

Tyson, C. A., and Witschi, H. (Eds.) (1991–1994)
Methods in Toxicology **series**
Academic Press, San Diego

This series presents updates of specific techniques to be used in various toxicologic fields. To date, the series includes:

Vol. 1A, *In Vitro Biological Systems*
Vol. 1B, *In Vitro Toxicity Indicators*

Vol. 2, *Mitochondrial Dysfunction*
Vol. 3A, *Male Reproductive Toxicology*
Vol. 3B, *Female Reproductive Toxicology*

Watson, R. R. (Ed.) (1992)
In Vitro Methods of Toxicology
CRC Press, Boca Raton, FL

Reviews the myriad of alternative techniques being suggested for replacement of traditional animal studies. The various chapters present the current state of affairs with a look to validation and approval of these test methods in the future.

Witschi, H. P. (Ed.) (1980)
The Scientific Basis of Toxicity Assessment *(Developments in Toxicology and Environmental Science*, Vol. 6)
Elsevier/North Holland, New York

Examines how to detect and how to predict untoward interactions of chemicals with living systems. It covers how to best use the information that is generated in experiments with animals to predict hazard for man, and what can be learned from radiation biology.

Yocom, J. E., and McCarthy, S. M. (1991)
Techniques for Measuring Indoor Air Quality
Wiley, New York

Serves as a practical guide on how to design an indoor air quality monitoring program, describes various techniques for a number of pollutants, and presents methods for measurement. The theory of air infiltration and the practice of ventilation rates are discussed. A summary of international regulations and guidelines covering IAQ is included as well as an extensive summary of original research on the topic.

Zurlo, J., Rudacille, D., and Goldberg, A. M. (1994)
Animals and Alternatives in Testing
Liebert, New York

Addresses the use of animals in toxicity testing and the scientific status of alternatives. It advocates replacement, reduction, and refinement to existing whole animal procedures, and reviews legal requirements for animal testing.

See Also:
Section on Animals in Research

Section on Regulatory Toxicology

Baselt: *Biological Monitoring Methods for Industrial Chemicals*, 2nd ed. (Biomonitoring/Biomarkers)

Benson: *Handbook of Good Laboratory Practice* (Regulatory Toxicology)

Bisesi and Kohn: *Industrial Hygiene Evaluation Methods* (Occupational Health)

Bitton and Dutka: *Toxicology Testing Using Microorganisms*, Vols. 1 and 2 (Environmental—Aquatic)

Burleson *et al: Methods in Immunotoxicology* (Target Sites—Immune)

Brusick: *Methods for Genetic Risk Assessment* (Genetic Toxicology)

Cairns: *Ecological Toxicity Testing* (Environmental Toxicology—General)

Coligan: *Current Protocols in Immunology* (Target Sites—Immune System)

Covello and Merkhofer: *Risk Assessment Methods: Approaches for Assessing Health and Environmental Risks* (Risk Assessments)

Crawley: *Current Protocols in Neuroscience* (Target Sites—Nervous System)

Dean: *Basic Mutagenicity Tests: UKEMS Recommended Procedures* (Genetic Toxicology)

Dracopoli: *Current Protocols in Human Gentics* (Genetic Toxicology)

ECETOC: *Monograph No. 7: Recommendations for the Harmonization of International Guidelines for Toxicity Studies* (Regulatory Toxicology)

ECETOC: *Monograph No. 11: Eye Irritation Testing* (Target Sites—Sensory)

ECETOC: *Monograph No. 12: Alternative Apporaches for the Assessment of Reproductive Toxicity* (Developmental and Reproductive Toxicology)

ECETOC: *Monograph No. 14: Skin Sensitization Testing* (Target Sites—Skin)

ECETOC: *Monograph No. 18: Evaluation of the Neurotoxic Potential of Chemicals* (Target Sites—Nervous System)

ECETOC: *Monograph No. 21: Immunotoxicity* (Target Sites—Immune)

ECETOC: *Monograph No. 22: Evaluation of Chemicals for Oculotoxicity* (Target Sites—Sensory)

Frazier: *A Critical Evaluation of Alternatives to Acute Ocular Irritation Testing* (Target Sites—Sensory)

Grice: *Current Issues in Toxicology* (General History and General)

Hayes: *Principles and Methods of Toxicology*, 3rd ed. (General History and General)

Heindel and Chapin: *Female Reproductive Toxicology* (*Methods in Toxicology*, Vol. 3B) (Target Sites—Reproductive)

Hill: *Freshwater Field Tests for Hazard Assessment of Chemicals* (Environmental—Aquatic)

Hobson: *Dermal and Ocular Toxicology* (Target Sites—Sensory)

Kilbey *et al: Handbook of Mutagenicity Test Procedures* (Genetic Toxicology)

Kimmel and Kochhar: *In Vitro Methods in Developmental Toxicology* (Developmental Toxicology)

Kirkland: *Supplementary Mutagenicity Tests* (Genetic Toxicology)

Levy and Herrington: *Non-Isotopic Methods in Molecular Biology* (Molecular, Cellular, and Biochemical Toxicology)

Loprieno: *Alternative Methodologies for the Safety Evaluation of Chemicals in the Cosmetic Industry* (Chemicals—Cosmetics and Other Consumer Products)

Ness: *Surface and Dermal Monitoring for Toxic Exposures* (Target Sites—Skin)

Newman: *Quantitative Methods in Aquatic Ecotoxicology* (Environmental—Aquatic)

Pentreath: *Experimental in Vitro Neurotoxicology* (Target Sites—Nervous System)

Rogiers: *Human Cells in Vitro Pharmco-Toxicology* (Molecular, Cellular, and Biochemical Toxicology)

Schmauder: *Methods in Biotechnology* (Biotechnology/Biomarkers)

Schweizer: *Methods in Biotechnology* (Biotechnology/Biomarkers)

Tardiff *et al: Methods to Assess DNA Damage and Repair: Interspecies Comparisons* (Genetic Toxicology)

Thomas: *Endocrine Methods* (Target Sites—Endocrine)

Trower: *In Vitro Mutagenesis Protocols* (Genetic Toxicology)

Tyson and Frazier: *In Vitro Biological Systems* (*Methods in Toxicology* Vols. 1A and 1B) (Molecular, Cellular, and Biochemical Toxicology)

Tyson and Frazier: *In Vitro Biological Systems* (*Methods in Toxicology* Vol. 1B) (Molecular, Cellular, Biochemical Toxicology)

Wells: *Microscale Testing in Aquatic Toxicology* (Environmental Toxicology—Aquatic)

Willeke: *Aerosol Measurement* (Target Sites—Respiratory System)

Wu: *Recombinant DNA Methodology II* (Molecular Toxicology)

Zalups and Lash: *Methods in Renal Toxicology* (Target Sites—Kidney)

Zbinder: *The Brain in Bits and Pieces* (Target Sites—Nervous System)

Journals

ATLA, Alternatives to Laboratory Animals

***In Vitro* Toxicology**

Journal of Pharmacological and Toxicological Methods

Toxicology *in Vitro*

Toxicology Methods

Journal Articles

Balls, M. (1998). Mechanistic approaches and the development of alternative toxicity test methods. ***Environ. Health Perspect.* 106** (Suppl. 2), 453–457.

Beatty, D. A., and Piegorsch, W. W. (1997). Optimal statistical design for toxicokinetic studies. ***Stat. Meth. Med. Res.* 6,** 359–376.

Benfenati, E., and Gini, G. (1997). Computational predictive programs (expert systems) in toxicology. ***Toxicology* 119**(3), 213–225.

Bidey, S. P. (1995). Thyroid follicular cells in monolayer culture. *In vitro* models for thyroid toxicity testing. ***Methods Mol. Biol.* 43,** 33–42.

Brack, W., and Rottler, H. (1994). Toxicity testing of highly volatile chemicals with green algae: A new assay. ***Environ. Sci. Pollut. Res. Inter.* 1,** 223–228.

Bruner, L. H., *et al.* (1998). Validation of alternative methods for toxicity testing. ***Environ. Health Perspect.* 106** (Suppl. 2), 477–484.

Bucher, J. R., *et al.* (1996). National Toxicology Program studies: Principles of dose selection and applications to mechanistic based risk assessment. ***Fundam. Appl. Toxicol.* 31,** 1–8.

Burchiel, S. W., *et al.* (1997). Assessment of immunotoxicity by multiparameter flow cytometry. ***Toxicol. Appl. Pharmacol.* 38,** 38–54.

Campanella, L., *et al.* (1995). Immobilised yeast cells biosensor for total toxicity testing. ***Sci. Total Environ.* 171,** 227–234.

Davila, J. C., Rodriguez, R. J., Melchert, R. B., and Acosta, D., Jr. (1998). Predictive value of in vitro

model systems in toxicology. ***Annu. Rev. Pharmacol. Toxicol.* 38,** 63–96.

Dayan, A. D. (1996). Transgenic rodents in toxicology. ***Int. J. Exp. Pathol.* 77**(6), 251–256.

El-Masri, H. A., Reardon, K. F., and Yang, R. S. H. (1997). Integrated approaches for the analysis of toxicologic interactions of chemical mixtures. ***Crit. Rev. Toxicol.* 27,** 175–197.

Green, S. (1994). Progress of various U. S. regulatory agencies in reviewing alternative test methods. ***J. Toxicol. Cutaneous Ocular Toxicol.* 13,** 339–343.

Guengerich, F. P., Gillam, E. M. J., and Shimada, T. (1995). New applications of bacterial systems in problems in toxicology. ***Crit. Rev. Toxicol.* 26,** 551–583.

Guengerich, F. P., *et al.* (1996). New applications of bacterial systems to problems in toxicology. ***Crit. Rev. Toxicol.* 26,** 551–592.

Hamada, C., *et al.* (1998). Tree-type algorithm for statistical analysis in chronic toxicity studies. ***J. Toxicol. Sci.* 23,** 173–181.

Hansch, C., *et al.* (1995). Comparative QSAR in toxicology: Examples from teratology and cancer chemotherapy of aniline mustards. ***Crit. Rev. Toxicol.* 25,** 67–90.

Hart, R. W., *et al.* (1996). The effects of dietary restriction on drug testing and toxicity. ***Exp. Toxicol. Pathol.* 48**(2/3), 121–127.

Hashimoto, M. (1996). Current issues with regard to single dose toxicity studies. ***J. Toxicol. Sci.* 21**(5), 417–420.

Hasspieler, B. M., *et al.* (1996). In vitro toxicological methods for environmental health testing. ***Rev. Environ. Health* 11**(4), 213–227.

Hisham, A. E., Reardon, K. F., and Yang, R. S. H. (1997). Integrated approaches for the analysis of toxicologic interactions of chemical mixtures. ***Crit. Rev. Toxicol.* 27,** 175–198.

Horbach, G. J. M. J., and DeGroene, E. M. (1995). Transgenic cell lines and changes in gene function and expression: Useful tools in toxicity testing? ***Toxicol. in Vitro* 9,** 509–512.

Huggett, A. C., *et al.* (1996). Comparative method of toxicity testing. ***Food Chem. Toxicol.* 34,** 183–192.

Igarashi, T. (1998). Recent progress of the international harmonization of toxicological testing: Impact and implementation of ICH guidelines. International Conference Harmonization. ***J. Toxicol. Sci.* 23** (Suppl. 2), 255–257.

Janusch, A., *et al.* (1997). Current status and future developments of databases on alternative methods. The report and recommendations of ECVAM Workshop 25. ***ATLA* (*Alternatives to Laboratory Animals*) 25,** 411–422.

Kappus, H., and Yang, R. S. (1996). Toxicity testing of chemical mixtures: Some general aspects and need of international guidelines. ***Food Chem. Toxicol.* 34**(11/12), 1173–1174.

Kim, B. S., and Margolin, B. H. (1999). Statistical methods for the Ames Salmonella assay: A review. ***Mut. Res.* 436,** 113–122.

Lilius, H., *et al.* (1995). The use of freshly isolated gill epithelial cells in toxicity testing. ***Toxicol. in Vitro* 9,** 299–305.

MacGregor, J. T., *et al.* (1995). New molecular endpoints and methods for routine toxicity testing. ***Fundam. Appl. Pharmacol.* 26,** 156–173.

Meulenbelt, J., *et al.* (1998). Healthy volunteer studies in toxicology. ***Toxicol. Lett.* 103,** 35–39.

Morton, D. M. (1998). Importance of species selection in drug toxicity testing. ***Toxicol. Lett.* 102–103,** 545–550.

Munro, I. C., *et al.* (1996). Alternative approaches to the safety assessment of macronutrient substitutes. ***Regul. Toxicol. Pharmacol.* 23,** S6–S14.

Ohno, Y. (1998). Recent progress of the international harmonization of toxicological testing: toxicokinetics. ***J. Toxicol. Sci.* 23** (Suppl. 2), 265–267.

Potera, C. (1997). Tracking toxicants. ***Environ. Health Perspect.* 105,** 48–50.

Purchase, I. F., Botham, P. A., Bruner, L. H., Flint, O. P., Frazier, J. M., and Stokes, W. S. (1998). Workshop overview: Scientific and regulatory challenges for the reduction, refinement, and replacement of animals in toxicity testing. ***Toxicol. Sci.* 43**(2), 86–101.

Ryffel, B. (1997). Impact of knockout mice in toxicology. ***Crit. Rev. Toxicol.* 27,** 135–154.

Schoen, E. D. (1996). Statistical designs in combination toxicology: A matter of choice. ***Food Chem. Toxicol.* 34**(11/12), 1059–1065.

Walker, R. (1998). Toxicity testing and derivation of the ADI. ***Food Additives Contam.* 15** (Suppl.), 11–16.

Wilson, A. G., *et al.* (1994). A tiered approach to pharmacokinetic studies. ***Environ. Health Perspect.* 102,** 5–11.

Zeiger, E., and Stokes, W. S. (1998, February). Validating new toxicology tests for regulatory acceptance. ***Regul. Toxicol. Pharmacol.*** **27**(1, Pt. 1), 32–37.

VETERINARY TOXICOLOGY

Adams, H. R. (Ed.) (1995)
Veterinary Pharmacology and Therapeutics, 7th ed.
Iowa State Univ. Press, Ames

Provides a comprehensive resource on the basic and applied principles of veterinary pharmacology and therapeutics. Focuses on basic mechanisms of representative drugs from the important classes of therapeutic agents. Emphasizes pharmacodynamics and pharmacokinetics as well as their clinical application.

Brander, G. C., Pugh, D. M., Bywater, R. J., and Jenkins, W. L. (1991)
Veterinary Applied Pharmacology and Therapeutics, 5th ed.
Bailliere Tindall, Philadelphia

Provides the student of veterinary medicine with a comprehensive but succinct background to pharmacology and therapeutics. The main sections include the principles of pharmacology; drugs used in the modification of cell, tissue, organ, and system function; drugs used in the control of infectious diseases; and the essentials of pharmacy in veterinary practice.

Craigmill, A. L., Sundlof, S. F., and Riviere, J. E. (Eds.) (1994)
Handbook of Comparative Pharmacokinetics and Residues of Veterinary Therapeutic Drugs
CRC Press, Boca Raton, FL

Data are presented on antimicrobial drugs, therapeutic agents, pesticides, growth promoters, and environmental contaminants. Information includes physicochemical constants and chemical structures, legal tissue tolerances, and pharmacokinetic parameters derived from the literature analysis.

Fowler, M. E. (1993)
Veterinary Zootoxicology
CRC Press, Boca Raton, FL

Provides facts, techniques, methodologies, and regimens for the more effective clinical management of animals poisoned or envenomated by other animals.

Gfeller, R. W., and Messonnier, S. (1998)
Handbook of Small Animal Toxicology and Poisonings
Mosby, St. Louis

Provides ready access to information on all aspects of toxicoses and poisonings of dogs and cats.

Humphereys, D. (1988)
Veterinary Toxicology, 3rd ed.
Bailliere Tindall, Philadelphia

Compendium of information regarding agents used in veterinary practice. The agent groupings include minerals and inorganics, toxic gases and vapors, drugs, pesticides, poisonous plants, mycotoxins, venomous bites and stings, and radioactive materials.

Joint FAO/WHO Expert Committee on Food Additives
Residues of Some Veterinary Drugs in Animals and Foods: Monographs
Food and Agriculture Organization of the United Nations, Rome

Published periodically with the *FAO Food and Nutrition Paper* series. Summarizes the safety data on selected veterinary drug residues. Each monograph covers biological data of the drug, metabolism studies, and evaluations. Extensive bibliographies are included.

Joint FAO/WHO Expert Committee on Food Additives
Toxicological Evaluation of Certain Veterinary Drug Residues in Food
World Health Organization, Geneva

Published periodically within the *WHO Food Additives* series. Summarizes the safety data on selected veterinary drug residues. Each monograph covers biological data of the drug, toxicological studies, and evaluations. Extensive bibliographies are included.

Jones, T. C. (1997)
Veterinary Pathology, 6th ed.
Williams and Wilkins, Baltimore

A standard text in comparative pathology. The sixth edition introduces new information on immunopathology and pathogenesis, viral diseases, environmental toxins, parasitic diseases, and nutritional problems in domestic and captive animals.

Lorgue, G., *et al.* (1996)
Clinical Veterinary Toxicology
Blackwell, Oxford

English-language edition of an original French publication, providing succinct advice on the management of animal poisoning.

Messonnier, G. (1997)
Handbook of Small Animal Toxicology and Poisonings
Mosby, St. Louis

A portable handbook providing practitioners with ready access to information on all aspects of toxicoses and poisonings of dogs and cats, including patient assessment and management and details.

Moats, W. A., and Medina, M. B. (Eds.) (1996)
Veterinary Drug Residues
American Chemical Society, Washington, DC

Covers drug residues in animal tissues because they may be toxic in food products, they may produce pharmacologic effects in consumers, or they may cause allergic reactions in sensitive individuals. The book points out the need to adhere to prescribed dosages and withdrawal times and warns against the use of unauthorized materials. A total of 18 chapters develop the topic in detail.

Murphy, M. J. (1996)
A Field Guide to Common Animal Poisons
Iowa State Univ. Press, Ames

A quick reference for veterinary practitioners and students. Discusses the prevelance of animal exposure to toxins, and provides treatment regimens, toxin summaries, selected bibliographies, additional sources of information, and indices of toxins.

Osweiler, G. D. (1996)
Toxicology
Williams & Wilkins, Baltimore

Presents an outline for independent study for the practicing veterinarian. The basic sections include the general principles of toxicology, how toxicants affect major body systems at the clinical level, and specific agents. The format of this book makes it useful to general toxicologists as well.

Osweiler, G. D., Carson, T. L., Buck, W. B., and Van Gelder, G. A. (1985)
Clinical and Diagnositic Veterinary Toxicology, 3rd ed.
Kendall/Hunt, Dubuque, IA

Directed toward the veterinary student for the purpose of discussing clinical and diagnostic areas. Following the presentation of basic toxicologic concepts, metals, feed-related toxicants, industry-related toxicants, antibacterials, fungicides, herbicides, insecticides, toxic gases, household and commercial products, biotoxins, and plant-related toxins are discussed.

Plumb, D. C. (1995)
Veterinary Drug Handbook, 2nd ed.
Iowa State Univ. Press, Ames

A one-volume veterinary compendium including both drugs approved for veterinary species and nonapproved drugs routinely used. The book includes adverse effects, warnings, overdosage, acute toxicity, and drug reactions.

See Also
Section on Animals in Research

Chalmers: *Literature Review* (Environmental Toxicology—Hazardous Waste)

Cheeke: *Natural Toxicants in Feeds, Forages, and Poisonous Plants* (Biotoxins)

Cornelius: *Advances in Veterinary Science* (Miscellaneous)

Crawford: *Animal Drugs and Human Health* (Food and Nutrition)

Potter: *Epidermal Cellular Characteristics* (Biotoxins)

Journal

Veterinary and Human Toxicology

Journal Articles

Bertini, S., *et al.* (1995). Benzodiazepine poisoning in companion animals. ***Vet. Hum. Toxicol.*** **37**(6), 559–562.

Cornell, J., *et al.* (1995). Poisonous plant identification: A comparison of databases designed for veterinary use. ***Vet. Hum. Toxicol.*** **37**(5), 482–485.

Dohoo, I. R., *et al.* (1998). Veterinary research and human health. ***Can. Vet. J.*** **39,** 548–556.

Drobatz, K. J. (1994). Clinical approach to toxicities. ***Vet. Clin. North Am. Small Anim. Practice*** **24**(6), 1123–1138.

Galey, F. D. (1995). Diagnostic and forensic toxicology. ***Vet. Clin. North Am. Equine Practice*** **11**(3), 443–454.

Hungerford, L. L., *et al.* (1995). The potential utility of animal poisoning data to identify human exposure to environmental toxins. ***Vet. Hum. Toxicol.*** **37**(2), 158–162.

Mautino, M. (1997). Lead and zinc intoxication in zoological medicine: A review. ***J. Zool. Wildlife Med.*** **28,** 28–35.

Montforts, M. H., *et al.* (1999). The exposure assessment for veterinary medicinal products. ***Sci. Tot. Environ.*** **225,** 119–122.

Morgan, R. V. (1994). Lead poisoning in small companion animals: An update (1987–1992). ***Vet. Hum. Toxicol.*** **36,** 18–22.

Salkowski, A. A., and Penney, D. G. (1994). Cyanide poisoning in animals and humans: A review. ***Vet. Hum. Toxicol.*** **36**(5), 455–466.

Whitlock, R. H., and Buckley, C. (1997) Botulism. ***Vet. Clin. North Am. Equine Practice*** **13,** 107–128.

MISCELLANEOUS

Banbury Reports
Cold Spring Harbor Laboratory Press, Cold Spring Harbor, NY

A wide variety of reports related to toxicology, with an emphasis on carcinogenicity, have been published as part of this series.

Black, J. (1992)
Biological Performance of Materials, 2nd ed.
Dekker, New York

Focuses on the biocompatibility of materials. It covers the concept of biocompatibility and the effect of materials on biological systems. It emphasizes methods for determining biocompatibility and the qualification, standardization, and regulation of implant materials.

British Medical Association (1998)
Health and Environmental Impact Assessment: An Integrated Approach
Earthscan, London

Shows why we need to develop an integrated approach to health and environmental impact assessment of development projects and how they might be achieved. Numerous case studies and examples.

Calabrese, E. J. (1983)
Principles of Animal Extrapolation
Wiley, New York

Presents a comprehensive formulation of the biological basis of interspecies differences in susceptibility to toxic agents so that animal experimentation may offer predictions of human responses that are more accurate. The types of extrapolation discussed include those from average animal model to average human, from small animals to large ones, from high-risk animal to high-risk human, and from high-dose exposures to lower, more realistic ones. Although an older book, the principles and discussion make this a valuable resource.

Calabrese, E. J. (1991)
Multiple Chemical Interactions
Lewis, Chelsea, MI

Covers the multifaceted aspects of chemical interactions by first providing the conceptual basis for predicting responses to complex environmental mixtures. This is followed by documentation illustrating how these principles can be applied to make reasonable predictions in specific situations. The book is composed of major sections dealing with general principles, the biochemical basis of interaction conceptually, carcinogenesis and developmental effects, interactions by chemical classes (inorganics, organics, drugs, and pollutants), and regulatory perspectives.

Chambers, P. L., Chambers, C. M., Bolt, H. M., and Preziosi, P. (Eds.) (1992)
Toxicology from Discovery and Experimentation to the Human Perspective
Elsevier, New York

Contains the proceedings of the 6th International Congress of Toxicology in 1992. It contains plenary lectures, lectures from symposiums and workshops, and a variety of selected short communications. The contents are not organized by subject, and they appear to be a compilation of manuscripts submitted to the *Journal Toxicology Letters,* Vols. 64/65 (1992).

Cornelius, C. E., and Simpson, C. F. (Eds.) (1987)
Advances in Veterinary Science and Comparative Medicine: Volume 31, Experimental and Comparative Toxicology
Academic Press, New York

Focuses on carcinogenicity with particular emphasis on the liver. It also contains an overview of neurobehavioral toxicology, immunotoxicology, the endocrine system as a target organ, ocular toxicology, and the use of γ-glutamyltransferase in toxicology.

Duncan, W. A. M. (Ed.) (1973)
Toxicology: Review and Prospect
Excerpta Medica, Amsterdam

Contains information which establishes the basis for much of today's work in the field. This book was developed from a symposia sponsored by the European Society for the Study of Drug Toxicity. Included in this book are excellent sections on pharmacokinetics, reproduction, interrelation between experimental toxicology and clinical studies, mutagenicity, and the relationship between drug therapy and adverse effects. Particularly useful is the first chapter in each of the sections.

Fox, M. (1998)
Glossary for the Worldwide Transportation of Dangerous Goods
Lewis, Boca Raton, FL

Describes the regulations surrounding the shipping of dangerous goods around the world. Includes regulatory references.

Furst, A. (1996)
The Toxicologist as Expert Witness: A Hint Book for Courtroom Procedure
Taylor & Francis, Washington, DC

An easy to read guide that provides necessary information allowing a toxicologist to be the most effective witness possible. Based on the author's extensive experience as an expert witness, the book covers major and minor pretrial and posttrial issues.

Gad, S., and Anderson, R. C. (1990)
Combustion Toxicology
CRC Press, Boca Raton, FL

Covers the basics of inhalation toxicology and heat stress physiology, the toxicity of smoke and combustion gases, combustion toxicity testing, regulations concerning smoke toxicity, combustion toxicity of polymers by class, and influence of flame retardants and other additives.

Galli, C. L., Murphy, S. D., and Paoletti, R. (1980)
The Principles and Methods in Modern Toxicology: Proceedings of the International Course on the Principles and Methods in Modern Toxicology Held in Belgirate, Italy, October 22–26, 1979
Elsevier/North-Holland, New York

Course given in order to discuss state-of-the-art developments in the field of environmental toxicology in the Year 1979. The topics are general and include metabolism, principles of genetic toxicology, reproductive toxicology, teratology, testing for carcinogenicity, conduct of chronic studies, short-term tests for carcinogenicity, legislative action, pathology, and interactions between environmental pollutants.

Grice, H. C. (Ed.) (1984)
Current Issues in Toxicology
Springer-Verlag, New York

Deals with the development and refinement of methods and systems to evaluate the safety of chemicals. It encompasses two topics; the selection of doses in chronic toxicity/carcinogenicity studies and the impact of age-associated (geriatric) pathology on these systems.

Guzelain, P. S., Henry, C. J., and Olin, S. S. (1992)
Similarities and Differences between Children and Adults
ILSI Press, Washington, DC

Generated from a conference designed to explore responsiveness of children and adults to various agents and to explore similarities and differences. The book presents a characterization of similarities and differences, drug case studies, environmental case studies, pesticide case studies, and implications for risk assessment. In addition, multidisciplinary approaches and areas for future research are discussed.

INFORM Publications, (New York)

INFORM is a nonprofit environmental research and education organization that publishes a variety of documents that examine toxic release and other data and are of relevance to industry, government, and environmental groups. Among the publications are *Toxics Watch, Risks on Record,* and *Preventing Industrial Toxic Hazards.*

(1998)
Kirk-Othmer Encyclopedia of Chemical Technology, 4th ed.
Wiley, New York

This 27-volume encyclopedia features over 1000 articles in fields such as agriculture, biotechnology, materials science, chemical engineering, ecology and industrial hygiene, legal issues, and others of value to toxicologists and all scientists. Wiley is planning for an online version in 1999.

Matthews, B. L. (Ed.) (1998)
Defining Multiple Chemical Sensitivity
McFarland and Co., Jefferson, NC

Considers medical information, legal information, and the science and literature of this little-understood complex of disorders that is alarmingly real to the individuals suffering from it.

Meyer, E. (1989)
Chemistry of Hazardous Materials, 2nd ed.
Brand Regents/Prentice Hall, Englewood Cliffs, NJ

Prepared by primarily addressing the needs of firefighters and other professions concerned with handling hazardous materials. The book presents procedures whereby hazardous materials can be safely handled and stored. The book is divided into two sections—the first reviews elementary chemistry and the second deals with hazardous materials regulations with illustrative examples.

National Fire Protection Association (1997)
Fire Protection Guide to Hazardous Materials, 12th ed.
National Fire Protection Association Press, Quincy, MA

Provides essential information that can be used effectively during preplanning activities. It is useful in minimizing the effects of fires and other emergencies involving chemicals and aids firefighters in making plans for handling various types of chemical emergencies.

National Research Council (1990)
Tracking Toxic Substances at Industrial Facilities: Engineering Mass Balance versus Materials Accounting
National Academy Press, Washington, DC

In response to a congressional mandate, this book examines whether knowing the amounts of toxic substances entering and leaving manufacturing facilities is useful in evaluating chemical releases to the environment, waste reduction progress, and chemical management practices. Tracking of these substances with rigorous engineering data is compared with a less resource-intensive alternative to determine the feasibility and potential usefulness to the public and the government.

National Research Council, Institute of Medicine, Committee on Environmental Justice (1999)
Toward Environmental Justice: Research, Education, and Health Policy Needs
National Academy Press, Washington, DC

Highlighted with case studies from five locations where the committee traveled to hear citizen and researcher testimony. Considers all aspects of the situation, including identifying environmental hazards and assessing risk for populations of varying ethnic, social, and economic backgrounds and the need for methodologies that uniquely suit the populations at risk.

Reed, D. J. (Ed.) (1995)
Proceeding of the International Congress of Toxicology—VII
Elsevier, Amsterdam

Procedings from a symposium that presented a variety of important scientific papers covering all aspects of toxicology in an up-to-date manner. The chapters were peer-reviewed and provide good examples of current issues/work in research ranging from epidemiology to mechanistic research.

Scott, R. A., Jr. (Ed.) (1979)
Toxic Chemical and Explosives Facilities
American Chemical Society, Washington, DC

Volume 9 in the *ACS symposium* series. Addresses classification, measurement, and control of hazards in explosives and toxic chemical facilities in order to minimize the risk to employees. Practical examples are included on work practices, lighting and electrical requirements, and engineering controls for these laboratories.

Seiler, J. P. (Ed.) (1998)
Diversification in Toxicology: Man and Environment
Springer-Verlag, Berlin

Proceedings of the 1997 Eurotox Congress Meeting held in Arhus, Denmark. Covers areas such as reproductive effect of environmental chemicals, receptor-mediated toxic responses, new frontiers in human and ecological toxicology, chemoprevention of cancer, and molecular approaches in toxicological research.

Seiler J. P., and Vilanova, E. (Eds.) (1997)
Applied Toxicology: Approaches through Basic Science
Springer-Verlag, Berlin

Provides a good overview of the state-of-the-art information on emerging issues from a symposium in 1996. Topics include transgenic animal models in toxicology, immunotoxicology, and toxic oil syndrome. The papers also present current reviews of experimental approaches in important areas of human relevance.

Stock, T., and Lohs, K. (Eds.) (1996)
The Challenge of Old Chemical Munitions and Toxic Armament Wastes
Oxford Univ. Press, New York

Examines the problem of disposing of chemical and toxic armaments once they are no longer required.

Thomas, H., Hess, R., and Waechter, F. (Eds.) (1995)
Toxicology of Industrial Compounds
Taylor & Francis, London

Compilation of workshop papers on the toxicity of high-volume-produced industrial chemicals. It focuses on the individual structure, biological fate, potential toxicity to mammals, and the molecular mechanisms possibly underlying such adverse effects. Topics cover generally approved facts and mechanisms, and areas of investigative and regulatory uncertainty are addressed and explored.

Travis, C. C., and Etnier, E. L. (Eds.) (1983)
Health Risks of Energy Technologies. AAAS Selected Symposium No. 82
Westview, Boulder, CO

Examines the relationship between energy economics and risk analysis. This includes the problems of applying traditional cost–benefit analysis to long-term environmental problems and the public's perception and acceptance of risk.

U.S. Public Interest Research Group (PIRG)
Washington, DC

The main office and the many state PIRGs make available a wide variety of documents and reports. Some recent ones include *Too Close to Home: A Report on Chemical Accident Risks in the United States; Troubled Waters: A Report on Toxic Releases into America's Waterways; and Poisoning our Future: The Dangerous Legacy of*

Persistent Toxic Chemicals. Contact U.S. PIRG, 218 D Street S.E., Washington, DC 20003. *http://www.pirg.org*.

Volans, G. N., Sims, J., Sullivan, F. M., and Turner, P. (1990)
Basic Science in Toxicology. Proceedings from the 5th International Congress of Toxicology
Taylor & Francis, London

A compilation of papers presented as Plenary Lectures and Symposia at the fifth International Congress of Toxicology in Brighton, UK, 1989. Symposium topics include metabolic and kinetic studies, risk assessment, ecotoxicology, the basis for selective toxicity in the lung, the use of mechanistic information in the evaluation of risk for carcinogens, immunotoxicology, susceptibility of different age groups to toxic damage, use of mechanistic studies in developmental and reproductive studies, mechanism of action and efficacy of antidotes, environmental neurotoxins, and mechanisms of chemically induced cell injury.

Von Recum, A. (1998)
Handbook of Biomaterials Evaluation: Scientific, Technical, and Clinical Testing of Implant Materials, 2nd ed.
Taylor & Francis, Philadelphia

Deals with the physical, chemical, mechanical, and regulatory considerations of synthetic materials used in surgical and implant procedures. The book is aimed at the researcher/clinician working on humans and/or animals.

Wilson, C. (1993)
Chemical Exposure and Human Health
McFarland, Jefferson, NC

Interesting reading for those desiring to gain a perspective on individual case management. The author considers herself to have intense specific chemical sensitivity which demonstrated the difficulty in both diagnosis and care of individuals. It is hoped that a careful reading will note the existence of health problems and that total integrated care is the solution.

Journal Article

Lax, M. B. (1998). Multiple chemical sensitivities: The social construction of an illness. ***Int. J. Health Services*** **28,** 725–745.

New research avenues in combustion toxicology (1996). ***Toxicology*** **115**(1/2), 185–200.

This Page Intentionally Left Blank

CHAPTER

3

Journals

PHILIP WEXLER

My heart aches, and a drowsy numbness pains
My sense, as though of hemlock I had drunk,
Or emptied some dull opiate to the drains
One minute past, and Lethe-wards had sunk.

(John Keats, ''Ode to a Nightingale'')

Scientific journals have a long and honorable history. Their beginnings generally date back to 1665, when the French ***Le Journal des Scavans*** and the English ***Philosophical Transactions*** (of the Royal Society of London) began publication within months of each other. General scholarly journals of this type, and, later, journals in broad areas of science and medicine, were repositories of early toxicology papers. Scientific disciplines became, as they continue to become, more specialized, and toxicological literature gradually found its way into journals in areas such as medicine, chemistry, biology, industrial hygiene, and particularly pharmacology. The ''***Index-Catalogue of the Library of the Surgeon-General's Office, United States Army***'', forerunner of the National Library of Medicine's ''***Index Medicus***'', was first published in 1880. It listed books, journals, and theses published prior to that date and included the subject headings of ''Toxicology'' and ''Poisons.'' The preponderance of this early scientific literature was written in German, French, and English.

Some early journals devoted to toxicology were ***Sammlung von Vergifiungsfaellen*** (Germany, begun 1930, currently called ***Archives of Toxicology***), ***Farmakilogiia i Toksikologiia*** (Russia, begun in 1938, currently called ***Eksperimentalnaia i Klinicheskaia Farmakologiia***), and ***Acta Pharmacologica et Toxicologica*** (Denmark, begun in 1945, currently called ***Pharmacology and Toxicology***). In the U.S., the journal ***Toxicology and Applied Pharmacology,*** begun in 1945, became one of the official journals of the United States Society of Toxicology, founded in 1961. One might note that journal title changes are a not-uncommon occurrence. The conceptual link between pharmacology and toxicology, quite evident in the early days, continues today and is therefore reflected in the literature. Cross-disciplinary linkages are also apparent in journals concentrating on the environment and pollution. Today, toxicology continues to be spread across the broader scientific journal literature, although as this chapter demonstrates, there remain many journals that focus on toxicology in general or specialized terms. Entire journal titles are devoted to such areas as aquatic toxicology, molecular toxicology, immunotoxicology, neurotoxicology, and *in vitro* toxicology.

As with books, journals today are not limited to print media. Journals may be available on CD-ROM or online through the Internet, typically on their publishers' Web sites. Publishers, which are listed in Chapter 9, may offer the entire text or selected portions of journal issues online. Alternately, they may keep readers up to date by providing online article abstracts or tables of contents. At the least, journal publishers with Web addresses provide descriptions of their journal titles and ordering information. Readers are encouraged to consult the Web site of a journal's publisher to find out about electronic access.

The periodicals in this chapter represent a selective list of scientific journals that focus on toxicology and

related disciplines, such as risk analysis, occupational medicine, environmental health, and ecotoxicology. Many other journals that publish toxicological articles but whose thrust lies elsewhere are not included. Thus, although one of the journals in the list concerns immunopharmacology/immunotoxicology, the many other immunology titles, which may contain toxicology articles from time to time, are not included. At the end of the chapter is a brief list of related titles that include articles of bearing on toxicology.

Monograph series tend to be a nightmare in terms of bibliographic control. Are they books or are they journals? In the second edition of this book, such book series were included in the Journals chapter. Like journals, they are published on an ongoing basis, although usually not as frequently. However, in look and use, they are more like books, with individual volumes typically focusing on a single topic or a group of interrelated topics. Therefore, in this edition, monograph series and other special serial publications are found in Chapter 2, Books and Special Documents.

The journals that follow publish English-language articles exclusively or mostly. Foreign-language toxicology journals are cited in the individual country chapters later in this book. We have selected only titles that are currently being published. Closed (i.e., discontinued) titles are not included. Obviously some of these titles may be discontinued in the future, or change title, publisher, or place of publication. Vigilance is always necessary in keeping up with journals. Publishing industry takeovers compound the problem of identifying and locating journals. Dates, where available, represent the year (as accurate as we could find) that the journal, either under its current or previous title(s), was first published.

The list represents largely professional journals publishing technical and scientific articles. Magazines for general consumption only that carry articles related to toxicology and the environment are not part of this main list, although a number of them do an outstanding job of presenting current issues and controversies in easy-to-read and entertaining packages. Interestingly enough given the increasing consumer curiosity about health and science, some very fine professional journals in toxicology (e.g., ***Environmental Health Perspectives***) and science (e.g., ***Science***) have lately seen fit to devote a portion of their pages to just such general interest material.

To keep up with periodical titles—what's born, what dies, what changes—is not easy. Some helpful sources include:

- ***Pub List.*** (http://www.publist.com). A comprehensive online directory of information on over 150,000 print and electronic publications and 8,000 newspapers around the world. Free. Data come from sources such as ''Ulrich's International Periodicals Directory'' and ''Editor and Publisher International year book.''
- ***Ulrich's International Periodicals Directory.*** R. R. Bowker, New Providence, NJ (http://www.bowker.com). (Includes irregular serials and annuals.)
- ***Gale Directory of Publications and Broadcast Media.*** Gale, Detroit, MI (http://www.gale.com).
- ***The Standard Periodical Directory.*** Oxbridge Communications, New York (For Oxbridge's excellent online resource Mediafinder, which locates journals, books, and newsletters, go to http://www.mediafinder.com).
- ***Environmental Journals on the Internet.*** (http://www.cnie.org/journals.html). An online resource provided by the committee for the National Institute for the Environment.
- The **Library of Congress**' electronic catalogs. (http://lcweb.loc.gov).
- The **National Library of Medicine's** Public Access Catalog, ''Locator Plus'' (http://www.nlm.nih.gov/locatorplus).
- ***NewJour.*** Electronic journals and newsletters available on the Internet. (http://gort.ucsd.edu/newjour).

For information on bibliographic access to articles and other contents within journals, consult Chapter 6, Internet and Other Resources, and Chapter 7, Print Bibliographic Resources.

JOURNAL LISTINGS

Adverse Drug Reaction Bulletin (1964–)
Chapman and Hall, London

A bimonthly loose-leaf publication that typically presents a single article of clinical relevance on adverse effects of drugs.

Adverse Drug Reactions and Toxicological Reviews (1982–)
Oxford University Press, Oxford, UK

Provides critical reviews on the subjects of adverse drug reactions and the toxicology of substances to which people may be exposed in the home and workplace. Provides summaries of selected articles from other journals and offers book reviews.

Ambio (1972–)
Royal Swedish Academy of Sciences, Stockholm

Presents reports, synopses, and comments related to the sustainable use of natural resources, global change, and other general environmental issues.

American Industrial Hygiene Association Journal (1940–)
American Industrial Hygiene Association, Fairfax, VA

Publishes research and other articles concerning the recognition, evaluation, and control of potential occupational health hazards in the work environment and in the community.

American Journal of Industrial Medicine (1980–)
Wiley–Liss, New York

This distinguished journal covers a broad array of topics related to environmental and occupational health and is a good source for epidemiological studies.

Annals of the ICRP (1977–)
Pergamon Press, Oxford, UK

A review journal presenting the reports and recommendations of the International Commission on Radiological Protection, a group dedicated to providing guidance on the widespread use of radiation sources caused by developments in the field of nuclear energy.

Annals of Occupational Hygiene (1958–)
Elsevier Science, Oxford, UK

Published for the British Occupational Hygiene Society. This journal promotes all aspects of occupational and environmental hygiene and health. It is aimed at all who are interested in the effects of work on health. Occupational toxicology is one of the core subject areas represented.

Annual Review of Pharmacology and Toxicology (1961–)
Annual Reviews, Palo Alto, CA

In aggregate, this review series with extensive references presents an encyclopedic look at all aspects of toxicology and pharmacology. It has a subject index for the current volume and cumulative author and chapter title indices for volumes from the preceding five years.

Applied Occupational and Environmental Hygiene (1986–)
Taylor and Francis, Philadelphia

Published for the American Conference of Governmental Industrial Hygienists, this journal presents original studies and reports whose conclusions can be used by health and safety professionals in the prevention of occupational and environmental disease and injury.

Aquatic Toxicology (1981–)
Elsevier, Amsterdam

Publishes original scientific papers and reviews dealing with such broad topics as mechanisms of toxicity in aquatic environments, effects of agents on aquatic ecosystems, toxicant-induced alterations in organisms, and human health aspects of aquatic toxicology.

Archives of Complex Environmental Studies (1989–)
S. Siuro, Tampere, Finland

An international interdisciplinary journal on health sciences, environmental sciences, and applied environmental technology.

Archives of Environmental Contamination and Toxicology (1972–)
Springer-Verlag, New York

A repository of research articles covering air, water, and soil contamination and pollution and their human health aspects, as well as the effects of deleterious substances in the total environment.

Archives of Environmental Health (1960–)
Heldref Publications, Washington, DC

The official publication of the Society for Occupational and Environmental Health. Publishes epidemiological, clinical, and experimental studies dealing with the effects of environmental agents on human health. Especially interested in the health significance of toxic waste, new energy technology and industrial processes, and the environmental causation of neurobehavioral dysfunction, birth defects, cancer, and chronic degenerative disease.

Archives of Toxicology (1930–)
Springer-Verlag, Berlin

This august journal with a long history aims to provide up-to-date information on the latest advances in toxicology. Particular emphasis is given to studies relating to defined effects of chemicals and mechanisms of toxicity, including toxic activities at the molecular level in humans and experimental animals. Also devotes space to analysis, toxicokinetics, and forensic toxicology. It is the official journal of the European Society of Toxicology (EUROTOX) and publishes the proceedings of EUROTOX meetings as annual supplements.

Archives of Toxicology, Kinetics and Xenobiotic Metabolism (1993–)
Toxicology Section of the Serbian Medical Society, Belgrade, Federal Republic of Yugoslavia

Devoted to the evaluation of data, methods, and opinions in the fields of toxicology, pharmacology, clinical pharmacology, and xenobiotic metabolism.

Atmospheric Environment (1967–)
Elsevier Science, Oxford, UK

Covers all aspects of the interaction of people and ecosystems with their atmospheric environment. Includes such areas as air pollution research, air quality and its effects, dispersion and transport, deposition biospheric-atmospheric exchange, etc.

Biodegradation (1990–)
Kluwer Academic, Dordrecht, The Netherlands

Publishes papers on all aspects of science pertaining to the detoxification, recycling, amelioration, or treatment of waste materials and pollutants by naturally occurring microbial strains or associations or recombinant microorganisms.

Bioelectromagnetics (1980–)
Wiley-Liss, New York

Journal of the Bioelectromagnetics Society, the Society for Physical Regulation in Biology and Medicine, and the European Bioelectromagnetics Association. Devoted to research on biological systems as they are influenced by natural or manufactured electric and/or magnetic fields.

Biomarkers (1996–)
Taylor and Francis, London

Subtitled *Biochemical Indicators of Exposure, Response and Susceptibility to Chemicals.* Includes papers on the development and validation of biomarkers and their use and interpretation. Contains original articles, short communications, and reviews.

Biomedical and Environmental Sciences (1988–)
Chinese Academy of Preventive Medicine, Beijing

An international journal with an emphasis on scientific findings in China. Publishes English-language articles dealing with biological and toxic effects of environmental pollutants on humans and other forms of life. Also publishes reports dealing with the entry, transport, and fate of natural and anthropogenic chemicals in the biosphere and their impact on human health and well-being.

Bulletin of Environmental Contamination and Toxicology (1966–)
Springer-Verlag, New York

Provides rapid publication of significant advances and discoveries in the fields of air, soil, water, and food contamination and pollution, as well as articles on methodology and other disciplines concerned with the introduction, presence, and effects of toxicants in the total environment.

Cancer Causes and Control (1990–)
Rapid Science Publisher, London

Reports on and stimulates new avenues of investigation into the causes, control, and subsequent prevention of cancer.

Carcinogenesis (1980–)
Oxford University Press, Oxford, UK

A multi-disciplinary journal publishing full-length papers and short communications in the areas of cancer biology, molecular epidemiology, cancer prevention, and carcinogenesis (including viral, chemical, and physical carcinogenesis, metabolism of carcinogens, and the formation, detection, identification, and quantification of environmental carcinogens).

Cell Biology and Toxicology (1984–)
Kluwer Academic, Dordrecht, The Netherlands

Official journal of the Societe Pharmaco-Toxicologie Cellulaire. Provides a rapid publication outlet for papers in the areas of cell biology and genetic, molecular, and cellular toxicology.

Central European Journal of Occupational and Environmental Medicine (1995–)
Occupational Health Foundation and National Institute of Occupational Health, Budapest, Hungary

Deals with health effects and prevention of work-related diseases, epidemiological studies, and experimental studies on occupational and environmental health effects.

Chemical Research in Toxicology (1988–)
American Chemical Society, Washington, DC

Published with the cooperation of the International Society for the Study of Xenobiotics. Includes articles, communications, invited reviews, and perspectives on structural, mechanistic, and technological advances in research related to the toxicological effects of chemical agents.

Chemico-Biological Interactions (1965–)
Elsevier, Shannon, Ireland

Subtitled *A Journal of Molecular and Biochemical Toxicology,* this is the official journal of the Hepatocyte Users Group of North America, publishing research reports, rapid communications, review articles, and commentaries that examine: the molecular aspects of cytotoxicity, carcinogenesis, mutagenesis, and teratogenesis; and the molecular mechanisms by which drugs exert their therapeutic or toxic effects.

Chemosphere (1972–)
Elsevier Science, Oxford, UK

Subtitled *Chemistry, Biology and Toxicology as Related to Environmental Problems.* Covers topics such as environmental fate of chemicals, ecotoxicology, atmospheric chemistry and global change, environmental chemicals and analysis, air and water pollution, toxicology and effects on humans, occupational hazards and exposure, and environmental technology. The May 1997 issue covered the proceedings of a conference on biological environmental specimen banking.

Comments on Toxicology (1986–)
Gordon and Breach, Amsterdam

Part B of ***Comments on Modern Biology.*** A vehicle for concisely written critical discussions of recent important developments in toxicology. Intended for the toxicologist, chemist, biologist, and regulator. Recent special issues covered apoptosis, endocrine disrupters, and alternative methods.

Comparative Biochemistry and Physiology. Part C: Pharmacology, Toxicology, and Endocrinology (1983–)
Elsevier Science, New York

Publishes original articles concerned with chemical and drug action at different levels of organization; biotransformation of xenobiotics; mechanisms of toxicity, including reactive oxygen species and carcinogenesis; hormones and receptors; natural products chemistry; and signal transduction.

Contact Dermatitis (1975–)
Munksgaard, Copenhagen

The official publication of the European Society of Contact Dermatitis, this journal is designed primarily for clinicians interested in various types of occupational dermatitis. This includes both allergic and irritant (toxic) types of contact dermatitis, occupational (industrial) dermatitis and consumer's dermatitis from such products as cosmetics and toiletries.

Critical Reviews in Environmental Science and Technology (1970–)
CRC Press, Boca Raton, FL

An international forum for the critical review of current knowledge on the broad range of topics constituting environmental science.

Critical Reviews in Toxicology (1971–)
CRC Press, Boca Raton, FL

Extensive up-to-date critical assessment of toxicology and related scientific disciplines.

Drug and Chemical Toxicology (1977–)
Marcel Dekker, New York

Publishes full-length research papers, review articles, and short communications relating to the broad spectrum of toxicological data relevant to risk assessment and harmful effects due to exposure.

Drug Metabolism and Disposition (1973–)
Williams and Wilkins, Baltimore, MD

An official publication of the American Society for Pharmacology and Experimental Therapeutics. Articles describe the results of original research on xenobiotic metabolism and disposition. Xenobiotics include therapeutic agents as well as environmental chemicals, and research may involve the use of *in vivo* or *in vitro* approaches, including cultured cells and heterologous expression systems.

Drug Metabolism and Drug Interactions (1974–)
Freund, London

Devoted to mechanisms by which drugs and other foreign compounds are metabolized; the mechanisms by which drugs may interact with each other as well as with biological systems; and the pharmacological and toxicological consequences of such metabolism and interaction.

Drug Metabolism Reviews (1972–)
Marcel Dekker, New York

Features critical, in-depth reviews dealing with the fate of xenobiotics (drugs and other foreign compounds) in any biological system.

Drug Safety (1986–)
ADIS International, Auckland, New Zealand

Aims to assist in the further development of the rational use of drugs, focusing on practical medical aspects relevant to the diagnosis and treatment of acute poisonings and the recognition, epidemiology, management, and avoidance of adverse drug reactions.

Ecosystem Health (1995–)
Blackwell Science, Malden, MA

Official journal of the International Society for Ecosystem Health. Focuses on the relationship between changing environments and human health, methods of ecosystem health management at various scales, and analysis of intent and effectiveness of policies and programs designed to promote the health and integrity of the earth's ecosystems.

Ecotoxicology (1992–)
Chapman and Hall, London

Publishes fundamental research on the effects of toxic chemicals on populations, communities, and terrestrial, freshwater, and marine ecosystems. Aims to eluci-

date mechanisms and processes whereby chemicals exert their effects on ecosystems and the impact caused at the population or community level.

Ecotoxicology and Environmental Safety (1977–)
Academic Press, Orlando, FL

Official journal of the International Society of Ecotoxicology and Environmental Safety. Publishes manuscripts dealing with studies of the biological and toxic effects caused by natural or synthetic chemical pollutants to ecosystems, whether animal, plant, or microbial.

Environment (1969–)
Heldref Publications, Washington, DC

Offers authoritative analyses of key environmental issues via comprehensive articles, critical reviews of major governmental and institutional reports, book recommendations, commentaries, and news briefs.

Environment International (1978–)
Elsevier Science, New York

Subtitled, *A Journal of Science, Technology, Health, Monitoring and Policy*. Includes contributions in such areas as concentration of elements and compounds, notably pollutants; release rates of pollutants from various sources; transport of pollutants in the environmental media; and health and ecological effects of pollutants. Volume 22, Supplement 1, 1996, consisted of the proceedings of the Sixth International Symposium on the Natural Radiation Environment.

Environmental and Nutritional Interactions (1997–)
Taylor and Francis, Philadelphia

A forum for original research and comprehensive critical reviews dealing with the interactions between agents in the environment and nutrients in the diet.

Environmental Dermatology (1994–)
Japanese Society for Contact Dermatitis, Nagoya, Japan

The official journal of the Japanese Society for Contact Dermatitis. Publishes manuscripts covering the scope of environmental (daily life and occupational) dermatology from basic studies to pre-clinical and clinical studies.

Environmental Engineering Science (1997–)
Mary Ann Liebert, Larchmont, NY

Publishes papers on environmental science topics that include development and application of fundamental principles toward solving problems in land, air, and water media.

Environmental Epidemiology and Toxicology (1996–)
Stockton Press, New York

Papers deal with basic and applied research in the fields of clean technology, occupational medicine, immunology, and toxicology, including case reports and risk assessment associated with hazardous wastes and groundwater.

Environmental Geochemistry and Health (1978–)
Chapman and Hall, London

Covers all aspects of applied environmental geochemistry, including pollution and the influence of the environment on plant, animal, and human life.

Environmental Health and Preventive Medicine (1996–)
Japanese Society for Hygiene, Sapporo, Japan

Official journal of the Japanese Society for Hygiene. Devoted to the publication of papers on human health sciences related to biological, physical, chemical, medical, psycho-social, and other environmental factors.

Environmental Health Perspectives (1972–)
U.S. National Institute of Environmental Health Sciences, Research Triangle Park, NC

A very informative and well-designed journal serving as a forum for the discussion of issues in environmental health, including molecular studies related to environmental health and susceptibility. Includes perspectives, correspondence, commentary, news, and research articles, plus occasional supplements—recently on breast cancer, chemical sensitivity, and reproductive toxicology.

Environmental Management (1976–)
Springer-Verlag, New York

An international journal for decision-makers, scientists, and environmental auditors. Publishes research and opinion concerning the use and conservation of natural resources, the protection of habitats, and the control of hazards.

Environmental Management and Health (1990–)
MCB University Press, Bradford, UK

Examines environmental factors and their impact on human health to suggest possible remedies and to adapt an interdisciplinary approach to the problem of managing the environment so as to reduce the deleterious effects of humanity's activities in this century.

Environmental Modelling and Software (1986–)
Elsevier Science, New York

Publishes research articles, review papers and short communications on recent advances in environmental modelling and software.

Environmental and Molecular Mutagenesis (1979–)
Wiley-Liss, New York

Publishes original research papers on mutation and mutation-related topics, such as mechanisms of mutagenesis, environmental modification of DNA, repair of DNA damage, genetic and cytogenetic methods for studying genetic damage, mutagenicity screening, methods for estimating mutagenic hazards to humans, and epidemiological studies relating to environmental mutagens.

Environmental Monitoring and Assessment (1981–)
Kluwer Academic Publishers, Dordrecht, The Netherlands

Emphasizes technical developments and data arising from environmental monitoring and assessment, the use of scientific principles in the design of monitoring systems, and the use of monitoring data in assessing pollution risks to humans and the environment.

Environmental and Nutritional Interactions (1997–)
Taylor and Francis, Philadelphia

A forum for original research and comprehensive critical reviews dealing with the interactions between agents in the environment and nutrients in the diet.

Environmental Pollution (1980–)
Elsevier Science, Oxford, UK

An international journal addressing issues relevant to the nature, distribution, and ecological effects of all types and forms of chemical pollutants in air, soil, and water.

Environmental Research (1967–)
Academic Press, Orlando, FL

Subtitled *A Journal of Environmental Medicine and the Environmental Sciences*. Publishes original reports describing studies of the toxic effects of environmental agents and conditions in humans and animals, including both experimental subjects and ecosystems. A true multi-disciplinary journal.

Environmental Science and Pollution Research International (1994–)
ECOMED, Landsberg, Germany

A wide-ranging look at a variety of issues relevant to the environment and toxicology.

Environmental Science and Technology (1967–)
American Chemical Society, Washington, DC

Covers a wide range of environmental disciplines via feature articles, environmental policy analysis, research watch, letters, research papers, communications, and critical reviews.

Environmental Sciences (1991–)
Scientific Publishing Division of MYU, Tokyo

Includes original research and reviews on the chemical characteristics of substances found in air, water, and soil and their biological and toxicological effects on plants, animals, and humans.

Environmental Toxicology and Chemistry (1982–)
SETAC Press, Pensacola, FL

The official journal of the Society of Environmental Toxicology and Chemistry. Divided into three sections: Environmental Chemistry, Environmental Toxicology, and Hazard/Risk Assessment.

Environmental Toxicology and Pharmacology (1996–)
Elsevier, Amsterdam

Publishes results of studies concerning toxic and pharmacological effects of human and veterinary drugs and of environmental contaminants in animals and humans. Full-length papers, short communications, full-length reviews, and mini-reviews.

Environmental Toxicology (1986–)
John Wiley, New York

Formerly called ***Environmental Toxicology and Water Quality.*** Devoted to the publication of papers on all aspects of environmental toxicology, including mechanisms, fate, and pathways; ecosystem impact assessment, water, air, and soil quality criteria; etc.

Experimental and Toxicologic Pathology (1967–)
Gustav Fischer Verlag, Jena, Germany

Official journal of the Gesellschaft fuer Toxikologische Pathologie. Publishes original experimental investigations on the pathogenesis of disease, especially diseases in which toxic agents are involved.

Food Additives and Contaminants (1984–)
Taylor and Francis, London

Includes articles relating to the detection, determination, occurrence, persistence, safety evaluation, and control of naturally occurring and man-made additives and contaminants in the food chain.

Food and Chemical Toxicology (1963–)
Elsevier Scientific, Exeter, UK

A continuation of ***Food and Cosmetics Toxicology.*** An international journal published in association with BIBRA (British Industrial Biological Research Association). Publishes papers reporting and interpreting original toxicological research, particularly studies presenting an understanding of the mechanisms that underlie toxic effects or improvements in methods for

predicting adverse effects. Also includes brief communications, reviews, letters to the editor, abstracts from the literature, and a current awareness section.

Food and Drug Law Journal (1946–)
Food and Drug Law Institute, Washington, DC

The official journal of the Food and Drug Law Institute. Papers on the progress of the law in the fields of foods, drugs, cosmetics, medical devices, and biologics.

Free Radical Biology and Medicine (1987–)
Elsevier Science, New York

The official journal of the Oxygen Society. Features papers on chemical, biochemical, physiological, pathological, pharmacological, toxicological, and medical approaches to free radical research.

Free Radical Research (1985–)
Harwood Academic, Amsterdam

Publishes articles on the chemistry of free radicals, the production of free radicals by xenobiotics and biological systems, free radical damage to cells and tissues, and defense mechanisms against free radical damage.

Green Chemistry (1999–)
Royal Society of Chemistry, Cambridge, UK

Covers all research that relates to a reduction in the environmental impact of chemicals, whether from improved production methods; formulation and delivery systems; the use of sustainable resources; use or recovery and recycling of waste; or product substitution. Includes life-cycle analysis, environmental risk analysis, and legislation.

Health Physics (1958–)
Williams and Wilkins, Baltimore, MD

Official journal of the Health Physics Society. Publishes manuscripts on the theoretical and applied fields of radiation protection, including ionizing and nonionizing radiation.

Human and Ecological Risk Assessment (1995–)
CRC Press, Boca Raton, FL

Designed to enhance the communication and cooperation of professionals working on human risk assessment with those in ecological risk assessment. Looks at such issues as exposure assessment, hazard assessment, environmental fate assessment, epidemiology, animal extrapolation, risk management, and risk communication.

Human and Experimental Toxicology (1981–)
Stockton Press, Basingstoke, UK

The official journal of the British Toxicology Society. Papers are published on all aspects of experimental and clinical studies of functional, biochemical, immunologic, and pathological toxic processes and disorders *in vivo* and *in vitro*; on their causal mechanisms; on toxicity in human and animal patients; and on the treatment of toxicity.

Immunopharmacology and Immunotoxicology (1978–)
Marcel Dekker, New York

A forum for publication of clinical studies and research results in the areas of immunopharmacology and immunotoxicology. The basic theme deals with alterations of the immune system.

Indoor Air (1991–)
Munksgaard International Publishers, Copenhagen

Official journal of the International Society of Indoor Air Quality and Climate. Provides a forum for reporting original research results in the broad area defined by the indoor environment of nonindustrial buildings.

Indoor and Built Environment (1992–)
Karger, Basel

The journal of the International Society of the Built Environment. Topics covered pertain to the quality of the indoor and built environment and how these might affect the health, performance, efficiency, and comfort of people living or working there.

Industrial Health (1963–)
National Institute of Industrial Health, Kawasaki, Japan

Covers research pertaining to prevention of occupational diseases and to the maintenance and promotion of workers' health.

Inhalation Toxicology (1989–)
Taylor and Francis, Philadelphia

A key forum for international exchange of the latest advances in pulmonary toxicology. Topics include the pathogenesis and mechanism of lung disease, extrapolation of animal data to humans, effects of inhaled chemicals on the extrapulmonary system, innovative lung model systems for predicting human disease, aerosol science, and new inhalation exposure techniques.

International Archives of Occupational and Environmental Health (1930–)
Springer-Verlag, Berlin

Covers topics such as clinical and epidemiological studies on morbidity and mortality, studies relevant to the estimation of human health risks, human experimental studies on environmental health effects, and

methods. Includes original articles, editorials, reviews, short communications, and book reviews.

International Journal of Environmental Forensics (1999–)
Amherst Scientific Press, Amherst, MA

A forum for scientific investigations that address contamination within the environmental media of air, water, soil and biota that is subject to law court, arbitration, public debate, or formal argumentation. The journal is an international, quarterly, peer-reviewed publication offering scientific studies that explore source, fate, transport, and human health and ecological effects of environmental contamination, with contamination being delineated in terms of chemical characterization, biological influence, responsible parties, and legal consequences.

International Journal of Environmental Health Research (1991–)
Carfax Publishing Company, Abingdon, UK

A quarterly publication devoted to rapid publication of research in environmental health. It considers the natural environment and health, the built environment and health, and communicable diseases.

International Journal of Environmental Studies (1997–)
Gordon and Breach, London

Section A, *Environmental Studies,* covers areas such as ecology, occupational hygiene, industrial health, radiation, noise, pollution, environmental medicine, etc. Section B, *Environmental Science and Technology,* covers areas such as acid rain, air and water pollution control processes and technology, occupational health, water chemistry, etc.

International Journal of Occupational and Environmental Health (1995–)
Hanley and Belfus, Philadelphia

Publishes papers in the broad field of occupational and environmental medicine.

International Journal of Occupational Medicine and Environmental Health (1988)
Nofer Institute of Occupational Medicine and the Polish Association of Occupational Medicine, Lodz, Poland

Provides a good, largely European perspective on occupational medicine and environmental health.

International Journal of Radiation Biology (1959–)
Taylor and Francis, London

Focuses on the physical, chemical, and especially biological and medical effects of ionizing and nonionizing radiation. Includes book reviews and meetings calendar.

International Journal of Toxicology (1982–)
Taylor and Francis, Philadelphia

Formerly titled *Journal of the American College of Toxicology,* this is the College's official journal. Offers papers on the toxicity of industrial chemicals, pharmaceutical agents, environmental contaminants, and other entities and explores their mechanisms of action or relevance to human health. Special issues are devoted to the Cosmetic Ingredients Review Expert Panel and the Acute Toxicity Data Report.

Internet Journal of Medical Toxicology (1998–)
American College of Medical Toxicology
http://www.ijmt.umn.edu

Sponsored by the American College of Medical Toxicology, this strictly online journal publishes editorials, clinical case conferences, news, and other items related to medical toxicology, and it solicits e-mail comments from readers to generate discussion.

In Vitro and Molecular Toxicology (1986–)
Mary Ann Liebert, Larchmont, NY

Subtitled *A Journal of Molecular and Cellular Toxicology.* The official publication of the Industrial In Vitro Toxicology Group. Reports on investigative work about the molecular and cellular basis and expression of diverse toxic phenomena.

Journal of the Air and Waste Management Association (1955–)
Air and Waste Management Association, Pittsburgh, PA

Presents papers of interest to professionals in the air pollution control and waste management fields.

Journal of Analytical Toxicology (1977–)
Preston Publications, Niles, IL

Papers relate to the isolation, identification, and quantitation of potentially toxic substances and their biotransformation products in specimens of human, animal, or environmental origin.

Journal of Applied Toxicology (1981–)
John Wiley and Sons, Chichester, UK

Areas of concern include the study of toxic effects of chemicals and materials in the fields of teratology, reproduction, mutagenesis, carcinogenesis, health, the environment, pathology, pharmacokinetics, and biochemical mechanisms, as well as epidemiology and analytical methods and alternatives to the use of animals.

Journal of the Association of Food and Drug Officials (1937–)
Association of Food and Drug Officials, York, PA

The mission of the Association of Food and Drug Officials as reflected in its journal, is to further uniformity in the adoption and enforcement of food, drug, medical devices, cosmetics, and product safety laws, rules, and regulations.

Journal of Biochemical and Molecular Toxicology (1986–)
John Wiley and Sons, New York

Contains original research papers, rapid communications, mini-reviews, and book reviews, all focusing on the molecular mechanisms of action and detoxification of exogenous and endogenous chemicals and toxic agents.

Journal of Environmental Biology (1980–)
JEB Foundation, Muzaffarnagar, India

A research journal publishing original research and short research papers, as well as short reviews, dealing with environmental pollution and toxicology of plants and animals.

Journal of Environmental Health (1938–)
National Environmental Health Association, Denver, CO

Official publication of the National Environmental Health Association, presenting interesting feature articles, updates, news items, calendar, and career opportunities, all relating to environmental health.

Journal of Environmental Medicine (1998–)
John Wiley and Sons, Chichester, UK

Publishes original papers relating to environmental medicine and allied disciplines, focusing on the adverse effects on humans of external physical, chemical, and biological factors in the general environment, primarily from a medical standpoint. Emphasizes identification, prevention, diagnosis, and management of adverse health effects in humans, related to the physical and chemical contamination of outdoor and indoor air, soil, and water.

Journal of Environmental Monitoring (1999–)
Royal Society of Chemistry, Cambridge, UK

Dedicated to assessing exposure and health risks through the latest developments in measurement science. Intended for environmental and health professionals in industry, officials from governmental and regulatory agencies, and research scientists interested in the environment.

Journal of Environmental Pathology, Toxicology and Oncology (1977–)
Begell House, New York

Official organ of the International Society for Environmental Toxicology and Cancer. Publishes research on ecological effects on the structure and function of cells and tissues, with an emphasis on the environmental effects on carcinogenesis.

Journal of Environmental Quality (1972–)
American Society of Agronomy, Madison, WI

Deals with aspects of environmental quality in natural and agricultural ecosystems. Main sections are technical reports, reviews and analyses, short communications, and environmental issues.

Journal of Environmental Radioactivity (1984–)
Elsevier Science, Oxford, UK

Includes research and review papers on all aspects of the occurrence of radioactivity in natural systems.

Journal of Environmental Science and Health
New York: Marcel Dekker.

Part A, ***Environmental Science and Engineering and Toxic and Hazardous Substance Control,*** covers science and engineering as applied to environmental problems. Part B, ***Pesticides, Food Contaminants, and Agricultural Wastes,*** focuses on such areas as analytical techniques applicable to residues, persistence, binding, translocation, biodegradation, fate, etc. Part C, ***Environmental Carcinogenesis and Ecotoxicology Reviews,*** covers environmental carcinogenesis, related broad aspects of other environmentally induced pathogenesis, and ecotoxicology.

Journal of Exposure Analysis and Environmental Epidemiology (1991–)
Stockton Press, New York

Official organ of the International Society of Exposure Analysis. Papers deal with measurements, modeling, instrumentation, and questionnaires; studies on chemical, biological, and physical principles required to analyze human exposure from single and multiple media and routes; and epidemiological investigations.

Journal of Food Protection (1977–)
International Association of Milk, Food, and Environmental Sanitarians, Des Moines, IA

Official publication of the International Association of Milk, Food, and Environmental Sanitarians (IAMFES), whose mission is to provide food safety professionals worldwide with a forum to exchange information on protecting the food supply.

Journal of Hazardous Materials Science (1975–)
Elsevier, Amsterdam

Deals with all aspects of hazardous materials arising from their inherent chemical or physical properties. The scope of this journal ranges from basic aspects of preparation and handling to risk assessment and the presentation of case histories of incidents involving real hazards to employees or the public.

Journal of Natural Toxins (1992–)
Alaken, Fort Collins, CO

A journal for research and investigation of toxins of natural origins.

Journal of Nutritional and Environmental Medicine (1990–)
Carfax Publishing Company, Abingdon, UK

Formerly the *Journal of Nutritional Medicine*. Focuses on studies of clinical relevance in areas such as toxicology, nutritional toxicology, chemical sensitivity, allergy, nutrition and reproductive function, antioxidants, nutritional supplementation, etc.

Journal of Occupational and Environmental Medicine (1959–)
Williams and Wilkins, Baltimore, MD

Official journal of the American College of Occupational and Environmental Medicine. A wide-ranging journal covering many areas related to occupational medicine and the environment.

Journal of Pharmacological and Toxicological Methods (1978–)
Elsevier Science, New York

Formerly published as ***Journal of Pharmacological Methods.*** Publishes original scientific papers arising from the development of new and/or existing methods of investigation used in pharmacology and toxicology.

Journal of Products and Toxics Liability (1977–)
Pergamon Press, New York

Covers products and toxics liability issues from legal, medical, scientific, engineering, human factors, ergonomic, and allied disciplines.

Journal of Radiation Research (1960–)
Japan Radiation Research Society, Chiba, Japan

Official organ of the Japan Radiation Research Society. Articles in a broad spectrum of radiation research areas.

Journal of Radiological Protection (1981–)
Institute of Physics Publishing, Bristol, UK

Official journal of the UK Society for Radiological Protection. Covers all aspects of radiological protection, including non-ionizing and ionizing radiation, dosimetry, biological effects, etc.

Journal of Soil Contamination (1992–)
CRC Press, Boca Raton, FL

The main vehicle of communication of the Association for the Environmental Health of Soils (AEHS). Covers such areas as analytical chemistry, site assessment, environmental fate and modeling, remediation techniques, risk assessment issues, regulatory issues, and legal considerations.

Journal of Toxicological Sciences (1976–)
Japanese Society of Toxicological Sciences, Tokyo

An official journal of the Japanese Society of Toxicological Science. A general toxicology journal with an emphasis on experimental animal studies.

Journal of Toxicology. Clinical Toxicology (1968–)
Marcel Dekker, New York

An official publication of the American Academy of Clinical Toxicology and the European Association of Poisons Centres and Clinical Toxicologists. Publishes peer-reviewed scientific research related to advances in clinical toxicology.

Journal of Toxicology. Cutaneous and Ocular Toxicology (1982–)
Marcel Dekker, New York

Official journal of the International Society of Ocular Toxicology (ISOT). Explores cutaneous and ocular irritation, sensitization, phototoxicity, and photoallergenicity of cosmetics, drugs, soaps and other detergents, fragrances, textiles, preservatives, adhesives, environmental exposures, and occupational exposures.

Journal of Toxicology. Toxin Reviews (1982–)
Marcel Dekker, New York

Brings together assorted papers related to toxins—their characteristics, activities, and mechanisms of action.

Journal of Toxicology and Environmental Health (1975–)
Taylor and Francis, Philadelphia

Considers articles on the toxicological effects of natural and anthropogenic environmental pollutants and their actions on intact organisms as well as in *in vitro* systems. Fields of special interest include carcinogenesis, mutagenesis, teratology, neurotoxicity, environmental factors affecting health, risk assessment, and other toxi-

cological phenomena. In two parts, A and B. Part B is entitled ''Critical Reviews.''

Molecular Carcinogenesis (1985–)
Wiley-Liss, New York

Presents information describing investigations of molecular aspects of the mechanisms involved in chemical, physical, and viral (biological) carcinogenesis—in the forms of brief communications, research papers, and working hypotheses.

Mutagenesis (1986–)
Oxford University Press, Oxford, UK

A multi-disciplinary journal designed to bring together research aimed at the identification, characterization, and elucidation of the mechanisms of action of physical, chemical, and biological agents capable of producing genetic change in living organisms and at the study of the consequences of such changes.

Mutation Research (1964–)
Elsevier, Amsterdam

A group of journals related to mutagenesis, chromosome breakage, and related subjects. The five sections, published individually with their own titles, but under the collective title of *Mutation Research* have color-coded bindings and are subtitled: *Fundamental and Molecular Mechanisms of Mutagenesis; Mutation Research Genomics; DNA Repair; Reviews in Mutation Research;* and *Genetic Toxicology and Environmental Mutagenesis.*

Natural Toxins (1992–)
Wiley-Liss, New York

This journal publishes original research papers and review articles on the occurrence, isolation, identification, and characterization of natural products with toxic activities. Emphasis is placed on evaluating the significance of the effects of such toxicants in humans.

Neurotoxicology (1979–)
INTOX Press, Little Rock, AR

Publishes peer-reviewed original research dealing with the effects of toxic substances on the nervous system of humans and experimental animals of all ages. Emphasizes papers dealing with the neurotoxic effect of environmentally significant chemical hazards, manufactured drugs, and naturally occurring compounds.

Neurotoxicology and Teratology (1981–)
Elsevier Science, New York

Sponsored by the Behavioral Toxicology Society and the Neurobehavioral Teratology Society. Presents original research reports of systematic studies in the areas of neurotoxicology and developmental toxicology in which the primary emphasis and theoretical content are on the nervous system and behavior. Includes brief communications and mini-reviews.

Occupational and Environmental Medicine (1944–)
British Medical Journal Publishing Group, London

Formerly ***The British Journal of Industrial Medicine.*** Includes papers relevant to occupational and environmental medicine, including epidemiological studies and toxicological studies of chemicals of industrial, agricultural, and environmental importance.

Occupational Hygiene (1994–)
Gordon and Breach Science Publishers, Amsterdam

Subtitled *Risk Management of Occupational Hazards,* this journal publishes papers on the fundamental aspects of the field, including the detection, evaluation, and control of hazards, and related topics such as occupational medicine, waste management, and environmental protection.

Occupational Medicine (1951–)
Rapid Science Publishers, London

Designed to enhance the standards and quality of the practice of occupational medicine via original papers, reviews, viewpoints, book reviews, etc.

Pesticide Biochemistry and Physiology (1971–)
Academic Press, Orlando, FL

Papers deal with the biochemistry and physiology of insecticides, herbicides, fungicides, acaracides, nematocides, rodenticides, and similar compounds—including nonlethal pest control agents—in terms of the biochemistry and physiology of both target and nontarget organisms and the biochemical transformations of the agents themselves.

Pesticide Science (1970–)
John Wiley, New York

Covers all aspects of research and development, application, use, and impact on the environment of products designed for pest control and crop protection.

Pharmacology and Toxicology (1945–)
Nordic Pharmacological Society, Copenhagen

Continues ***Acta Pharmacologica et Toxicologica.*** Publishes a wide-ranging array of papers in the general areas of experimental and clinical pharmacology and toxicology.

Quality Assurance (1991–)
Taylor and Francis, Washington, DC

A quarterly journal for papers in the discipline of quality assurance and quality control in the biological, physical, and engineering sciences and technology. The journal examines principles generic to all quality assurance programs as well as specific methods used to assure quality in scientific research, laboratory tests, data analysis and presentation, and manufacturing.

Radiation and Environmental Biophysics (1963–)
Springer-Verlag, Berlin

Devoted to fundamental and applied issues in radiation research and biophysics, including the biophysics of ionizing and non-ionizing radiation, biological effects of physical factors, and risk assessment and modeling for radiation and environmental factors.

Radiation Research (1954–)
Carden Jennings Publishing Company, Charlottesville, VA

Official journal of the Radiation Research Society. Publishes original articles, rapid communications, short communications, commentaries, and letters related to radiation effects and related subjects in the areas of physics, chemistry, biology, and medicine. Covers ionizing radiation; ultraviolet, visible, and infrared light; and microwaves, ultrasound, and heat.

Regulatory Toxicology and Pharmacology (1981–)
Academic Press, Orlando, FL

Official journal of the International Society of Regulatory Toxiciology and Pharmacology. Devoted to reports of significant developments, public opinion, scientific data, and ideas that bridge the gap between scientific information and the legal aspects of toxicological and pharmacological regulation.

Reproductive Toxicology (1987–)
Elsevier, New York

Features original research on the influence of chemical and physical agents on reproduction. In particular, seeks to link information on the application of *in vitro,* animal, and clinical research to the practice of clinical medicine.

Research Communications in Pharmacology and Toxicology (1996–)
PJD Publications, Westbury, NY

Offers reviews, research articles, and letters in the fields of pharmacology and toxicology, including molecular and clinical studies.

Reviews of Environmental Contamination and Toxicology (1962–)
Springer-Verlag, New York

Continuation of ***Residue Reviews.*** Includes detailed review articles concerned with any aspect of chemical contaminants, including pesticides, in the total environment, in terms of toxicological considerations and consequences.

Reviews in Environmental Health (1972–)
Freund Publishing House, London

This quarterly periodical offers comprehensive reviews in the field of environmental health and disease. It deals with the physiological and psycho-sociological inter-relationships between humans and their surroundings.

Reviews in Toxicology (1997–)
IOS Press, Amsterdam

Devoted to timely reviews on important and fundamental aspects of toxicology, including but not restricted to mechanisms of toxic action; metabolism and molecular biology of xenobiotic-metabolizing enzymes; population and other environmental effects; analytical toxicology and the fundamental basis of toxicity testing; and *in vivo* and *in vitro* toxic effects. Consists of four series: Series A, Biochemical Toxicology; Series B, Environmental Toxicology; Series C, Pesticide Toxicology; and Series D, In Vitro Toxicology and Risk Assessment.

Risk: Health, Safety and Environment (1990–)
Franklin Pierce Law Center, Concord, NH

The official publication of the Risk Assessment and Policy Association. A refereed, interdisciplinary quarterly exploring public and private efforts to manage science and technology for net reduction in the probability, severity, and aversive quality of health, safety, and environmental impacts of natural and artificial hazards.

Risk Analysis (1981–)
Plenum Publishing, New York

An official publication of the Society for Risk Analysis. Provides a focal point for new developments in risk analysis for scientists from a wide range of disciplines. It deals with health risks, engineering, mathematical and theoretical aspects of risks, and social and psychological aspects of risks, such as risk perception, acceptability, economics, and ethics.

SAR and QSAR in Environmental Research (1993–)
Gordon and Breach Science Publishers, Reading, UK

Papers cover fundamental and practical aspects of the structure-activity and structure-property relationships in the fields of environmental science, agrochemistry, toxicology, pharmacology, and applied chemistry. Focuses on emerging techniques for the building of SAR and QSAR models.

Scandinavian Journal of Work, Environment and Health (1975–)
Finnish Institute of Occupational Health, Helsinki, Finland

Deals with topics concerning the interactions between work and health—such as occupational medicine, epidemiology, toxicology, hygiene, safety, physiology, psychology, ergonomics, and sociology.

Science of the Total Environment (1972–)
Elsevier, Amsterdam

Concerned with changes in the natural level and distribution of chemical elements and compounds that may affect the well-being of the living world, and ultimately harm humanity itself. Emphasis is placed on applied environmental chemistry.

Teratogenesis, Carcinogenesis, Mutagenesis (1980–)
Wiley-Liss, New York

Publishes original research on the evaluation and characterization of teratogens, carcinogens, and mutagens. Also features critical reviews focused on topics of interest to specialists in teratology, cancer biology, and mutation research.

Teratology (1968–)
Wiley-Liss, New York

Publishes reports of studies in all areas of abnormal development and related fields. ''Teratogen Update'' is a feature dealing with the current knowledge of known human teratogens.

Toxic Substance Mechanisms (1979–)
Taylor and Francis, Philadelphia

Continues *Toxic Substances Journal*. Deals with all aspects of toxic substances, publishing scientific and technical papers, as well as those that are oriented more toward public policy or informational.

Toxicologic Pathology (1972–)
Society of Toxicologic Pathologists, Woodbury, NJ

An official publication of the Society of Toxicologic Pathologists. Papers divided into the following sections: safety assessment, investigative toxicologic pathology, environmental toxicologic pathology, and laboratory animal pathology.

Toxicological and Environmental Chemistry (1972–)
Gordon and Breach Publishers, New York

Devoted to the fundamental aspects of analysis, metabolism, general chemistry, and biochemistry of xenobiotic compounds and natural toxins as related to the environment and human health.

Toxicological Sciences (1998–)
Oxford University Press, Carey, NC

This journal replaces *Fundamental and Applied Toxicology*, for many years one of the Society of Toxicology's official publications. It encompasses all aspects of toxicology.

Toxicology (1973–)
Elsevier Science, Shannon, Ireland

Publishes original scientific papers on the biological effects arising from the administration of chemical compounds, principally to animals, tissues, and cells, but also to humans. Special sections on immunotoxicology and toxicology information resources.

Toxicology and Applied Pharmacology (1959–)
Academic Press, New York

An official journal of the Society of Toxicology. Publishes original research pertaining to the action of chemicals, drugs, and natural products on the structure and function of animal (including human) cells and/or tissues. Considers papers on mechanistic approaches and those dealing with alternatives to the use of experimental animals.

Toxicology and Ecotoxicology News (1994–)
Taylor and Francis, London

Contains reviews on areas of current interest in toxicology, environmental toxicology, and ecotoxicology.

Toxicology and Industrial Health (1985–)
Stockton Press, New York

Deals with basic and applied research in toxicology, biochemical toxicology, genetic and cellular toxicology, and risk assessment associated with hazardous wastes and groundwater.

Toxicology Letters (1977–)
Elsevier, Amsterdam

An international journal for the rapid publication of short reports on all aspects of toxicology, especially mechanisms of toxicity.

Toxicology Methods (1991–)
Taylor and Francis, London

Papers cover all aspects of the development and use of new methods and techniques in toxicology and safety assessment.

Toxicology in Vitro (1987–)
Pergamon Press, Oxford, UK

An international journal produced in association with BIBRA and publishing research and reviews on the use of *in vitro* techniques for determining the toxic effects of chemicals and elucidating their mechanisms of action.

Toxicon (1962–)
Elsevier Science, Oxford, UK

The official journal of the International Society on Toxinology, this journal focuses on toxins from animals, plants, and microorganisms.

Veterinary and Human Toxicology (1977–)
Publication Office, Comparative Toxicology Laboratories, Kansas State University, Manhattan, KS

The broad field of toxicology is covered, with original research, case reports, field observations in domestic and wild animals and in humans, scientific reviews, documentation of unusual or controversial events, announcements and news items, and letters.

Waste Management (1980–)
Elsevier Science, Oxford, UK

Devoted to the presentation of hazardous, radioactive, and industrial wastes. Includes issues such as generation, prevention, control, treatment or detoxification, handling, and ultimate residual disposition.

Water, Air, and Soil Pollution (1971–)
Kluwer Academic Publishers, Dordrecht, The Netherlands

Covers physical and biological processes affecting flora, air, water, and solid earth in relation to environmental pollution. Topics include sources, transport, deposition, accumulation, disposition, and mitigation of acid precipitation; atmospheric pollution; heavy metals; water pollution; and effects of pollutants on human beings, vegetation, fish, aquatic species, microorganisms, animals, etc.

Water Environment Research (1930–)
Water Environment Federation, Alexandria, VA

Scope ranges from degradation of water resources and basic concerns of groundwater quality and pollution control to new methods for solving complex hazardous and toxic waste problems.

Xenobiotica (1971–)
Taylor and Francis, London

Subtitled *The Fate and Safety Evaluation of Foreign Compounds in Biological Systems*. Covers general xenobiochemistry, molecular toxicology, and clinical pharmacokinetics and metabolism.

ADDITIONAL JOURNALS CARRYING RELEVANT ARTICLES

General Science Journals

Annals of the New York Academy of Sciences

Nature

New Scientist

Science

Scientific American

Proceedings of the National Academy of Sciences of the United States of America

General Medical Journals

BMJ (formerly *British Medical Journal)*

JAMA (formerly *Journal of the American Medical Association)*

Lancet

Cancer

Cancer Epidemiology, Biomarkers and Prevention

Cancer Research

Journal of the National Cancer Institute

Epidemiology

American Journal of Epidemiology

Epidemiology

Pathology

American Journal of Pathology

Archives of Pathology and Laboratory Medicine

Experimental and Molecular Pathology

Journal of Clinical Pathology

Pharmacology

Clinical Pharmacology and Therapeutics

Drug Delivery

Journal of Pharmacology and Experimental Therapeutics

Naunyn-Schmiedebergs Archives of Pharmacology

Pharmacology and Therapeutics

Public Health

American Journal of Public Health

Canadian Journal of Public Health

Public Health Reports

Waste Management

P2: Pollution Prevention Review

Remediation

Waste Management and Research

Popular and Trade Magazines

Chemecology

E: The Environmental Magazine

EM (by the Air and Waste Management Association)

Greenpeace

CHAPTER

4

Newsletters

P. J. (BERT) HAKKINEN AND FREDERICK W. STOSS

He who has recourse to poison in order to think will soon be unable to think without poison.

(Charles Baudelaire, *Artificial Paradise*)

INTRODUCTION

Newsletters from professional societies and elsewhere are valuable and timely means of communicating toxicology and risk assessment information, including recent scientific developments and issues, upcoming meetings and documents, and other information. Newsletters also announce or comment on a wide variety of other types of information resources well before, if ever, they are identified and described by traditional indexing, abstracting, and current awareness services. As such, the newsletter itself serves as a bibliographic surrogate and as a current awareness service to the reader. In many cases, the newsletter is unparalleled as a source for identifying this fugitive or gray literature. The contents of newsletters vary greatly and can reflect the particular viewpoint of the newsletter editor, publisher, or sponsoring agency or organization.

The following newsletters contain toxicology and risk assessment information, and a sample copy is often available by contacting the sponsoring organization. While some newsletters may only be officially available to members of a particular organization, it may be possible to be put on the mailing list or to perhaps put oneself on a circulation list. Also, it needs to be noted that many newsletters are now also or only available as faxes or in electronic form on the Internet; this is reflected in some of the listings below. Readers should contact print newsletter publishers directly to determine whether they have become web accessible or exist in formats other than those described here. To identify newsletters and journals available in electronic formats, the Association of Research Libraries publishes the *Directory of Electronic Journals, Newsletters, and Academic Discussion Lists* (Washington, DC; ISSN 1057-1337).

GENERAL NEWSLETTER PUBLICATIONS AND INTERNET SITES

Emory University's MedWeb: Electronic Newsletters and Journals

Emory University Robert W. Woodruff Health Sciences Center Library's Internet World Wide Web Home Page:
http://www.medweb.emory.edu

Contains links to hundreds of journals, newsletters, organizations, documents, etc.

Environment and Internet: A Resource Guide to Practical Online Environmental Information

Gaia Corporation
8630 Fenton St., Suite 226
Silver Spring, MD 20910-3803
Phone: 301-608-9469
E-mail: gaia@imyssys.com

A monthly newsletter providing descriptive reviews of Internet resources related to environmental issues, particularly those related to the fields of environmental

engineering, environmental law and regulatory compliance, chemicals in the environment (properties, health effects, toxicity), and federal agency programs. This newsletter provides critical evaluations and reviews of individual resources described.

Gale Newsletters in Print and ***Gale Database of Publications and Broadcast Media***
Gale Research
835 Penobscot Building
645 Griswold St.
Detroit, MI 48226
Phone: 313-961-2242
Web: http://www.gale.com

''Newsletters in Print,'' covering newsletters in the U.S. and Canada, is also available as a subscription service by accessing the Gale Database of Publications and Broadcast Media via Gale's ''GaleNet'' World Wide Web home page at galenet.gale.com/. GaleNet also includes the Gale's Ready Reference, with 11 of Gale's most popular reference directories on newsletters, associations, databases, etc.

Hudson's Subscription Newsletter Directory, 13th ed.
The Newsletter Clearinghouse
44 West Market St.
PO Box 311
Rhinebeck, NY 12572
Phone: 914-876-2081
E-mail: hphudson@aol.com

''World's most complete guide devoted exclusively to subscription newsletters. Lists 4,899 subscription newsletters by 52 subject headings and 158 categories.''

Internet Medicine—A Critical Guide
Lippincott Williams and Wilkins
227 East Washington Square
Philadelphia, PA 19106-1780
Phone: 215-238-4200
Web: http://www.internetmedicine.com

Published monthly as a guide to medical databases, resources, Web sites, and documents on the Internet. Includes articles on new Web sites and databases, reviews of new Internet ''e-journals,'' case studies of information searching, etc.

MedWebPlus
y-DNA, Inc.
PO Box 15523
Atlanta, GA 30333
Phone: 404-633-8881
E-mail: info@y-dna.com
Web: http://www.medwebplus.com/

A ''health science information index'' Web site whose journals, newsletters, organizations, etc. are searchable via keywords and subjects.

Newsletter Access
Sue Reading
904 West 22nd Street, #3
Austin, TX 78705
E-mail: sue@newsletteraccess.com
Web: http://www.newsletteraccess.com/

''The Web source for expert information in every field.'' Can use the Web site to search over 5000 newsletters via keywords or subjects. Includes information from Hudson's Subscription Newsletter Directory, plus many additional additions including free and e-mail newsletters.

The Newsletter on Newsletters
The Newsletter Clearinghouse
44 West Market St.
PO Box 311
Rhinebeck, NY 12572
Phone: 914-876-2081
E-mail: hphudson@aol.com

Published twice monthly as ''the only independent newsletter covering all aspects of newsletter publishing: editing, graphics, management, and promotion.'' Includes ''news, views, trends, and techniques for the newsletter professional.''

ONLINE SOURCES OF FULL-TEXT COVERAGE

Online sources of full-text coverage of newsletters, such as many of the toxicology-related titles listed below, include:

Bureau of National Affairs (see *Chemical Regulation Reporter* listing)
Environmental Law Institute (see Environmental Law Institute listing)
LEXIS/NEXIS
News Net
Occupational Health Services, Inc.
PTS NEWSLETTER DATABASE
Westlaw

LISTING OF NEWSLETTERS

The following listing also includes documents published by organizations as ''magazines'' or ''bulletins'' that serve the same general information-sharing purposes as a newsletter.

Adverse Drug Reaction Bulletin
Chapman and Hall
Subscriptions Department
International Thompson Publishing Services Ltd.
Cheriton House
North Way
Andover, Hants SP10 5BE, U.K.
Phone: 01264-342713

Published bimonthly. Covers adverse effects of drugs, including non-pharmaceuticals (e.g., herbs).

Agency for Toxic Substances and Disease Registry
Hazardous Substances & Public Health
Emory University Health Sciences Center Library's Internet World Wide Web ''MedWeb'' home page:
http://www.cc.emory.edu/WHSCL/medweb.ejs.html

Published quarterly.

Air and Waste Management Association (AWMA)
A&WMA News and ***A&WMA Environmental Compliance News***
One Gateway Center, Third Floor
Pittsburgh, PA 15222
Phone: 800-270-3444 or 412-232-3444
E-mail: info@awma.org.
Web: http://www.awma.org

A&WMA News is published monthly for members. *A&WMA Environmental Compliance News,* published monthly, covers regulatory compliance information about air pollution, hazardous waste, and water. A&WMA's vision is to be the premier international environmental organization promoting global responsibility.

Air Quality Sciences, Inc.
AirfAQS
Air Quality Sciences, Inc.
1337 Capital Circle
Atlanta, GA 30067
Phone: 800-789-0419 or 770-933-0638
Web: http://www.aqs.com

Published quarterly. Includes reviews on indoor air topics, including microorganisms, analytical methods, emissions of volatile organic compounds from building materials and consumer products, etc.

Air/Water Pollution Report's Environment Week

Formerly *Air/Water Pollution Report*. See Business Publishers, Inc., *Environmental Health Letter* listing.

American Academy of Environmental Medicine (AAEM)
Environmental Physician
American Academy of Environmental Medicine
Box CN 1001-2001
New Hope, PA 18938
Phone: 316-684-5500
E-mail: aaem@bellatlantic.net
Web: http://www.healthy.net/pan/pa/naturaltherapies/aaem

Formerly the Society for Clinical Ecology. Newsletter published quarterly. This association of physicians and others interested in the clinical aspects of environmental medicine promotes an understanding of environmental illness and methods of controlling environmental illness.

American Academy of Forensic Sciences
American Academy of Forensic Sciences
410 N. 21st St.
Suite 203
Colorado Springs, CO 80901-0669
Phone: 719-636-1100
Web: http://www.aafs.org

Newsletter published bimonthly. Contains information about the forensic sciences.

American Association for Clinical Chemistry (AACC)
Clinical Chemistry News
American Association for Clinical Chemistry
2101 L St., NW
Suite 202
Washington, DC 20037-1526
Phone: 202-857-0717
Web: http://www.aacc.org

Newsletter published monthly. Contains information about clinical toxicology, molecular pathology, and other topics.

American Bar Association, Section of State and Local Government Law
Environmental Law Committee
Environmental Law Committee
Stephanie Brown, Committee Chair
U.S. EPA
401 M Street, SW (MC-2272A)
Washington, DC 20460
Phone: 202-564-2596
E-mail: brown-stephanie@epamail.gov
Web: http://www.abanet.org/statelocal/environment/

Newsletter describing the American Bar Association's programs, activities, and other initiatives related to the environment; and news about environmental laws and policies is available on the Web site. Committee mem-

bers also get *Local Government Law Weekly* and Quarterly *State and Local Law News.*

American Board of Toxicology (ABT)
American Board of Toxicology
PO Box 30054
Raleigh, NC 27622
Phone: 919-847-8601
E-mail: abtox@mindspring.com

Newsletter published annually. Contains information of interest to toxicologists certified by this organization.

American College of Forensic Examiners (ACFE)
Forensic Examiner
American College of Forensic Examiners
611 East Wells St.
Milwaukee, WI 53202
Phone: 414-226-2169
E-mail: acfe@execinc.com
Web: http://www.acfe.com

Formerly the American Board of Forensic Examiners. Newsletter published monthly. Contains information about the forensic sciences.

American College of Medical Toxicology (ACMT)
American College of Medical Toxicology
777 E. Park Drive
PO Box 8820
Harrisburg, PA 17105-8820
Phone: 717-558-7846
Web: http://www.acmt.net

Formerly the American Board of Medical Toxicology. Newsletter published three or four times a year. Members include physicians interested in clinical (medical) toxicology.

American College of Toxicology (ACT)
American College of Toxicology
9650 Rockville Pike
Bethesda, MD 20814
Phone: 301-571-1840
Web: http://www.actox.org

Newsletter published bimonthly. Contains information of interest to members of this organization, including annual meeting details, courses, research opportunities, calendar of events, etc.

American Crop Protection Associaton (ACPA)
Bulletin; Growing Possibilities; and ***This Week and Next***
American Crop Protection Association
1156 15th St., NW
Suite 400
Washington, DC 20005
Phone: 202-296-1585
Web: http://www.acpa.org

Formerly the National Agricultural Chemicals Association. *Bulletin* is published periodically. *Growing Possibilities* is published quarterly. *This Week and Next* is published weekly. Include information about agricultural chemical products (e.g., fumigants, scalicides, plant sprays and dusts, defoliants, soil disinfectants, weed killers, insecticides, and rodenticides). (Also see listing for International Group of National Associations of Manufacturers of Agrochemical Products (GIFAP).)

American Fund for Alternatives to Animal Research
AFAAR News
American Fund for Alternatives to Animal Research
c/o Dr. Ethel Thurston
175 W. 12th St., No. 16-G
New York, NY 10011
Phone: 212-989-8073

Newsletter published three times a year. Contains information about in vitro alternatives to the use of whole animals in toxicology.

American Industrial Health Council (AIHC)
Bulletin and ***Newsletter***
American Industrial Health Council
2001 Pennsylvania Ave., NW, Suite 760
Washington, DC 20006
Phone: 202-833-2131
E-mail: membershipservices@aihc.org

Bulletin published weekly by fax. Contains information about AIHC's risk assessment and other activities, notices of new toxicology and risk assessment information for chemicals, and other information (e.g., proposed new U.S. EPA regulations, upcoming workshops, etc.). A hard-copy newsletter is published monthly.

American Petroleum Institute (API) Reports
American Petroleum Institute
1220 L St., NW
Washington, DC 20005-4070
Phone: 202-682-8000
Web: http://www.api.org

Newsletter published quarterly. Contains current issues and activities, including environmental and health topics related to petroleum.

Animal Welfare Information Center (AWIC)
Bulletin
U.S. Department of Agriculture
Agricultural Research Service

National Agriculture Library
10301 Baltimore Ave., 5th Floor
Beltsville, MD 20705-2351
Phone: 301-504-6212
E-mail: awic@nal.usda.gov
Web: www.nal.usda.gov/awic/awic.htm

Published quarterly, AWICs newsletter contains information for improved animal care and use in research, teaching, and testing.

Antimicrobics and Infectious Diseases Newsletter
Antimicrobics and Infectious Diseases Newsletter
Elsevier Science, Inc.
655 Ave. of the Americas
New York, NY 10010

Newsletter published monthly. Contains information on current and expected changes in regulatory standards and guidelines for antimicrobial agents. Includes information on new drugs, in vitro diagnostics, and the diagnosis and treatment of infectious disease. Also has editorials and case studies.

(U.S.) Army
Environmental Update
U.S. Army Environmental Center
SRIM-AEC-PA
Building E-4461T
Aberdeen Proving Ground, MD 21020-5401
Phone: 410-671-3348
E-mail: docmaster@aec.apgea.army.mil
Web: http://aec.army.mil/

Published quarterly by the Army Environmental Center. Contains articles on Army environmental programs (installation-specific and programmatic) and other environmental programs, projects, issues, technology, and regulations that have an impact on the Army or the military as a whole.

Asbestos and Lead Abatement Report

See Business Publishers, Inc., *Environmental Health Letter*

Asbestos Litigation Reporter

See *Toxic Clinical Litigation Reporter*

Association of Occupational and Environmental Clinics (AOEC)
AOEC Newsletter
Association of Occupational and Environmental Clinics
1010 Vermont Ave., NW, Suite 513
Washington, DC 20005
Phone: 202-347-4976
Web: http://occ.env-med.mc.duke.edu/oem/aoec.htm

Newsletter provides news and updates of information related to occupational and environmental health issues. Includes calendar items and reviews of various resources.

A&WMA News and ***A&WMA Environmental Compliance News***
Air and Waste Management Association
One Gateway Center, Third Floor
Pittsburgh, PA 15222
Phone: 800-270-3444 or 412-232-3444
E-mail: info@awma.org
Web: http://www.awma.org

A&WMA News is published monthly for members. *A&WMA Environmental Compliance News,* published monthly, covers regulatory compliance information about air pollution, hazardous waste, and water. A&WMA's vision is to be the premier international environmental organization promoting global responsibility.

AWI Quarterly
The Animal Welfare Institute
PO Box 3650
Washington, DC 20007
Phone: 202-337-2332
E-mail: awi@animalwelfare.com
Web: http://www.animalwelfare.com

Devoted to all aspects of animal welfare, including animals used in experimental research settings and alternatives to use of animals in laboratories.

***Biological Effects of Low-Level Exposure* (*BELLE*)**
BELLE Office
Northeast Regional Environmental Public Health Center
School of Public Health
University of Massachusetts
Amherst, MA 01003
Phone: 413-545-3164
E-mail: edwardc@schoolph.umass.edu
Web: http://www.belleonline.com

The Biological Effects of Low-Level Exposure (BELLE) Advisory Committee also publishes hard copies of the thrice-yearly BELLE newsletter. BELLE disseminates information on the appropriateness of various proposed dose-response curves for low-level exposures to chemicals and radioactivity. The World Wide Web home page contains information about the organization, upcoming meetings, and online versions of recent BELLE newsletters.

Biomedical Safety and Standards
Lippincott Williams and Wilkins
PO Box 1600
Hagerstown, MD 21741-9910
Phone: 800-638-3030 or 301-714-2300
Web: http://services.lww.com/customerservice/

Newsletter published 22 times a year. Topics include clinical safety and product hazards, accidents/incidents, recalls/investigative reports, news about standards and regulations, information about new information resources, etc.

The Blue Sheet

See F-D-C Reports, *The Rose Sheet*

British Industrial Biological Research Association (BIBRA)
(*BIBRA*) *Bulletin*
BIBRA (British Industrial Biological Research Association) International
Woodmansterne Rd.
Carshalton, Surrey SM5 4DS, U.K.
Phone: 44(0)181-652-1000
E-mail: help@bibra.co.uk
Web: http://www.bibra.co.uk

Published monthly as a current awareness journal ''in all areas of chemical toxicology,'' including summaries of key scientific findings an key legislative changes worldwide.

Brownsfield Business Information Network (BBIN)
The BBIN Report
McKenna & Cuneo, L.L.P.
1900 K St., NW
Washington, DC 20006-1108
Phone: 202-496-7761
Web: http://www.mckennacuneo.com

Newsletter published quarterly. Covers topics related to Brownsfields redevelopment efforts at the federal, state, and local levels. It also includes developments in emerging areas of environmental law, including environmental justice and regulatory reinvention initiatives.

Bureau of National Affairs (BNA)
1231 25th St., NW
Washington, DC 20037
Web: http://www.bna.com

Many of the following BNA publications are available for delivery and searching via the World Wide Web. Delivery and searching may also be available via other online services, e.g., LEXIS/NEXIS and Westlaw.

Chemical Regulation Newsletter

Published weekly. A reliable source for up-to-date reporting and reference on the regulation of chemicals, pesticides, and hazardous materials transport. Includes the Hazardous Materials Transportation Index to Chemical Regulations. Web: http://www.bna.com/prodcatalog/ens/alpha.html

Other toxicology- and risk assessment-related newsletters and other publications from BNA include:

Air and Water Pollution Control Guides
Web: http://www.bna.com/prodcatalog/ens/alpha.html

Desktop how-to manuals with step-by-step guidance on complying with federal and state pollution control regulations, including those related to air toxics.

Daily Environment Report
Web: http://www.bna.com/prodcatalog/ens/alpha.html

A daily briefing on significant environmental actions and events of the past 24 hours.

Environment Reporter
Web: http://www.bna.com/prodcatalog/ens/alpha.html

An information resource on broadly defined environmental protection and pollution control, including issues related to toxic and hazardous chemicals and wastes.

Environment and Safety Compliance Calendar
Web: http://www.bna.com/prodcatalog/ens/alpha.html

A resource for day-to-day and long-range planning listing compliance deadlines over the next five years.

Environmental Compliance Bulletin
Web: http://www.bna.com/prodcatalog/ens/alpha.html

Practical, hands-on, how-to help and information for meeting environmental compliance obligations.

Environmental Due Diligence Guide
Web: http://www.bna.com/prodcatalog/ens/alpha.html

Provides legal reference support on environmental liability issues in real estate and other commercial transactions, including issues related to hazardous waste sites and other Superfund issues.

Federal Environment and Safety Regulatory Monitoring Report
Web: http://www.bna.com/prodcatalog/ens/alpha.html

Summarizes all proposed and final rules of the EPA, OSHA, and the hazardous materials transportation activities of the DOT.

International Environment Reporter
Web: http://www.bna.com/prodcatalog/ens/alpha.html

Provides information related to international environmental law and policy in the major industrialized and developing nations.

Job Safety and Health
Web: http://www.bna.com/prodcatalog/ens/alpha.html

Provides practical information on developing worker safety and health programs while complying with laws, regulations, and OSHA standards.

Occupational Safety and Health Reporter
Web: http://www.bna.com/prodcatalog/ens/alpha.html

Provides information on monitoring and complying with changing federal and state workplace safety and health requirements.

Product Safety and Liability Reporter
Web: http://www.bna.com/prodcatalog/ens/alpha.html

Provides comprehensive coverage of product liability litigation and product safety issues.

Right-to-Know Planning Guide
Web: http://www.bna.com/prodcatalog/ens/alpha.html

A how-to management guide that walks you through every aspect of compliance with federal and state community right-to-know laws.

State Environment and Safety Regulatory Monitoring Report
Web: http://www.bna.com/prodcatalog/ens/alpha.html

Provides up-to-date information related to environment and safety regulatory activity in all 50 states and the District of Columbia.

Toxics Law Reporter
Web: http://www.bna.com/prodcatalog/ens/alpha.html

Provides weekly notification of toxic tort, hazardous waste, and related insurance litigation.

Business Publishers, Inc.
951 Pershing Drive
Silver Spring, MD 20910-4464
Phone: 301-589-5103 or 800-274-6737
E-mail: bpinews@bpinews.com
Web: http://www.bpinews.com

Environmental Health Letter

Newsletter published biweekly. Contains information about environmental health policy, risk assessment, funding, and research. Includes coverage of pesticides, indoor air pollution, new toxicity endpoints, regulatory agency activities, endocrine modifiers, risk communication, infectious diseases, electromagnetic fields, climate change, etc. Other toxicology- and risk assessment-related newsletters from this publisher include:

Air/Water Pollution Report's Environment Week (formerly *Air/Water Pollution Report*)
Asbestos & Lead Abatement Report
Environmental Remediation Technology
Ground Water Monitor
Hazardous Waste News (formerly *Toxic Materials News*)
HazMat Transport News
Indoor Pollution News (formerly *Indoor Pollution Report*)
Medical Waste News
Noise Regulation Report
Nuclear Waste News
Occupational Health & Safety Letter
Sludge Newsletter
Solid Waste Report

Superfund Week

Newsletter published weekly. Includes information on federal and state legislation, programs, and efforts related to Superfund cleanup sites.

CATALYST

See (The) Johns Hopkins Center for Alternatives to Animal Testing

Canadian Centre for Occupational Health and Safety (CCOHS)
At the Centre
Canadian Centre for Occupational Health and Safety
250 Man St. East
Hamilton, Ontario, Canada, L8N 1H6
Phone: 416-572-2981 or 800-263-8276
E-mail: custserv@ccohs.ca
Web: http://www.ccohs.ca

Covers occupational safety and health news, including upcoming workshops and other meetings.

Canadian Network of Toxicology Centres
CNTC News
2nd Floor, Bovey Bldg.
Gordon Street
University of Guelph
Guelph, Ontario N1G 2W1
Phone: 519-837-3320
Web: http://www.uoguelph.ca/cntc/newslet.htm

Newsletter published twice a year. Goals include promoting communication among CNTC member scientists and the public and educating Canadians about toxicology.

Center for Environmental Communication Studies (CECS)
Center for Environmental Communication Studies
University of Cincinnati
PO Box 210184
Cincinnati, OH 45221-0184
Phone: 513-556-4440
E-mail: depoe@uc.edu or duffiejj@emial.uc.edu
Web: http://www.uc.edu/cees/newsletters.html

Newsletter published several times a year. Goal is to enhance the understanding and quality of communication processes and practices among citizen, industry, and government participants in environmental and health policy formation and implementation.

Center for Rare Earths and Magnets (CREM)

See Rare-Earth Information Center (RIC)

Center for Science in the Public Interest (CSPI)
Nutrition Action Healthletter
Center for Science in the Public Interest
1875 Connecticut Ave., NW, Suite 300
Washington, DC 20009
Phone: 202-332-9110
E-mail: cspi@cspinet.org
Web: http://www.cspinet.org

Newsletter published 10 times a year. Examines the effects of science and technology on society and policy development. Primary focus relates to food safety and nutrition at the national level. Emphasis is related to testing procedures for food additives, labeling requirements, and advertising practices. Supports a host of educational activities and information programs related to food safety issues.

ChemADVISOR, Inc.
ChemAdvisory
Available from ChemADVISOR, Inc.
750 William Pitt Way
Pittsburgh, PA 15238
Phone: 412-826-3750
E-mail: staff@chemadvisor.com
Web: http://www.chemadvisor.com

Newsletter published quarterly. Covers chemical safety and regulatory compliance in the workplace and elsewhere. Includes information about hazard communication and ecotoxicity.

Chemical Education Foundation (CEF) [formerly the National Association of Chemical Distributors Educational Foundation (NACDEF)]
Stewardship News
1525 Wilson Boulevard, Suite 750
Arlington, VA 22209
Phone: 730-527-6223
Web: http://www.chemed.org

Newsletter published quarterly. CEF is dedicated to promoting product stewardship activities and produces a range of materials to help companies meet their commitment to handle chemical safety throughout a product's life cycle (usage, storage, transportation, disposal, and recycling). CEF also produces materials geared toward communities and the general public.

Chemical Industries Newsletter
SRI Consulting, Chemical Business Research Division
SRI International
333 Ravenswood Ave.
Menlo Park, CA 94205-3477
Phone: 650-859-3900
Web: http://www-cmrc.sri.com

Newsletter published six times a year. Contains global business overviews of selected chemicals and materials (e.g., vitamins and various polymers/fibers), including environment-related information.

Chemical Industry Institute of Toxicology (CIIT)
Activities
Chemical Industry Institute of Toxicology
PO Box 12137
Research Triangle Park, NC 27709-2137
Phone: 919-558-1310
E-mail: CIITinfo@ciit.org
Web: http://www.ciit.org

Contains reviews and other information related to human risk assessments of chemicals, e.g., development and validation of testing methods, development of data used in risk assessments, and the doctoral and postdoctoral training of toxicologists. Also publishes other CIIT information-sharing newsletter-type documents, including CIIT *Impact* and CIIT *Insights*, discussing toxicology and risk assessment advances and issues and CIIT's efforts and research related to these topics.

Chemical Manufacturers Association (CMA)
News (and other CMA newsletters and update reports)
Chemical Manufacturers Association
1300 Wilson Blvd.
Arlington, VA 22209
Phone: 703-741-5000
Web: http://www.cmahq.com/

Magazine published 10 times a year. Contains information on chemical industry issues and activities related to chemicals, including human, environmental, risk assessment, and regulatory topics related to chemicals. A ''Publications and Resources Catalog'' updated yearly contains an extensive listing, descriptions, and

instructions for ordering information on CMA's many newsletters and update reports, including ones on responsible care, communications, international health, safety, and environmental topics, etc., some of which are only available to members of CMA. Catalog is available from CMA Publications Fulfillment, 341 Victory Drive, Herndon, VA 20170 (Phone: 703-709-0166).

Color Pigments Manufacturers Association (CPMA)
Color Pigments Manufacturers Association
PO Box 20839
Alexandria VA 22320
Phone: 703-684-4044

Newsletter published monthly. Contains information on the toxicity of inorganic and organic color pigments.

Community and Worker Right-to-Know News
Thompson Publishing Group
1725 K St., NW
Suite 700
Washington, DC 20006
Phone: 202-872-4000
Web: http://www.thompson.com

Published biweekly. Covers chemical disclosure requirements, emergency response programs, hazard communication, and industry liability. Includes disclosure and notification requirements of U.S. SARA Title III, the U.S. OSHA Hazard Communications Standard, and other U.S. regulatory programs.

Connecticut United for Research Excellence, Inc. (CURE)
BioRAP (Biological Research for Animals and People)
PO Box 5048
Wallingford, CT 06492-7548
Phone: 203-294-3521

Newsletter contains science and medicine topics of interest to students and others (e.g., cancer causation, prevention and treatment, overviews of various research occupations, and nutrition). BioRAP's target audience is children in grades 6–8. CURE is a non-profit coalition of universities and research institutes, health-related professional societies and corporations, hospitals, and voluntary health organizations.

Cosmetic Insider's Report
Cosmetic Insider's Report
270 Madison Avenue
New York, NY 10016
Phone: 212-951-6600
E-mail: stankatz@cosmeticindex.com
Web: http://www.cosmeticindex.com/ci/cir/

Newsletter published twice a month, except three times in July and once in December. Contains product news and other information of interest to the cosmetics industry.

Cosmetic, Toiletry and Fragrance Association (CTFA)
CTFA News
Cosmetic, Toiletry & Fragrance Association
1101 17th St., Suite 300
Washington, DC 20036-4702
Phone: 202-331-1969
Web: http://www.ctfa.org

Newsletter published 21 times a year for members of CTFA. Contains toxicology, regulatory and other information of interest to CTFA members. CTFA also publishes a *Tech/Reg Notes* newsletter and *Legislative and Regulatory Update* for members and a public *Cosmetic Ingredient Review Developments.*

Daily Environment Report

See Bureau of National Affairs

Daily Regulatory Reporter (DRR)
Jay R. Boyer, Editor
Daily Regulatory Reporter
Dakota Communications Group
PO Box 527
Fishers, TN 46038-0527
Phone: 317-844-0831
E-mail: jrboyer@dakotacg.com
Web: http://www.dakotacg.com

Daily Internet delivery of a summary of all federal environmental, health, safety, and risk regulatory activity from the previous day. Also includes regulatory agency and other press releases, summaries of news stories, etc. Also published as a technical edition covering environmental, safety, and health, and risk areas and as a safety and health edition covering issues relevant to occupational safety, health, and risk.

(U.S.) Department of Defense (DOD)
Hazardous Technical Information Services (HTIS) Bulletin
Defense Supply Center Richmond
DSCR-VBC/HTIS
8000 Jefferson Davis Highway
Richmond, VA 23297-5609
Phone: 804-279-5168 or 800-848-4847
E-mail: htis@dscr.dla.mil
Web: http://www.dscr.dla.mil/htis/htis.htm

Free bimonthly publication ''designed to keep U.S. federal agency personnel informed of technical and regulatory developments on the environmentally safe management of hazardous materials and wastes.''

(U.S.) Department of Housing and Urban Development (HUD)
Lead Post
U.S. Department of Housing and Urban Development
Office of Lead Hazard Control
451 7th St., SW
Room B-133
Washington, DC 20410
Phone: 202-755-1785
Web: http://www.hud.gov/lea/leapboff.html

Free quarterly publication describing lead pollution programs, resources, grants, and other resources for identifying potential lead hazards, strategies for prevention of exposure, and cleanup activities.

Dioxin Digest
Center for Health, Environment, and Justice
PO Box 6806
Falls Church, VA 22040-6806
Phone: 703-237-2249
E-mail: chw@essential.org
Web: http://www.essential.org/cchw/

This newsletter serves as a digest of information and resources for community activists and others seeking information to stop dioxin exposure. Each issue contains information and strategies for neighborhood and community groups, local officials and agency staff, and citizens seeking ways to reduce or eliminate exposure to dioxins. Coverage is international, and a calendar of events is provided.

EMF Health and Safety Digest
Rover S. Banks Associates, Inc.
PO Box 141049
Minneapolis, MN 55414-6049
Phone: 612-623-4600
E-mail: digest@rsba.com
Web: http://www.rsba.com

Formerly Transmission/Distribution Health & Safety Report. Published 10 times a year ''on behalf of the EMF Information Project.'' The EMF Project's support includes utility organizations worldwide. Covers electric and magnetic field research, regulations, litigation, meetings, etc.

Endocrine/Estrogen Letter
Global Press
2008 Q St., NW, Ste. 100
Washington, DC 20009
Phone: 202-667-2855
Web: http://www.eeletter.com

Published 24 times per year as a current awareness service providing unbiased information related to the topic of endocrine disrupters.

Entomological Society of America (ESA)
Entomological Society of America
9301 Annapolis Rd.
Lanham, MD 20706-3115
Phone: 301-731-4535
Web: http://www.entsoc.inter.net

Newsletter published monthly. Contains information on biochemistry and toxicology, insecticides, etc.

ENVIRONews
FiatLux Publications
PO Box 7776
Fremont, CA 94537-7776
Phone: 510-494-1185
E-mail: FiatLuxPub@aol.com
Web: http://www.envirocomp.org

Published bimonthly, and is official newsletter of EnviroComp Institute. Provides a summary and review of environmental activities, facts, opinions, products, publications and conferences and meetings. Topics related to toxicology and environmental health are included, including environmental Internet Web sites.

Environmental and Occupational Health Sciences Institute (EOHSI)
Environmental & Occupational Health Sciences Institute
170 Frelinghuysen Rd.
Piscataway, NJ 08855
Phone: 908-445-0110
Web: http://eohsi.rutgers.edu

Develops environmental and occupational health education newsletters and other materials for the schools, workplace, and community.

Environmental Compliance Bulletin

See Bureau of National Affairs

Environmental Defense Fund (EDF)
EDF Letter
Environmental Defense Fund
257 Park Ave., S.
New York, NY 10010
Phone: 800-684-3322
E-mail: edf@edf.org
Web: http://www.edf.org

Addresses a variety of environmental issues, including chemicals in the environment and public health aspects of chemicals.

Environmental, Health and Safety Bulletin
McKenna & Cuneo, L.L.P.
1900 K St., NW
Washington, DC 20006-1108

Phone: 202-496-7761
Web: http://www.mckennacuneo.com

Newsletter published 10 times a year. Includes developments in environmental, health, and safety laws and regulations.

Environmental Health Monthly
Center for Health, Environment, and Justice
PO Box 6806
Falls Church, VA 22040-6806
Phone: 703-237-2249
E-mail: cchw@essential.org
Web: http://www.essential.org/cchw/

This newsletter is designed for health care professionals, community leaders, local officials, and others seeking information about environmental health issues and concerns at the community level. *EHM* reviewers select original, technical articles from the environmental health and medicine literature (often provided as a reprint) and then provide lengthy descriptive reviews and summaries of the articles' content, results, and conclusions.

Environmental Laboratory: Washington Report
LRP Publications
747 Dresher Rd.
PO Box 980
Horsham, PA 19044-0980
Phone: 215-784-0860
Editorial Offices at 580 Village Blvd., Suite 140
West Palm Beach, FL 33409
Phone: 561-687-1220 ext. 724 or 561-687-9410

Published biweekly. Covers federal government news and regulatory compliance issues, industry developments, and practical aspects for environmental laboratory management. Coverage includes testing methods, standards, protocols, and contracts awarded and business aspects of environmental laboratory management, including those facilities providing services related to water quality, biomonitoring, and toxicology.

Environmental Law Compliance Updates
M. Lee Smith Publishers & Printers
PO Box 198867
Nashville, TN 37219-8867
Phone: 800-274-6615
E-mail: custserv@mleesmith.com
Web: http://www.mleesmith.com

Reports on the most recent state-specific environmental law developments via state-specific newsletters published monthly.

Environmental Law Institute (ELI)
Information available from Environmental Law Institute
1616 P St., NW, Suite 200
Washington, DC 20036
Phone: 202-939-3800
Web: http://www.eli.org

Developed by the Public Law Education Institute and the Conservation Foundation to conduct and sponsor research on environmental law and policy, maintain a clearinghouse for information, and provide training. Conducts research, including on toxic substances and hazardous waste topics. Publications include newsletters and other documents.

Environmental Manager
John Wiley & Sons—Journals
605 Third Ave.
New York, NY 10158
Phone: 212-850-6645
E-mail: subinfo@ Jwiley.com

Provides case studies, news, and issues-management scenarios for environmental problems, including those related to toxic-waste cleanup, underground storage tanks, and environmental health.

(U.S.) Environmental Protection Agency (EPA)
Activities Update
Web: http://www.epa.gov/ocepalll/actupd

Updated monthly.

(U.S.) Environmental Protection Agency (EPA)
Chemicals in Our Community
U.S. Environmental Protection Agency
Office of Pollution Prevention and Toxins (OPPT)
Environmental Assessment Division (Mail code 7408)
401 M St., SW
Washington, DC 20460
Phone: 202-554-1404
Web: http://www.epa.gov/opptintr/chemcomm

Consolidates ''Chemicals in the Environment'' and ''Chemicals in Progress Bulletin.''

(U.S.) Environmental Protection Agency (EPA) Newsletters

EPA's many Web-based newsletters may be accessed at www.epa.gov/epahome/newslett.htm.

(U.S.) Environmental Protection Agency (EPA)
OPPT NEWSBREAK
U.S. Environmental Protection Agency
Office of Pollution Prevention and Toxics (OPPT) Library
Northeast Mall, Room B606 (Mail code 7407)
401 M St., SW, Washington, DC 20460
Phone: 202-260-3944
E-mail: library-tsca@epamail.epa.gov
Web: http://www.epa,gov/opptintr/library/newsbrk.htm

Provides a daily synopsis via the Internet of environmental issues covered in the major U.S. national newspapers (e.g., *New York Times, USA Today, Washington Post, Washington Times*). Coverage includes information resources and services. Available as an electronic list by sending the command ''subscribe OPPT-NEWSBREAK Yourfirstname Yourlastname'' to: list server@unixmail.rtpnc.epa.gov, or at the Web site.

Environmental Remediation Technology

See Business Publishers, Inc., *Environmental Health Letter*

Environmental Reporter

See Bureau of National Affairs

Environmental and Research Foundation
Rachel's Environment & Health Weekly
Environmental Research Foundation
PO Box 5036
Annapolis, MD 21403-7036
E-mail: erf@rachel.org
Web: http://www.rachel.org

Newsletter published weekly and available free via the Internet. To subscribe, send Internet e-mail message (without the quotation marks) to ''rachel-weekly-request@world.std.com,'' with ''SUBSCRIBE'' in the message.

Environmental Software Report
Donley Technology
PO Box 152
Colonial Beach, VA 22443
Phone: 800-201-1595 or 804-224-9427
Web: http://www.donleytech.com

Published eight times a year, this is the only newsletter devoted exclusively to environmental software. Intended audience includes environmental managers, software developers, government officials, and consultants. Includes information and news about new and upgraded software packages, databases, and online systems from government and commercial developers.

Environment and Resource Management Division (ERMD)
ERMD News
Environment and Resource Management Division (ERMD)
Special Libraries Association
1700 Eighteenth St., NW
Washington, DC 20009-2508
Phone: 202-234-4700
E-mail: sla@sla.org

Formerly *ERMD Newsletter*. Published quarterly, provides information related to the activities of ERMD. Issues highlight new programs, services, publications, and other electronic resources. Partial text of the newsletter is available at www.wcocom/~rteeter/ermd/news/index.html.

European Association of Poisons Centres and Clinical Toxicologists (EAPCCT)
c/o Dr. J. Meulenbelt
General Secretary
National Poisons Control Centre
National Institute of Public Health and the Environment
PO Box 1, 3720 BA
B Bilthover
The Netherlands
Phone: 31-30-25085-61
Web: http://www.eapcct.org

Publishes a quarterly newsletter. Organization's purpose is to improve interactions between clinical toxicologists and poison information specialists.

European Centre for Ecotoxicology and Toxicology of Chemicals (ECETOC)
European Centre for Ecotoxicology and Toxicology of Chemicals
Ave. Van Nieuwenhuyse, 4 bte. 6
B-1160 Brussels, Belgium
Phone: 32-2-6753600
E-mail: francis.carpanini@ecetoc.org

Publishes a monthly *Information Sheet*. This chemical industry organization collects and disseminates toxicology information, organizes literature studies and testing programs, works with regulatory agencies and other groups, etc.

European Chemical Industry Council (CEFIC)
Spotlight
European Chemical Industry Council
Ave. Van Nieuwenhuyse, 4 Box 1
B-1160 Brussels, Belgium
Phone: 32-2-6767211
E-mail: mcil@cefic.be
Web: http://www.cefic.org/

Newsletter published 10 times a year. Covers the chemical industry in Europe, including safety issues. Has numerous working groups on chemicals.

European Environmental Mutagen Society
EEMS Newsletter
European Environmental Mutagen Society
c/o Nina Ostenfelot, Secretary
Genetic and Reproduction Toxicology
H. Lundbeck A/S
Ottiliavej 9
2500 Valby-Copenhagen, Denmark

E-mail: nos@lvnpeck.com
Web: http://193.51.164.11/eems/index.htm

Newsletter published twice a year. Covers genetic toxicology and environmental mutagenesis.

European Science Foundation
ESF Communications
European Science Foundation
1, quai Lezay-Marnesia
F-67080 Strasbourg Cedex, France
Phone: 33-0-388-76-7625
E-mail: communications@esf.org
Web: http://www.esf.org

Newsletter published twice a year. Activities include sponsorship of a fellowship program in toxicology.

EUROTOX (Association of European Toxicologists & European Societies of Toxicology)
c/o Professor E. Hietanen
Department of Clinical Physiology
University of Turku Hospital
Turku, FIN20520
Finland
Phone: 35-31-60-81403
E-mail: einohie@utu.fi
Web: http://www.uta.fi/eurotox/index.htm

Newsletter published three times a year. Contains information on drug toxicity and other areas of toxicology, including various kinds of toxic effects and testing methods.

Everyone's Backyard
Center for Health, Environment, and Justice
PO Box 6806
Falls Church, VA 22040-6806
Phone: 703-237-2249 or 703-237-8389
E-mail: CCHW@essential.org
Web: http://www.essential.org/orgs/cchw

This newsletter/journal is devoted to the strategies, achievements, and events of environmental health activists and advocates. Each issue contains feature articles describing specific issues, concerns, and achievements. Columns provide resources, strategies, and news related to the technical, scientific, legal, policy, and advocacy perspectives associated with environmental health and medicine, emergency preparedness, community response, and other local concerns about toxic, chemical, and hazardous wastes.

***EXtension TOXicology NETwork* (*EXTOXNET*)**

See *University of California, Davis, Environmental Toxicology Newsletter*

(*Inside Washington's*) *FDA Week*

See Inside Washington Publishers

F-D-C Reports
F-D-C Reports, Inc.
5550 Friendship Blvd., Suite One
Chevy Chase, MD 20815-7278
Phone: 800-332-2181 or 301-664-7258
E-mail: fdcr@fdcr.com
Web: http://fdcreports.com

Newsletters published weekly or monthly. Full texts of some F-D-C Reports are also available via CD-ROM and various online services. *The Rose Sheet*, containing U.S. FDA, trade organization, industry, and other information, is intended for executives in the toiletries, fragrances and skin care industry. Other newsletters from this publisher include:

Health News Daily
Pharmaceutical Approvals Monthly
The Blue Sheet (health policy and biomedical research)
The Gold Sheet (U.S. FDA-related quality control developments)
The Gray Sheet (medical devices, diagnosis and instrumentation)
The Green Sheet (pharmacy-related news)
The NDA Pipeline
The Pink Sheet (prescription pharmaceuticals and biotechnology)
The Silver Sheet (medical device-related quality control and design news)
The Tan Sheet (nonprescription pharmaceuticals and nutritional news)

Flavor and Extract Manufacturers Association (FEMA) of the United States
Regulatory & Legislative Update
Flavor and Extract Manufacturers' Association (FEMA) of the United States
1620 I St., NW, Suite 925
Washington, DC 20006
Phone: 202-293-5800

Update reports on regulatory and legislative issues of interest to the flavor industry.

(The) Food and Drug Law Institute (FDLI)
Update
The Food and Drug Law Institute
1000 Vermont Avenue, NW
Suite 1200
Washington, DC 20005
Phone: 202-371-1420
E-mail: comments@fdli.org
Web: http://www.fdli.org

Newsletter published bimonthly for members of this nonprofit, educational foundation whose mission is to increase knowledge of the laws, regulations, and policies pertaining to foods, human and animal drugs, medical devices, biological products, radiation-emitting products, and cosmetics.

Food Chemical News
CRC Press, Inc.
1101 Pennsylvania Ave., SE
Washington, DC, 20003
Phone: 1-800-272-7737
Web: http://www.crcpress.com

Newsletter published weekly. Contains information about regulation policy, developments in food science, and issues in food safety. Other newsletters and weekly updates from this publisher include:

Food Chemical News Guide
Food Labeling News
World Food Chemical News

Freshwater Foundation
Health & Environment Digest
Freshwater Foundation
Gray Freshwater Center
2500 Shadywood Road
Navarre, MN 55331
Phone: 612-471-7685
E-mail: Frshwtr@freshwater.org

Newsletter published 11 times a year. Contains information about relationships between human health and environmental problems and contaminants. Foundation's mission is to pursue the sustainable use of freshwater resources through education, conferences, publications, and research.

Fund for the Replacement of Animals in Medical Experiments (FRAME)
FRAME NEWS
FRAME
Russell & Burch House
96-98 North Sherwood St.
Nottingham NG1 4EE, UK
Phone: 44-0115-958-4740
E-mail: atla@frame-u.k.demon.co.uk
Web: http://www.frame-uk.demon.co.uk./

''FRAME is working towards a future in which the integrated use of computers to model structure activity relationships and biochemical, physiological and toxicological processes, and in vitro tests using human cells, will be used to assess human risk directly, without recourse to any animal testing of chemicals'' Fentem, J. and Balls, M. (1992). *In vitro* alternatives to toxicity testing in animals, ***CHEM. IND.* 6,** 207–211.

(*The*) *Gold Sheet*

See F-D-C Reports, *The Rose Sheet*

(*The*) *Gray Sheet*

See F-D-C Reports, *The Rose Sheet*

Global Crop Protection Federation (GCPF)
Bulletin
Avenue Louise 143
B 1050 Brussels, Belgium
Phone: 32-2-542-04-10
E-mail: info@gcpf.org

Formerly the International Group of National Associations of Manufacturers of Agrochemical Products (GIFAP); was also known as Groupement International des Associations Nationales de Fabricants de Produits Agrochimiques. Newsletter published bimonthly. Covers toxicology and other information for insecticides, fungicides, and herbicides.

Green Chemistry Institute (GCI)
1650 Research Boulevard
Rockville, MD 20850
Phone: 301-294-2854
E-mail: breenjl@westat.com
Web: http://www.lanl.gov/greenchemistry/news.html

Newsletter is published quarterly, and is available via the Web Home Page. Not-for-profit organization whose mission is to promote and foster green chemistry through information dissemination, chemical research, and conferences and symposia.

(*The*) *Green Sheet*

See F-D-C Reports, *The Rose Sheet*

Ground Water Monitor

See Business Publishers, Inc., *Environmental Health Letter*

Harvard Center for Risk Analysis (HCRA)
Risk in Perspective
Harvard Center for Risk Analysis
718 Huntington Avenue
Boston, MA 02115
Phone: 617-432-4497
E-mail: epatters@sph.harvard.edu
Web: http://www.hsph.harvard.edu/organizations/hcra/hcra.html

Newsletter published monthly. Contains exposure and risk assessment articles, commetaries, meeting, publications, etc.

Hawaii Heptachlor Research and Education Foundation
Heptachlor and Health
Hawaii Heptachlor Research and Education Foundation
1188 Bishop Street, Suite 2308
Honolulu, HI 96813
Phone: 808-531-2963
E-mail: rscudder@igc.apc.org

Newsletter published quarterly. Contains information about the effects of pesticides and other toxic substances.

Hazardous Materials Control Resources Institute (HMCRI)
Focus
Hazardous Materials Control Resources Institute
7237 Hanover Parkway
Greenbelt, MD 20770-3602
Phone: 301-982-9500

Newsletter published monthly. Covers safe management of hazardous materials and waste prevention, control, and cleanup.

Hazardous Substances & Public Health
Agency for Toxic Substances and Disease Registry
1600 Clifton Rd, NE
Mailstop E33
Atlanta, GA 30333
Phone: 404-639-5042
E-mail: kdrl@cdc.gov
Web: http://www.atsdr.cdc.gov/atsdrhome.html

Newsletter published quarterly. Contains articles about public health-related topics, including toxic effects of, and ways to protect against exposures to, various chemicals. Also includes course and book announcements and a calendar of events.

Hazardous Waste Litigation Reporter

See *Toxic Chemicals Litigation Reporter*

Hazardous Waste News (formerly *Toxic Materials News*)

See Business Publishers, Inc., *Environmental Health Letter*

Hazardous Waste Strategies Update

See *Toxic Chemicals Litigation Reporter*

HazMat Transport News

See Business Publishers, Inc., *Environmental Health Letter*

HAZNEWS
Profitastral Ltd.
Park House, 140 Battersea Park Rd.
London SW11 4NB UK
Phone: 44-171-498-2511
E-mail: subs@haznews.com

Provides international coverage of hazardous waste management issues, including health effects and site redemption technologies.

Health Effects Institute (HEI)
Update
Health Effects Institute
955 Massachusetts Ave.
Cambridge, MA 02139
Phone: 617-876-6700
E-mail: facts@healtheffects.org
Web: http://www.healtheffects.org

Newsletter published quarterly. The Health Effects Institute was chartered in 1980 as an independent, nonprofit corporation to provide high-quality, impartial, and relevant science on the health effects of pollutants from motor vehicles and other sources in the environment. Supported jointly by the U.S. Environmental Protection Agency (EPA) and industry, HEI has funded 160 studies and published almost 100 research reports, producing important research findings on the health effects of a variety of pollutants, including carbon monoxide, methanol and aldehydes, nitrogen oxides, diesel exhaust, ozone, and most recently, particulate air pollution. HEI has also been called on periodically to produce special reports reviewing an entire area of scientific literature on topics such as the health effects of asbestos, diesel exhaust, and oxygenates in fuel.

Human Ecology Action League (HEAL)
THE Supplement
Human Ecology Action League
PO Box 29629
Atlanta, GA 30359-1126
Phone: 404-248-1898
E-mail: HEALatnl@aol.com
Web: http://members.aol.com/healnatnl/index.html

Supplement available bimonthly via Web site. HEAL was established for individuals and organizations interested in the study of human ecology and multiple chemical sensitivities. Collects and disseminates information on human ecology and ecological illness to people suffering from such illness and to government agencies, scientists, and health care professionals.

Indoor Environment Review
IAQ Publications, Inc.
7920 Norfolk Ave., Suite 900
Bethesda, MD 20814
Phone: 301-913-0115 or 800-394-0115
Web: http://www.iaqpubs.com

Formerly *Indoor Air Review* Newspaper published monthly. ''Committed to providing news and information to help professionals in commercial, institutional, residential and light industrial settings develop the solutions and strategies required to evaluate, mitigate and manage indoor environments.''

Indoor Pollution News (Formerly *Indoor Pollution Report*)

See Business Publishers, Inc., *Environmental Health Letter*

Inside Washington Publishers
PO Box 7167
Ben Franklin Station
Washington, DC 20044
Phone: 703-416-8500 or 800-424-9068
E-mail: iwp@sprintmail.com
Web: http://www.iwpextra.com/helpfiles/aboutiwp.htm

Inside Washington's FDA Week

Newsletter published weekly. Reports on U.S. Food and Drug Administration policy, regulations, and enforcement activities.

Risk Policy Report

Newsletter published monthly. Includes editorials; special reports (topic reviews and organization profiles); summaries of U.S. EPA toxicology, risk assessment, and regulatory activities; and related activities of other organizations like the National Institute of Environmental Health Sciences, Department of Defense, Chemical Manufacturers Association, Natural Resources Defense Council, etc. This company also publishes *Inside EPA Weekly Report* and other environment- and health-related newsletters.

State Environmental Monitor

Newsletter published monthly. Includes editorials, reports, analyses, news briefs, draft legislation, book reviews, etc. Covers U.S. EPA, state, and regional environmental activities.

Superfund Report

Newsletter published monthly. Provides coverage of issues related to Superfund site identification, evaluation, remedial activities, and activities associated with government bodies and private sector initiatives related to Superfund.

(The) Institute for Environmental Toxicology (IET)
IET News
The Institute for Environmental Toxicology
C-231 Holden Hall
Michigan State University
East Lansing, MI 48824-1206
Phone: 515-353-6469
Web: http://www.iet.msu.edu/news.htm

Newsletter published biweekly via the Web site. Includes notices of meetings, job openings, scholarships, funding opportunities, and publications.

Institute for in Vitro Sciences, Inc. (IIVS)
Institute Update
Institute for In Vitro Sciences
21 Firstfield Rd., Suite 220
Gaithersburg, MD 20878
Phone: 301-947-6526
Web: http://www.iivs.org/

Newsletter published periodically. This nonprofit organization was formed in 1997 to provide in vitro contract toxicity testing and to provide expertise and testing for international validation programs. Works closely with other groups active in the alternative methods area. Activities also include regulatory interactions and training on alternative methods, along with educational workshops and symposia and management of in vitro toxicity databases.

Interface: Genes and the Environment
Center for Environmental Genetics (CEG)
University of Cincinnati
PO Box 670056
Cincinnati, OH 45267-0056
Phone: 513-558-5701
E-mail: dan.nebert@uc.edu
Web: http://www.med.uc.edu/CEG/CEG.html

Newsletter published several times a year. Examines the genetic aspects of environmental contaminants in the environment, such as the impact of environmental threats on DNA, genetic effects on pharmaceuticals, and molecular biology.

International Academy of Legal Medicine and Social Medicine
International Academy of Legal Medicine and Social Medicine
49 A, Ave. Nicolai
B-4802 Verviers, Belgium
Phone: 32-87-229821

Newsletter published three times a year. Covers legal and social medicine, including toxicology and other fields.

International Academy of Oral Medicine and Toxicology (IAOMT)
Bio-Probe* and *IN VIVO
International Academy of Oral Medicine and Toxicology
1640 North Arlington Heights Road, Suite 201
Arlington Heights, IL 60004
Phone: 847-253-0240
Web: http://www.sukel.com/iaomt.htm

Publishes two newsletters: *Bio-Probe,* published bimonthly on the scientific literature and legislative activities, and *In Vivo,* published quarterly. Covers the biocompatibility of materials used in dentistry.

International Association for Dental Research (IADR)
IAD Reports and Dental Research
International Association for Dental Research
1619 Duke St.
Alexandria, VA 22314-3406
Phone: 703-548-0066
E-mail: es@iadr.com
Web: http://www.iadr.com

Newsletter published quarterly. Topics include toxicology.

International Association of Environmental Analytical Chemistry (IAEAC)
International Association of Environmental Analytical Chemistry
Strengigosslize
CH-4123 Allschwil, Switzerland
Phone: 41-61-4812789
Web: http://www.gsf.de/unep/swiiac.html

Newsletter published semiannually. Covers environmental topics, analytical chemistry information for pollutants, etc.

International Association of Forensic Toxicologists (TIAFT)
Bulletin of the International Association of Forensic Toxicologists
Dr. Ilkka Ojanpera, Secretary
Department of Forensic Medicine
PO Box 40, FIN-00014
University of Helsinki, Finland
Phone: 358-9-1912-7487
E-mail: Ilkka.Ojanpera@helsinki.fi
Web: http://www.cbft.unipd.it/tiaft/

Newsletter published quarterly. Covers information on forensic toxicology and related areas.

International Commission for Protection against Environmental Mutagens and Carcinogens
ICPEMC News
International Commission for Protection Against Environmental Mutagens and Carcinogens
David Brusick
Covance Laboratories
9200 Leesburg Turnpike
Vienna, VA 22182-1649
Phone: 703-893-5400

Newsletter published annually.

International Committee on Food Microbiology and Hygiene (ICFMH)
Letter for Members (in Finnish)
International Committee on Food Microbiology and Hygiene
c/o Institute of Hygiene and Toxicology
Federal Research Centre for Nutrition
Engesserstr. 20
76131 Karlsruhe, Germany
Phone: 49-721-6625115
E-mail: wmorris@unixg.ubc.ca

Newsletter published quarterly. Covers food microbiology, especially safety and quality.

International Consumer Product Health and Safety Organization (ICPHSO)
ICPHSO Update
ICPHSO
PO Box 1785
Germantown, MD 20875-1785
Phone: 301-601-3240

Newsletter published several times a year. Covers consumer product health and safety issues. ICPHSO's mission is to promote the health and safety of consumer products. Members are from industry, government agencies, and elsewhere.

International Environmental Regulations Monitor
McKenna & Cuneo, L.L.P., and Technology Sciences Group, Inc.
1900 K St., NW
Washington, DC 20006-1108
Phone: 202-496-7761
Web: http://www.mckennacuneo.com

Newsletter published bimonthly. Covers major developments affecting the production and sale of chemicals, drugs, and pesticides and the transportation of hazardous wastes around the world. Topics include new substance notification, chemical testing, toxicology and risk assessment, import/export notification, classification, packaging and labeling, hazard commu-

nication, worker safety, transportation, treaty implementation, and the harmonizing of standards.

International Environment Reporter

See Bureau of National Affairs

***International Fragrance Association* (*IFRA*)**
IFRA, 8 rue Charles-Humbert
CH-1205 Geneva, Switzerland
Phone: 41-22-3213548
Web: http://www.ameliaww.com/fpin/IFRA.htm

Newsletter includes information about the safety evaluation and regulation of fragrance ingredients. (IFRA also issues guidelines and a code of practice for the safe use of fragrance ingredients.)

International Programme on Chemical Safety (IPCS)
IPCS Newsletter
International Programme on Chemical Safety
c/o World Health Organization
Ave. Appia
CH-211, Geneva 27, Switzerland
Phone: 41-22-7913588
E-mail: ipcsmail@who.ch
Web: http://www.who.ch/pcs

Newsletter published two or three times a year. Covers health risks to humans and the environment from chemicals. IPCS is mandated to establish the scientific basis for safe use of chemicals and to strengthen national capabilities for chemical safety.

***International Society of Exposure Analysis* (*ISEA*)**
Jed Waldman, Editor *ISEA Newsletter*
2151 Berkeley Way (EHLB)
Berkeley, CA 94704
Phone: 510-540-3427
E-mail: waldman@cal-iaq.org
Web: http://www.iseaweb.org

Newsletter published several times a year. Contains exposure and risk assessment news, meetings, legislation, publications, etc.

***International Society on Toxinology* (*IST*)**
Dr. Charlotte Ownby
President: Prof. Dr. Franc Gubensek
Department of Biochemistry and Molecular Biology
Jozef Stefan Institute
Jamova 39
Ljubljana, Slovenia
Phone: 386-61-177-3250
E-mail: franc.gubensek@ijs.si
Web: http://bio.ijs.si/ist.htm

Also known as *International Society on Toxicology.* Newsletter published quarterly. Covers information on animal, plant, and microbial toxins (poisons and venoms).

***International Union of Pharmacology* (*IUPHAR*)**
International Union of Pharmacology
IUPHAR Media
68 Half Moon Lane
London
UK 5E24 9JE
Phone: 44-171-737-8282
E-mail: admin@iuphar.org
Web: http://www.iuphar.org

Newsletter published twice a year. Includes toxicology information from national and international societies in pharmacology and related sciences.

International Union of Toxicology* (*IUTOX*) *Newsletter
Dr. Meryl H. Karol, Secretary General
University of Pittsburgh
260 Kappa Drive
Pittsburgh, PA 15238
Phone: 412-967-6530
E-mail: mhk@vms.cis.pitt.edu
Web: http://www. toxicology.org/iutox

Newsletter published annually. Reports on activities of the International Union of Toxicology and its 30 member societies around the world.

(The) Johns Hopkins Center for Alternatives to Animal Testing (CAAT)
Johns Hopkins Center for Alternatives to Animal Testing
111 Market Place, Suite 840
Baltimore, MD 21202-6709
Phone: 410-223-1693
E-mail: caat@caat.spharbor.jhu.edu
Web: http://altweb.jhsph.edu/altnews/news.html

As recently as 1997, published two newsletters, *CAATALYST* with information for middle-school students, and *Center for Alternatives to Animal Testing.* These newsletters contained information about the development and validation of in vitro alternatives to the use of whole animals in toxicology. However, since late 1997, Altweb's AltNews has replaced the printed issues of the *Center for Alternatives to Animal Testing* newsletter.

Johns Hopkins University, School of Public Health, Risk Sciences and Public Policy Institute
Risk Update
615 N. Wolfe Street
Suite 6033

Baltimore, Maryland 21205
Phone: 410-614-4962

Newsletter published an average of twice a year. Covers activities, courses, and other events sponsored by the Risk Sciences and Public Policy Institute and also general and late-breaking news about the risk sciences. Each issue includes a human health-related science policy issue.

Lead Inform: A Newsletter on Lead-Poisoning Prevention Issues
National Lead Information Center and the Environmental Health Center
National Safety Council, 1025 Connecticut Ave.
Suite 1200
Washington, DC 20036
Phone: 202-293-2270
E-mail: leadctr@nsc.org
Web: http://www.nsc.org/ehc/lead.htm

Provides notices of products, services, calendar of events, and other resources available free of charge or at low costs to individuals, educators, nonprofit organizations, government agencies (especially at local, municipal, and county levels), and other commercial interests all sharing a common need for information on lead poisoning-prevention. Back issues are available on the NSC Web Home Page. EHC is no longer managing the National Lead Information Hotline and Clearinghouse. The EPA contract for this program was granted to another contractor who has taken over the management of this national information program. The new provider of those services may be reached at (800) 424-LEAD or http://www.epa.gov/lead/nlic.htm.

Lead Poisoning Report
IAQ Publications, Inc.
2 Wisconsin Circle, Suite 430
Chevy Chase, MD 20815
Phone: 800-394-0115 or 301-913-0115
Web: http://www.iaqpubs.com

This monthly newsletter describes program and policy initiatives related to the detection, abatement, screening, diagnosis, and treatment of lead poisoning. Coverage also includes notes on litigation and lead pollution prevention strategies and programs.

The Link
Community Outreach and Education Program
Center for Molecular and Cellular Toxicology with Human Applications
Wayne State University
2727 Second Ave., Room 4000
Detroit, Michigan 48207-2654
Phone: 313-961-3348
E-mail: COEP@www.toxicology.wayne.edu
Web: http://www.wayne.edu/ehsctr/theLink.html

This newsletter promotes activities, services, and concerns for community education and understanding of environmental health issues. Links research scientists, educators (especially K–12), and members of the concerned community by promoting information and resources sharing and better understanding of environmental health issues.

Linus Pauling Institute
Linus Pauling Institute
Oregon State University
571 Weniger Hall
Corvallis, OR 97331
Phone: 541-737-5075
Web: http://osu.orst.edu/dept/lpi

Newsletter published two or three times a year. Contains information about the institute's research activities, including human toxicology.

(The) Medical Letter
The Medical Letter, Inc.
1000 Main St.
New Rochelle, NY 10801-7537
Phone: 800-211-2769
Web: http://www.medletter.com

Newsletter published biweekly. Contains information about new drugs, including toxic effects.

Medical Waste News

See Business Publishers, Inc., *Environmental Health Letter*

Microwave News
PO Box 1799
Grand Central Station
New York, NY 10163
Phone: 212-517-2800
E-mail: mwn@pobox.com
Web: http://www.microwavenews.com

Newsletter published bimonthly, and reports ''on the potential health and environmental impacts of electromagnetic fields (EMF) and radiation generated by many of the technologies of the 20th century.''

National Anti-Vivisection Society Bulletin
National Anti-Vivisection Society
53 W. Jackson
Suite 1552
Chicago, IL 60604

Phone: 800-888-NAVS
E-mail: navs@navs.org
Web: http://www.navs.org

Newsletter published quarterly. Among its topics are the compilation of statistics on usage of laboratory animals for experiments and information about alternatives to animals research.

National Art Materials Trade Association
News and Views
National Art Materials Trade Association
178 Lakeview Ave.
Clifton, NJ 07011
Phone: 704-546-6400

Newsletter published monthly. Includes information about toxicity and labeling issues.

National Association for Science, Technology and Society (NASTS)
Bulletin of Science, Technology and Society
National Association for Science, Technology and Society
133 Willard Building
University Park, PA 16802
Phone: 814-865-3044
Web: http://137.198.25.11/NASTS/nasts1.html

Newsletter published bimonthly. Promotes and provides a forum for examination and understanding of the impact of science and technology on society and the environment, and the roles citizens can take in guiding technology.

National Center for Environmental Health Strategies (NCEHS)
The Delicate Balance
National Center for Environmental Health Strategies
c/o Mary Lamielle
1100 Rural Ave.
Voorhees, NJ 08043
Phone: 609-429-5358

Newsletter published quarterly. Interests include public awareness of health problems caused by chemical and environmental pollutants, focusing on chemical sensitivity disorders.

National Committee for Clinical Laboratory Standards (NCCLS)
NCCLS Update
National Committee for Clinical Laboratory Standards
940 W. Valley Rd., Suite 1400
Wayne, PA 19087-1989
Phone: 610-688-0100
E-mail: exoffice@nccls.org
Web: http://www.nccls.org

Also known as the Clinical Laboratory Standards Organization (CLSO). Newsletter published bimonthly. Contains information about clinical laboratory testing, including development of national and international standards.

National Environmental Health Association (NEHA)
NEHA Member Mailing List
National Environmental Health Association
720 S. Colorado Blvd.
Suite 970, S. Tower
Denver, CO 80222-1925
Phone: 303-756-9090
Web: http://www.neha.org

Mailing list published bimonthly. Members include people working in environmental health and protection for governmental agencies, industry, academia, and elsewhere. Sections include general environmental health, hazardous waste/toxic substances, injury prevention and occupational health, and international environmental health.

National Foundation for the Chemically Hypersensitive (NFCH)
Cheers
National Foundation for the Chemically Hypersensitive
4407 Swinson Rd.
Rhodes, MI 48652
Phone: 517-697-3989

Newsletter published quarterly. Members include individuals with chemical hypersensitivity and their families and friends, along with health care professionals and others. Topics include multiple chemical sensitivity, environmental illness, food intolerance, total allergy syndrome, candida, and chronic fatigue.

(U.S.) National Institute of Environmental Health Sciences (NIEHS)/National Toxicology Program (NTP)
Update
National Institute of Environmental Health Sciences (NIEHS)/National Toxicology Program (NTP)
111 T. W. Alexander Drive
PO Box 12233
MD: A3-01
Research Triangle Park, NC 27709-2233
Phone: 919-541-3665 (NTP: 919-541-0530)
E-mail: mcfarland@niehs.nig.gov (NIEHS) or lange@niehs.nih.gov (NTP)
Web: http://ntp-server.niehs.nih.gov (for NTP)

NIEHS is part of the National Institutes of Health and conducts research on environment-related diseases. NIEHS includes the National Toxicology Program, which tests chemicals and coordinates federal research on environmental toxins. Newsletter published monthly. Includes NIEHS- and NTP-related toxicology activities and research results, announcements of conferences, reports, etc.

***National Paint and Coatings Association* (*NPCA*)**
Coatings and Primer
National Paint and Coatings Association
1500 Rhode Island Ave., NW
Washington, DC 20005
Phone: 202-462-6272
E-mail: npca@paint.org
Web: http://www.paint.org

Two newsletters published monthly. Members include manufacturers of paints and chemical coatings and suppliers of raw material and equipment. Conducts research and other activities.

National Pest Control Association (NPCA)
National Pest Control Association
8100 Oak St.
Dunn Loring, VA 22027
Phone: 703-573-8330
Web: http://www.pestworld.org

Newsletter for members only published eleven times a year. Also publishes a quarterly ''Pest Gazette'' newsletter as a marketing tool for businesses, and a periodic online ''News from National'' newsletter. Members include firms engaged in control of insects, rodents, birds, and other pests via the use of insecticides, rodenticides, miticides, fumigants, and nonchemical methods. Provides advice, and sponsors research and training.

National Registry of Environmental Professionals
NREP Report
National Registry of Environmental Professionals
PO Box 2099
Glenview, IL 60025-6099
Phone: 847-724-6631
E-mail: nrep@aol.com
Web: http://www.nrep.org

Newsletter published monthly. Contains information about developing standards of environmental site assessment, lead-based paint training, hazardous waste training, etc.

(U.S.) National Safety Council
Environment Writer and Environmental Issues Bulletin
National Safety Council/Environmental Health Center
1025 Connecticut Ave., NW
Suite 1200
Washington, DC 20036-5105
Phone: 202-293-2270 ext. 469
E-mail ehc@nsc.org
Web: http://www.nsc.org/ehc.htm

Newsletter is published 10 times per year. It provides insights and coverage of environmental topics for journalists and other environmental writers in the print and broadcast media. Includes book reviews and other descriptive articles related to the environment and the mass media. ''Monthly Backgrounder'' is a featured column describing the environmental aspects of a single chemical (compiled from resources such as government agencies and trade associations). The bulletin is a ''periodic resource for environmental, science, and health journalists'' on childhood diseases and other topics.

(U.S.) National Toxicology Program (NTP)
Update

See (*U.S.*) *National Institute of Environmental Health Sciences*

Science and Environmental Health Network (SEHN)
The Networker: The Newsletter of the Science and Environmental Health Network
Route 1
Box 73
Cleveland, ND 58434-98101
Phone: 701-763-6286
E-mail: 75114.1164@compuserve.com

A coalition of 42 environmental groups functioning as a hub of scientific networking in community and national environmental and public health protection efforts.

To subscribe to ***The Networker,*** send an e-mail message to 75114.1164@compuserve.com

Provides overviews or scientific and medical aspects of issues related to environmental health. Written for nontechnical audiences.

Noise Regulation Report

See Business Publishers, Inc., *Environmental Health Letter*

North American Mycological Association (NAMA)
The Mycophile
North American Mycological Association
Joe Miller, Executive Secretary
10 Lynne Brooke Place
Charleston, WV 25312-9521

Phone: 304-744-1654
E-mail: brightcloud@mciworld.com
Web: http://sorex.tvi.ec.nmius/nama

Newsletter published bimonthly. Includes toxicology and other information of interest to mycologists, mycophagists, and others.

Nuclear Waste News

See Business Publishers, Inc., *Environmental Health Letter*

Occupational Health & Safety Letter

See Business Publishers, Inc., *Environmental Health Letter*

Occupational Health Newsletter
Newsletter Information Services
PO Box 693
Manly, N.S.W. 2095 Australia
Phone: 61-2-9777500
E-mail: customepport@newsinfo.com.au
Web: http://www.hww.com.au/.

Published biweekly. Provides international coverage of occupational health issues, including policy and science information related to health and safety in the workplace environment. Subscribers also receive the bimonthly ''Inside OHS,'' more in-depth articles, case studies, and reports.

Occupational Safety & Health Reporter

See Bureau of National Affairs

Organization of Fish and Wildlife Information Managers (OFWIM)
OFWIM Newsletter
Organization of Fish and Wildlife Information Managers
c/o Kathy Quindlen, Secretary, OFWIM
Virginia Dept. of Game and Inland Fisheries
PO Box 11104
Richmond, VA 23230-1104
E-mail: kquindlen@DGIF.state.va.us

Newsletter Editor:
Jeff Smith
NJ Division of Fish, Game, & Wildlife
E-mail: jeffs@gis.dep.state.nj.us
Web: http://fwie.fw.vt.edu/ofwim

National-focus newsletter examines all aspects of data and information management related to fish and wildlife. Covers topics related to the issues of persistent chemicals in the environment and advisories related to the consumption of fish and other freshwater and marine organisms by humans.

(The) Pardalis Envirosafe eLetter
Steve Holcombe, Editor
Pardalis Software, Inc.
324 S. Husband St.
Stillwater, OK 74074
Phone: 888-869-6878
E-mail: pardalis@pardalis.com
Web: http://www.pardalis.com

''A weekly e-mail publication which consolidates and summarizes environmental and workplace safety issues published in the U.S. Federal Register during the preceding week.''

PESTed News
Agricultural Resources Center/PESTicide EDucation Project
115 West Main St.
Carrboro, NC 27510
Phone: 919-967-1886
Or 112 South Blount Street
Raleigh, NC 27603
Phone: 919-839-0159
Web: http://metalab.unc.edu/arc/pested.htm

Newsletter published several times a year. Provides information and resource news related to environmental protection and sustainable resource use with a special focus on pesticide reform, alternatives to pesticide use, and other aspects of pesticides and agriculture.

Pesticide Action Network North America (PANNA)
Global Pesticide Campaigner
Pesticide Action Network, North American Regional Center
49 Powell Street, Suite 500
San Francisco, CA 94102
Phone: 415-981-1771
E-mail: panna@panna.org
Web: http://www.igc.org/panna

Provides coverage of issues related to the international pesticide reform movement, including case studies and topics related to environmental justice, public health, and toxicology.

Pesticide Chemical News Guide
FCN Publishing, a division of CRC Press LLC
1725 K Street, NW
Washington, DC 20006
Phone: 202-887-6320.
Web: http://www.fcnpublishing.com.

Published in notebook form and updated monthly. ''The publication of record on Federal regulation of pesticide residues in food and feed,'' listing tolerances,

interim tolerances, action levels, proposed tolerances, pending tolerances, and regional tolerances and exemptions.

Pesticide and Toxic Chemical News
CRC Press
1725 K St., N.W., Suite 506
Washington, DC 20006-1401
Phone: 202-887-6320
Fax: 202-887-6335
E-mail: newsdiv@crcpress.com

Newsletter published weekly. Contains information on pesticides, toxic substances, and general issues of regulation and legislation, including U.S. EPA and other regulatory agency plans/actions.

(The) Pink Sheet

See F-D-C Reports, *The Rose Sheet*

Product Safety and Liability Reporter

See Bureau of National Affairs

Prop 65 News
230 California Street, Suite 603
San Francisco, CA 94111
Phone: 1-800-2-Prop65 or 415-544-0111
E-mail: prop65@prop65news.com
Web: http://www.prop65news.com/

Newsletter published monthly. Covers the State of California's Proposition 65 law.

PSR Reports
Physicians for Social Responsibility
1101 14th Street, NW
Suite 700
Washington, DC 20005
Phone: 202-898-0150
E-mail: snewsome@psr.org
Web: http://www.psr.org

Quarterly newsletter devoted to the medical concerns and aspects of environmental health threats. Provides analysis of environmental health issues from the medical community and is directed to citizens, officials, environmental advocates, and health care providers sharing interests in the area of environmental health. Also covers nuclear security and violence prevention.

Rachel's Environment and Health Weekly
Environmental Research Foundation
PO Box 5036
Annapolis, MD 21403-7036
Phone: 410-263-1584
E-mail: erf@rachel.org
Web: http://www.rachel.org

A weekly Internet-delivered document covering toxicology and risk assessment topics.

Rare-Earth Information Center (RIC)
Insight and ***RIC News***
R. William McCallum, Director
Center for Rare Earths and Magnetics
116 Wilhelm Hall
Iowa State University
Ames, IA 50011
Phone: 515-294-4736
E-mail: RIC@ameslab.gov
Web: http://www.external.ameslab.gov/RIC/

Renamed in 1996 as Center for Rare Earths and Magnets (CREM), with the RIC still serving as the information component of CREM. RIC News is a quarterly publication containing items of current interest concerning the science and technology of rare earths. RIC Insight, available to CREM supporters, is published monthly and contains editorial comments, opinions on the future directions of rare earths and late-breaking news.

Rachel Carson Council News
Rachel Carson Council, Inc.
8940 Jones Mill Rd.
Chevy Chase, MD 20815
Phone: 301-652-1877
E-mail: rccouncil@aol.com
Web: http://members.aol.com/rccouncil/ourpage

Newsletter published yearly. A clearinghouse and library with information at both scientific and layperson levels on pesticide-related issues, Rachel Carson Council develops its knowledge from literature searches and conversations with experts. It then provides answers to the public and produces various publications clarifying pesticide dangers and bringing alternative pest controls to the public's attention.

Registry of Comparative Pathology (RCP)
Comparative Pathology Bulletin
Registry of Comparative Pathology
c/o Armed Forces Institute of Pathology
Washington, DC 20306-0001
Phone: 202-782-2440
E-mail: oneill@afip.osd.mil
Web: http://www.afip.org/rcp

Newsletter is published quarterly. Includes information about biomedical research, particularly the comparative pathology of animals and animal models of disease.

Reproductive Toxicology Center (RTC)
Repitox
Reproductive Toxicology Center
Columbia Hospital for Women Medical Center
2440 M Street, NW, Suite 217
Washington, DC 20037-1404
Phone: 202-293-5137
E-mail: reprotox@reprotox.org

Document published quarterly on hard copy, computer diskette, and CD-ROM. Includes information on the effects of the chemical and physical environment on human fertility, pregnancy, and fetal development.

Resources for the Future (RFF)
Center for Risk Management Newsletter
Center for Risk Management
Resources for the Future
1616 P St., NW
Washington, DC 20036
Phone: 202-328-5000
E-mail: info@rff.org
Web: http://www.rff.org

Newsletter published quarterly. Contains information about RFF's broad program of fundamental research, policy analysis, and outreach related to the management of risks to public health and the environment. Funded by U.S. EPA, U.S. DOE, and various foundations, corporations, and institutes.

Right-to-Know News

See *Community and Worker Right-to-Know News*

Risk Communication Network
RISKOM
Network Administrator
Hayley Slade
Centre for Continuing Education
The Registry
University of East Anglia
Norwich NR4 7TJ, UK
Phone: 44 (0) 1603 593016
E-mail: H.Slade@uea.ac.uk
Web: http://www.uea.ac.uk/env/cer/

Newsletter is published periodically and is accessible via the Internet. The Risk Communication Network was first suggested by a group of experts convened by the World Health Organisation's European (WHO/EURO) office in 1990. The Network was then begun at the Centre for Environmental and Risk Management (CERM) at the University of East Anglia in 1992.

Risky Business Living in a Chemical World: A Newsletter of Environmental Health Sciences Education
Health and Environmental Resources for Educators
Department of Environmental Health
University of Washington
4225 Roosevelt Way, NE, #100
Seattle, WA 98105-6099
Phone: 206-616-2643
E-mail: riskyb@u.washington.edu
Web: http://depts.washington.edu/envhlth/

Published three times a year. The HERS@UW Program provides K–12 teachers and information providers with resources for introducing environmental health issues into the classroom. Serves as a scientific and technical link between the resources of the university and educators. Inventories of Internet resources, classroom projects, and training for teachers and educators are included in the newsletter.

(The) Rose Sheet

See F-D-C Reports, *The Rose Sheet*

Royal Society of Chemistry (RSC)
Analyst
Royal Society of Chemistry
Burlington House
Piccadilly, London W1V 0BN, England
Phone: 44-171-4378656
E-mail: langers@rsc.org
Web: http://www.rsc.org

Newsletter published monthly. RSC includes chemists and others in most countries of the world. Subcommittees include one on toxicology.

SCHC News
Society for Chemical Hazard Communication
PO Box 1392
Annandale, VA 22003-9392
Phone: 703-658-9246
E-mail: SCHCLori@aol.com
Web: http://www.schc.org/newsletters/schcnews.htm

Published twice per year for members. Covers strategies for improving risk communication pertinent to hazardous chemicals in workplace environments. Newsletter assists SCHC in improving the business of hazard communication among businesses, industries, agencies, and the public by exchanging ideas, experiences, and resources.

Science and Environmental Health Network (SEHN)
The Networker
Science and Environmental Health Network
RR 1 Box 73
Windsor, ND 58434-9801
Phone: 701-763-6286
E-mail: 75114.1164@compuserve.com
Web: http://www.sehn.org

Newsletter is from a coalition of 42 environmental groups functioning as a hub of scientific networking in community and national environmental and public health protection efforts. Included among SEHN's organizations are: Alliance for Justice, American Lung Association, Arizona Toxics Project, Citizen Action, Commission for Racial Justice, United Church of Christ, Downwinders at Risk, Ecology Center of Ann Arbor, Environmental Health Network, Environmental Law Institute, Environmental Defense Fund, Labor/Community Strategy Center, Mothers and Others for a Livable Planet, National Wildlife Federation, Natural Resources Defense Council, OMB Watch, Physicians for Social Responsibility, Southeast Network for Economic and Environmental Justice, The Wilderness Society, U.S. Public Interest Research Group, and Working Group on Right to Know.

***Science for the People* (*SFTP*)**
Science for the People
PO Box 364
Somerville, MA 02143
Phone: 617-547-0370

Newsletter published periodically. Covers the social implications of science and technology. SFTP working groups include one on toxic chemicals.

***The Scientists Center for Animal Welfare* (*SCAW*)**
7833 Walker Drive, Suite 410
Greenbelt, MD 20770-3229
Phone: 301-345-3500
E-mail: info@scaw.com
Web: http://www.scaw.com/

Publishes a quarterly newsletter and other documents. Newsletters cover national policies and how to comply, industrial concerns, biomedical research issues in all research animals, book reviews, and information on national association meetings. A nonprofit educational association of individuals and institutions, SCAW acknowledges the benefits and the need for biomedical experimentation on animals but also is dedicated to the principle that a humane concern for animals complements the conduct of science. SCAW serves as an objective, credible source of information for the research community regarding the appropriate use of animals in research. The Center also provides information for the general public and media.

Scrip World Pharmaceutical News
PJB Publications LTD.
18-20 Hill Rise
Richmond, Surrey, TW10 6UA, UK
Phone: 44-0181-332-8826
E-mail: rachel@scrip.demon.co.uk
Web: http://www.pjbpubs.co.uk/scrip/scrhome.html
U.S. Office:
Deborah Lockwood
1775 Broadway, Suite 511
New York, NY 10019
Phone: 212-262-8230

Newsletter published twice weekly. Includes U.S. and other news about pharmaceuticals.

(*The*) *Silver Sheet*

See F-D-C Reports, *The Rose Sheet*

Skin and Allergy News
International Medical News Group, a division of W. B. Saunders Company
12230 Wilkins Ave.
Rockville, MD 20852
Phone: 800-445-6975 or 301-816-8700
E-mail: sknews@imng.com
Web: http://urology.medscape.com/IMNG/SkinAllergyNews/public/about.SkinAllergyNews.html

Newspaper published monthly. Includes clinical developments in dermatology, U.S. FDA approvals, health care policy news, etc.

Sludge Newsletter

See Business Publishers, Inc., *Environmental Health Letter*

Soap and Detergent Industry Association (SDIA)
SDIA News
Soap and Detergent Industry Association
3/5 Clair Road
Haywards Health
West Sussex RH16 3DP
Phone: 44-0-1444-450884/44153
E-mail: info@sda.org.uk

Newsletter published three times a year. Information includes toxicology and regulatory issues associated with soaps and detergents in the UK

Society for in Vitro Biology (SIVB)
In Vitro Report (formerly the Tissue Culture Association)
Society for In Vitro Biology
9315 Largo Drive West
Suite 255
Largo, MD 20774
Phone: 301-324-5054
E-mail: sivb@sivb.org
Web: http://www.sivb.org

Newsletter published bimonthly. Contains information about the maintenance and experimental use of

tissue cells in vitro and about the development and evaluation of procedures using tissue cells.

Society for Risk Analysis (SRA)
RISK Newsletter
Society for Risk Analysis
1313 Dolley Madison Blvd., Suite 402
McLean, VA 22101-3926
Phone: 703-790-1745
E-mail: sra@burkinc.com
Web: http://www.sra.org

Newsletter published three times a year. Contains risk assessment-related information from varied areas, including human and environmental risk assessment.

Society for Technical Communication (STC)
Intercom and ES&H News
Society for Technical Communication
901 N. Stuart St., Suite 904
Arlington, VA 22203-1854
Phone: 703-522-4114
E-mail: stc@stc-va.org
Web: http://www.stc.org

Published ten times a year, this ''magazine'' provides articles of interest to technical communicators. Also the environmental, safety, and health communication special interest group publishes ''ES&H News,'' a quarterly newsletter.

Society of Environmental Journalists (SEJ)
SEJ News and ***TipSheet***
Society of Environmental Journalists
PO Box 27280
Philadelphia, PA 19118
Phone: 215-836-9970
E-mail: sej@sej.org
Web: http://www.sej.org

SEJ News is published quarterly. The biweekly *TipSheet* is faxed or e-mailed to members and news organizations. Both publications also available via the World Wide Web. The Society's mission is to advance public understanding of environmental issues by improving the quality, accuracy, and visibility of environmental reporting.

Society of Environmental Toxicology and Chemistry (SETAC) News and SETAC Europe News
Society of Environmental Toxicology and Chemistry
1010 N. 12th Ave.
Pensacola, FL 32501-3367
Phone: 850-469-1500
E-mail: setac@setac.org
Web: http://www.setac.org

Newsletters (SETAC News and SETAC Europe News) published bimonthly. Contain information promoting the use of multidisciplinary approaches to examine the impacts of chemicals and technology on the environment, other environmental topics, meetings, etc.

Society of Forensic Toxicologists (SOFT)
ToxTalk
Society of Forensic Toxicologists
Administrative Office
PO Box 5543
Mesa, AZ 85211-5543
Phone: 602-839-9106

Newsletter published quarterly. Covers information about the forensic sciences.

Society of Prospective Medicine (SPM)
An Ounce of Prevention
Society of Prospective Medicine
230 McKee Place, Suite 400
Pittsburgh, PA 15213
Phone: 412-647-1087
E-mail: info@spm.org
Web: http://www.spm.org

Newsletter published periodically. Contains information about extending the useful life expectancy of individuals by identifying actual and potential health hazards (e.g., diseases causing death and disability) and by developing and implementing risk assessment techniques and risk reduction programs.

Society of Toxicologic Pathologists (STP)
Society of Toxicologic Pathologists
19 Mantua Road
Mount Royal, NJ 08061
Phone: 609-423-3610
E-mail: stphq@talley.com
Web: http://www.toxpath.org

Newsletter published quarterly. Contains information about the pathological changes produced by pharmacological, chemical, and environmental agents.

Society of Toxicology
Communique
Society of Toxicology
1767 Business Ctr. Drive, Suite 302
Reston, VA 22090
Phone: 703-438-3115
E-mail: sothq@toxicology.org
Web: http://www.toxicology.org

Newsletter published five times a year. Contains editorials and covers toxicology and risk assessment news, meetings, legislation, publications, etc.

Solid Waste Report

See Business Publishers, Inc., *Environmental Health Letter*

State Environment and Safety Regulatory Monitoring Report

See Bureau of National Affairs

State Environmental Monitor

See Inside Washington Publishers

Styrene Information and Research Center (SIRC)
SIRC Bulletin, SIRC Executive Update, and ***SIRC Review***
Styrene Information and Research Center
1300 Wilson Boulevard, Suite 1200
Arlington, VA 22209
Phone: 703-741-5010
Web: http://www.styrene.org

SIRC Executive Update is published bimonthly, and the other two documents are published periodically. Include health, safety, and regulatory information on styrene.

Superfund Report

See Inside Washington Publishers

Superfund Week

See Business Publishers, Inc.

Synthetic Organic Chemical Manufacturers Association (SOCMA)
The Chemical Bond
Synthetic Organic Chemical Manufacturers Association
1850 M Street NW, Suite 700
Washington, DC 20036
Phone: 202-721-4100

Newsletter published monthly. Covers synthetic organic chemicals made from coal, natural gas, crude petroleum, and certain natural substances. Committees include ones on government affairs, hazardous waste, occupational safety and health, and toxic substances.

(The) Tan Sheet

See F-D-C Reports, *The Rose Sheet*

TecCom Inc.'s RiskWorld
Web: http://www.riskworld.com

Web site contains exposure and risk assessment news, meetings, legislation, publications, software, etc.

Texas Public Policy Foundation
Policy Action Update
Texas Public Policy Foundation
PO Box 40519
San Antonio, TX 78229
Phone: 210-614-0080
Web: http://www.tppf.org

Newsletter published via fax several times monthly. Covers state environmental news, federal issues, and rules and regulations of interest to ''free market'' environmentalists.

Toxic Chemicals Litigation Reporter
Andrews Publishing
175 Stafford Avenue
Building 4, Suite 140
Wayne, PA 19087
Phone: 610-225-0510
Web: http://www.andrewspub.com

This semimonthly title serves as a national journal for litigation involving claims of personal injury and property damage from exposure to toxic chemicals. Andrews Publishing also publishes ''Asbestos Ligitation Reporter,'' ''Hazardous Waste Litigation Reporter,'' and ''Hazardous Waste Strategies Update.''

Toxicological History Society (THiS)
Mithridata
Toxicological History Society
John Trestrail, III
5757 Hall St., SE
Grand Rapids, MI 49546-3845
Phone: 616-774-5329

Newsletter published semiannually. Covers the history of poisons and antidotes and the impact of toxicology on events in world history.

Toxics in Your Community Newsletter
Citizen's Environmental Coalition
33 Central Ave.
Albany, NY 12210
Phone: 518-462-5527
Fax: 518-465-8349
E-mail: cectoxic@igc.apc.org
Web: http://www.crisny.org/not-for-profit/cectoxic

Quarterly newsletter from a statewide grassroots environmental organization that strives to eliminate threats to health and the environment through community assistance programs, publications and information, and statewide advocacy campaigns.

Toxics Law Reporter

See Bureau of National Affairs

Tufts Center for Animals and Public Policy
Animal Policy Report

Center for Animals and Public Policy
Tufts University School of Veterinary Medicine
200 Westboro Rd.
North Grafton, MA 01536
Phone: 508-839-7991
Web: http://www.tufts.edu/vet/cfa/aboutcfa.html

Newsletter is published quarterly, and covers ethical, legal, regulatory, and technical aspects of animals used in laboratory research.

University of California, Davis, Center for Animal Alternatives

UC ALERT (*University of California Alternatives in Education, Research and Testing*)
University of California Center for Animal Alternatives, School of Veterinary Medicine
One Shields Avenue
Davis, CA 95616-8684
Web: http://www.vetmed.ucdavis.edu/Animal_Alternatives/main.htm

In addition to the newsletter published periodically, publications include resource guides. Mission is to gather and disseminate information concerning animal alternatives, so as to improve the well-being and quality of life of animals wherever possible, and to optimize their contribution to education and research.

University of California, Davis, Cooperative Extension

Environmental Toxicology Newsletter
Web: http://ace.orst.edu/info/extoxnet/newsletters/ghindex.html

Newsletter published ''occasionally at irregular intervals.'' Contains toxicology and risk assessment news, toxicology reviews of chemicals, etc.

University of North Carolina

ESE Notes
Department of Environmental Health Sciences and Engineering (CB 7400)
School of Public Health
University of North Carolina
Chapel Hill, NC 27599-7400
Phone: 919-966-1171
E-mail: LauraMarcial@unc.edu
Web: http://www.sph.unc.edu/envr/esenotes.htm

Published in hard copy bi-annually and online quarterly. Provides broad coverage of environmental issues with an emphasis on those related to environmental sciences or impact on public health.

University of Washington

See *Risky Business Living in a Chemical World*

Working for Animals Used in Research, Drugs and Surgery (WARDS)

Our Animal WARDS and ***Science and Animal Care***
8150 Leesburg Pike, Suite 512
Vienna, VA 22182-1655
Phone: 703-442-4511
E-mail: oawards@erols.com
Web: http://www.erols.com/oawards/

''Dedicated to the practical, professional care of animals.'' Publishes two quarterly newsletters, ''Our Animal WARDS'' for all individuals concerned about the welfare of research and companion animals, and ''Science and Animal Care'' for those interested in technical discussions of recent initiatives and ongoing activities directed at minimizing animal pain and suffering and developing alternatives to animal experimentation.

World Federation of Associations of Clinical Toxicology Centers and Poison Control Centers

Bulletin of the World Federation
World Federation of Associations of Clinical Toxicology Centers and Poison Control Centers
Secretary General: Jacques Descotes
Centre Anti-Poisons
Hopital Edouard Herriot
5 pl d'Arsonval
69003 Lyon
France
Phone: 33-78-54-80-22

Bulletin is published quarterly. Purposes of the organization include education and training, collection and dissemination of information, and poison prevention.

World Health Organization

See International Programme on Chemical Safety (IPCS)

CHAPTER

5

General Interest and Popular Works

FREDERICK W. STOSS

It is his theory that all medicinal virtues are comprised within those substances which we term vegetable poisons. These he cultivates with his own hands, and is said even to have produced new varieties of poison, more horribly deleterious than Nature, without the assistance of this learned person, would ever have plagued the world withal.

(Nathaniel Hawthorne, *Rappaccini's Daughter*)

Toxicology and environmental health are topics important not just to the scientific community but to consumers and the public at large. In many cases, toxic chemicals and their presence in the environment also serve as catalysts for community action. As noted in the second edition of this book, large-scale environmental catastrophes and incidents such as Love Canal, Bhopal, and Chernobyl served to stimulate and sustain high levels of interest in and awareness of the events that threaten our environment and the health of the public. To this list can be added other headline-grabbing events, such as the massive oil spill of the Exxon Valdez, the outbreak of water-borne illness in the drinking water of several major U.S. metropolitan areas, and recent outbreaks of food poisonings from large-scale contamination of vegetables and produce, meats, and other consumer products.

From the industrial revolution on, and perhaps earlier, there has been no shortage of publications directed at general readers that decry the dangers inherent in food, drugs, chemicals, and the environment. Rachel Carson's *Silent Spring*, though, struck a powerful chord and was certainly one of the most influential works of this group. The book's publication took place during the midst of a tremendous period of social unrest and change in America, and it was instrumental in helping to launch the contemporary environmental movement of the 1970s. A large part of this chapter is the literary legacy of *Silent Spring*.

Another driving force behind the public's concern about and increased knowledge of the presence of toxic chemicals in the environment has been the Toxic Release Inventory (TRI). The publication of the results of the first inventory in June 1989 proved to be a great revelation, not only to individuals, but to neighborhoods, communities, and cities across the nation. People were startled at the extent to which industries and businesses were discharging chemicals into the environment. The reaction from industries and businesses in response to these revelations was also surprising and relatively swift, and the result has been generally positive—an overall decline in air, water, and land emissions over that 10+ years TRI data have been collected. TRI has also spawned a host of popular works related to toxicology and the environment.

The public's increased awareness has also been stimulated and sustained by a surge of publications in the print media that try to explain the effects of hazardous chemicals on humans and the environment. These types of publications are referred to as 'popular' or 'general interest' works. As the public increases its understanding of the nature of toxic substances, the already fine line between popular and technical works becomes less distinct. However, these popular works serve as an all-important resource for initiating dialogue and helping the public to understand the issues at hand.

Public libraries may be the closest, most accessible resource for environmental information. In many instances citizens of a neighborhood or community may feel threatened, unwelcomed, or uncomfortable in an academic or agency library. Increased awareness by citizens and concerns for the environment, especially those related to environmental health and the impacts of chemicals in the environment, provide a compelling need for public libraries to offer data and information resources empowering residents to learn about environmental issues, respond to them, and become actively involved in decision-making processes and policy developments. To assist in this process, Libraries for the Future has published ''The Environmentalist's Guide to the Public Library'' <www.lff.org/services/envgui.html>.

Another category of information designed for consumers and the general public consists of brochures, pamphlets, booklets, and flyers—resources that can be used to build vertical files for libraries and information centers, serve as resource materials for public meetings and community or neighborhood coalitions, and otherwise assist in alerting people to issues related to toxicology. Most of these types of information tend to be brief and serve as pointers to other, more detailed resources.

One of the best-known resources of such booklets and pamphlets is the Channing L. Bete Company, Inc. (200 State Road, South Deerfield, MA 01373-0200; 800/628-7733). They produce booklets and pamphlets on a wide variety of topics, including the environment and health. Booklets and pamphlets are geared for children and adult audiences. Bulk orders for public distribution (booklets' front and back covers can be imprinted with company or organization logos, physician or clinic office name and address, library name and address, emergency phone numbers, message, etc.) are a mainstay service of Channing Bete. Some of their toxicology-related titles are:

Chemicals in Your World
Groundwater Protection
Hazardous Products in the Home—A Guide to Proper Use and Disposal
Lead Can Be Deadly—Keep Your Child Safe
Lead in Drinking Water
Lead in Your Water
Lead—Is Your Child at Risk
Managing Yard Waste
Needed: Clean Water
Safe Drinking Water
Using Household Chemicals Safely

Professional societies (see Chapter 15, Organizations, for detailed listings) may also produce this type of general-interest material for members, members' organizations, and others interested in the topic. For example, the American Chemical Society's Department of Government Relations and Science Policy supports the Office of Legislative and Regulatory Programs (1155 16th Street, NW Washington, DC 20036; 202/872-8725; www.acs.org), which has produced and updated a series of information pamphlets (that have undergone an extensive external review process to assure scientific accuracy and nonbias). These materials have been produced at a reading level of the high-school chemistry student and serve as exceptional resources not only for students but for the general public as well. These pamphlets introduce the topic from a scientific perspective but are direct and readable. Toxicology-related titles are:

Chemical Risk: A Primer
Chemical Risk: Personal Decisions
Hazardous Waste Management
Pesticides

The American Congress of Government Industrial Hygienists (ACGIH, Kemper Woods Center, 1330 Kemper Meadow Dr., Suite 6000, Cincinnati, OH 45240; 513/742-3355 fax; pubs@ACGIH.org; http//www.ACGIH.org) is usually associated with the publication of technical documents and reference works. However, ACGIH produces materials that can be considered basic reference resources and that represent issues related to toxicology and environmental and occupational health in more general settings, including ''ACGIH Threshold Limit Values'' and ''Biological Exposure Indices.''

Nonprofit organizations are good sources of general-interest information, usually presented from some advocacy perspective. Such groups fall into two major categories, public interest groups (e.g., Greenpeace, Sierra Club, Natural Resources Defense Fund, Environmental Defense Fund) and special interest groups (e.g., American Council on Science and Health and the Cato Institute). For example, the American Council on Science and Health publishes a series of informational booklets and pamphlets:

Alar Five Years Later
Asbestos
Cigarettes: What the Warning Label Doesn't Tell You
Commentary on Mark Green's Lead & Kids: Why Are 30,000 NYC Children Contaminated?
Eating Safely: Avoiding Foodborne Illness
Is a Deal with the Cigarette Industry in the Interest of Public Health?
Lead and Human Health
Multiple Chemical Sensitivity

Public Health Concerns About Environmental Polychlorinated Biphenyls (PCBs)
The Tobacco Industry's Use of Nicotine as a Drug

Several periodicals provide news releases and book reviews of general interest and popular works. A new publication, Counterpoise (published by the American Library Association's Alternatives in Print Task Force of the Social Responsibilities Round Table), provides reviews of works published by small, independent, alternative, and progressive presses. There is a regular feature on the environment and ecology. Other periodicals providing reviews of general interest and popular works include:

The Amicus Journal
E Magazine
The Electronic Green Journal
Environment
Internation Wildlife
National Wildlife
Sierra
Whole Earth
Wilderness

Government agencies (see Chapter 15) also serve as good sources for general types of information. They can provide—usually at low or no cost—a wide variety of booklets, pamphlets, and other resources around which an excellent vertical file can be developed.

The U.S. Environmental Protection Agency (EPA) is an obvious example of a resource for these types of information. EPA makes these materials available to the public through their Public Information Center (PIC). In 1997, the PIC was folded into the EPA Library, which was named the EPA Information Resources Center (EPA Headquarters, 401 M Street, SW, Waterside Mall, Washington, DC 20460; 202/260-7751; www.epa.gov/). Individual EPA titles related to toxicology and environmental health are:

Catalog of EPA Environmental Education Materials and Resources, EPA-171-B-98-003.
Chemicals in Your Community: A Guide to Emergency Planning and the Community Right-to-Know Act (September 1988).
Citizens Guide to Pest Control and Pesticide Safety, 730-K-95-001 (September 1995).
A Citizens Guide to Radon, 2nd Edition: The Guide to Protecting Yourself and Your Family from Radon 402-K92-001 (September 1994) (in conjunction with the U.S. Public Health Service).
Consumers Guide to Radon Reduction: How to Reduce Radon Levels in Your Home, 402-K92-003, (August 1992).
EPA Air Quality Trends (annual).
EPA's Pesticide Programs, 21T-1005 (May 1991).
Guide to Environmental Issues, 520/B-94-001 (September 1996) (includes chapters on pesticides, hazardous water, public health, community safety, and health and environmental risk).
Handbook of Tools for Managing Federal Superfund Liability Risks at Brownfields and Other Sites, EPA-330-B-98-001.
Healthy Lawn/Healthy Environment: Caring for Your Lawn in an Environmentally Friendly Way, 700-K-92-005 (June 1992).
Household Hazardous Waste: Steps to Safe Management, EPA-530-F-92-031.
It's Easy Being Green! A Guide to Planning and Conducting Environmentally Aware Meetings and Events.
The Inside Story: A Guide to Indoor Air Quality, 402-K-93-007 (April 1995).
Pesticides and Food: What You and Your Family Need to Know, EPA-735-F-98-001.
Reducing Radon Risks: There are Two Ways to Protect Your Family from Radon, First the Hard Way—Holding Your Breath, 52011-89-027 (September 1992).
This is Superfund: A Citizens Guide to EPA's Superfund Program, 540-K-93-008 (March 1994).
Superfund: An Organizational Description and Directory, EPA-330-K-97-001.
Toxic Release Inventory: Public Data Release, Executive Summary 745-S-96-001 (June 1996, most current year available).

Other government agencies produce booklets and pamphlets and should be contacted accordingly. Examples would include the General Accounting Office (GAO, Washington, DC 20548-0001; 202/512-6000, 301/258-4066 fax, 301/413-0006 TDD; info@www.gao.gov; www.gao.gov; e.g., *Superfund Program Management,* GAO/HR-97-14) and the National Research Council (e.g., *Frontiers in Assessing Human Exposures to Environmental Toxicants: Report of a Symposium,* available from the National Academy Press, 2101 Constitution Ave. NW, Washington, DC 20418).

The Library of Congress Science Reference Section of the Science and Technology Division produces a series of *LC Tracer Bullets.* These bibliographic guides are used to locate published materials on various topics, including *Chemical Exposure: Toxicology, Safety, and Risk Assessment* (TB 91-11); *Chemical and Biological Warfare* (*CBW*) (TB 90-9); *Identifying Chemical Elements, Determining Chemical Composition* (no. 31); *Medical Waste* (no. 33); *Pesticides and Food* (TB 94-5); and *Poisonous Plants* (TB 90-4).

Trade associations also serve as a good source of booklets, flyers, and pamphlets. The Chemical Manu-

facturers Association, for instance, has published brochures on risk analysis, Superfund, pollution prevention, and deep wells. Many of the works listed in this section are not subject to the academic scrutiny of the peer review process, which is encountered for scientific and technical reports, journals, and books. This chapter provides titles representing a broad spectrum of political, social, economic, and scientific beliefs. Works from special and public interest groups are found in this compilation. It is left to the reader to accept or reject various opinions, viewpoints, and other aspects of these works.

COMPENDIA

General and popular works typically are published as books. There are several useful compendia from which comprehensive inventories of books, by topic, can be compiled:

Beacham's Guide to Environmental Issues and Sources (1993)
Beacham Publishing, Inc., Washington, DC

This multi-volume reference work provides a detailed inventory of resources related to a broad range of environmental topics, including sections in chapters on Nuclear Energy: Radiation; Freshwater Pollution: Drinking Water; Air Pollution: Health Effects; Agriculture: Groundwater Contamination; and individual chapters on Food Safety; Hazardous Waste Management; and Health and the Environment. For each section, there are compilations of general interest and technical books (annotated and nonannotated entries; general-interest periodicals, bibliographies, reference works, and other sources of information.

Earth Works: Recommended Fiction and Nonfiction About Nature and the Environment for Adults and Young Adults (1997)
Neal Schman Publishers, New York

More than 2,600 books have been evaluated and annotated in this collection of recommended readings. Topical coverage is broadly defined for the environment and includes related selections from the chapters on Activities and Issues (with sections on agriculture, human–animal relations, solid and toxic waste) and Environmental Action (with sections on activism and direct action, greener homes and gardens, and green businesses and industry).

The Environmental Source Book (1992)
Lyons & Buford, New York

Provides a useful overview of environmental issues; an inventory of key advocacy organizations; a list of general information sources, periodicals, funding sources, and history for a variety of environmental topics, including a chapter on hazardous substances and waste.

Reading About the Environment: An Introductory Guide (1993)
Libraries Unlimited, Englewood, CO

Contains more than 800 annotated entries of books and popular magazines on broad environmental topics, including specific chapters on: Toxic Waste; Pesticides, Cosmetics, Food Additives, and Other Chemicals; Radiation; and Health Problems in the Environment.

GENERAL INTEREST AND POPULAR WORKS

Acton, J. P. (1989)
Understanding Superfund: A Progress Report
Rand, Santa Monica, CA

Altman, R. (1990)
The Complete Book of Home Environmental Hazards
Facts on File, New York

Anderson, M. K. (1987)
Environmental Diseases
Watts, New York

Anonymous (1997)
Animal Nutrition: You May Be Poisoning Your Pet Unknowingly, a Little Each Day
Setter Publications, Bowie, MD

Anonymous (1996)
Citizens Guide to Pest Control and Pesticide Safety
DIANE Publishing Company, Upland, PA

Anonymous (1994)
Household Hazardous Waste Management: A Manual for One-Day Community Collection Programs
DIANE Publishing, Upland, PA

Anonymous (1993)
Toxic Waste Time Bomb
Gareth Stevens, Inc., Milwaukee, WI

Apfel, R. J. (1984)
To Do No Harm
Yale University Press, New Haven, CT

Arneson, D. J. (1991)
Toxic Cops
Watts, New York

Ashford, N. A. and Caldart, C. C. (1996)
Technology, Law, and the Working Environment, Rev. Ed.
Island Press, Covelo, CA

Ashton, J. (1999)
The Perils of Progress: The Health and Environmental Hazards of Modern Technology and What You Can Do About Them
International Specialized Book Services, Portland, OR

Banerjee, B. N. (1986)
Bhopal Gas Tragedy: Accident or Experiment?
Paribus Publishers and Distributors, New Delhi, India

Banerjee, B. N. (1987)
Environmental Pollution and Bhopal Killings
Gian Publishing, Delhi India

Banik, A. E. and Wade, C. (1990)
Your Water and Your Health
Keats, New Canaan, CT

Barnett, H. C. (1994)
Toxic Debts and the Superfund Dilemma
University of North Carolina, Chapel Hill, NC

Bartlett, D. B. and Steele, J.B. (1985)
Forevermore, Nuclear Waste in America
WW Norton, New York

Bartone, J. C. (1994)
Consumer Reference Book and Index About Hazardous Substances in Your Life
ABBE Publishers Association of Washington, DC, Annadale, NY

Baver, M. (1994)
Managing Your Household Hazardous Waste: A Step-by-Step Guide
Government Institutes, Rockville, MD

Bell, I. R. (1982)
Clinical Ecology: A New Medical Approach to Environmental Illness
Common Knowledge Press, Bolinas, CA

Bellini, J. (1986)
High Tech Holocaust
Sierra Club Books, San Francisco

Bergin, E. J. (1984)
The American Survival Guide: How to Survive in Your Toxic Environment
Avon, New York

Bogard, W. (1989)
The Bhopal Tragedy: Language, Logic, and Politics in the Production of a Hazard
Westview, Boulder, CO

Bower, L. M. (1995)
Healthy Household: A Complete Guide for Creating a Healthy Indoor Environment
Healthy House Institute, Bloomington, IN

Breecher, M. M. (1992)
Healthy Homes in a Toxic World: Preventing, Identifying and Eliminating Hidden Health Hazards in Your Home
Wiley, New York

Brickman, R., Jasanoff, S., and Ilgen, T. (1982)
Chemical Regulation and Cancer: A Cross-National Study of Policy and Politics
Cornell University (Program on Science, Technology, Society) Ithaca, NY

Briggs, S. A. (1992)
Basic Guide to Pesticides: Their Characteristics and Hazards
Hemisphere, Washington, DC

Brodeur, P. (1985)
Outrageous Misconduct
Pantheon Books, New York

Brower, M., and Leon, W.
The Consumer's Guide to Effective Environmental Choices: Practical Advice from the Union of Concerned Scientists
Three Rivers Press

Brown, M. H. (1988)
The Toxic Cloud: The Poisoning of America's Air
Perennial, New York

Brown, M. H. (1981)
Laying Waste: The Poisoning of America by Toxic Chemicals
Pantheon, New York

Brown, P. and Mikkelsen, E. J. (1990)
No Safe Place: Toxic Waste, Leukemia, and Community Action
University of California Press, Berkeley, CA

Bryant, B. (1995)
Environmental Justice
Island Press, Covelo, CA

Bryant, B. (1992)
Race and the Incidence of Environmental Hazards: A Time for Discourse
Westview Press, Boulder, CO

Bullard, R. D. (1993)
Confronting Environmental Racism: Voices from the Grassroots
South End, Boston, MA

Bullard, R. (1994)
Dumping in Dixie: Race, Class, and Environmental Quality, 2nd ed.
Westview, Boulder, CO

Bullard, R. D. (biannual updates)
People of Color Environmental Groups
Environmental Justice Resource Center, Atlanta GA.

Bullard, R. D. (1996)
Unequal Protection: Environmental Justice and Communities of Color
Sierra Club Books, San Francisco.

Bureau of National Affairs (1993)
Guide to Federal Environmental Laws
Bureau of National Affairs, Washington, DC

Buttram, H. (1996)
Our Toxic World: Who Is Looking after Our Kids? A Guide for Parents to Protect Their Children from Environmental Chemicals and Other Toxic Substances
Foresight America Foundation for Preconception Care, Plumsteadville, PA

Byrd, R. (1990)
1996 Guide to Superfund
Pasha Publications, Arlington, VA

Caglioti, L. (1983)
The Two Faces of Chemistry (translated)
MIT Press, Cambridge, MA

Cairncross, F. (1995)
Green, Inc.
Island Press, Covelo, CA

Calabrese, E. J. (1996)
Healthy Living in a Toxic World: Simple Ways to Protect Yourself and Your Family from Hidden Health Risks
Pinon Press, Colorado Springs, CO

Calabrese, E. J. (1984)
Healthy Living in an Unhealthy World: What You Can Do to Reduce the Risks of Cancer and Other Environmentally Induced Diseases for You and Your Family
Simon and Schuster, New York

Caldicott, H. (1992)
If You Love This Planet: A Plan to Heal the Earth
Norton, New York

Carson, R. (1962)
Silent Spring
Houghton Mifflin, Boston, MA

Center for Study of Responsive Law (1980)
Eating Clean
Center for Study of Responsive Law, Washington, DC

Cherniack, M. (1986)
The Hawks Nest Incident: America's Worst Industrial Disaster
Yale University Press, New Haven, CT

Chishti, A. (1986)
Dateline Bhopal: A Newsman's Diary of the Gas Disaster
Concept, New Delhi, India

Chivian, E. (Ed.) (1993)
Critical Condition: Human Health and the Environment
MIT Press, Cambridge, MA

Church, T. W, Nakamura, R. T, and O'Connor, R. E. (1993)
Cleaning Up the Mess
Brookings Institute, Washington, DC

Citizens Clearinghouse for Hazardous Wastes (now the Center for Health, Environment, and Justice) (1996)
Taking Action to Stop Dioxin
Citizens Clearinghouse for Hazardous Wastes, Falls Church, VA

Clarke, L. B. (1989)
Acceptable Risk?
University of California Press, Berkeley

Cohen, G., and O'Connor, J. (Eds.) (1990)
Fighting Toxics: A Manual for Protecting Your Family, Community, and Workplace
Island Press, Washington, DC

Cohen, S. (Ed.) (1986)
Behavior, Health, and Environmental Stress
Plenum, New York

Colborn, T., Dumanoski, D., and Myers, J. P. (1996–1997)
Our Stolen Future: Are We Threatening Our Fertility, Intelligence & Survival—A Scientific Detective Story
NAL-Dutton, New York

CONCERN (1987)
Pesticides: A Community Action Guide
CONCERN, Washington, DC

Congressional Digest (1998)
Superfund Reform: Cleaning Up Americas Toxic Waste Sites
Congressional Digest, Washington, DC

Conservation Foundation
Toxics in the Air: Reassessing the Regulatory Framework
The Conservation Foundation, Washington, DC

The Conservation Foundation (1987)
America's Waste: Managing for Risk Reduction
The Conservation Foundation, Washington, DC

Council on Economic Priorities Staff (1986)
Hazardous Waste Management: Reducing the Risk
Island Press, Washington, DC

Council on Environmental Quality (annual)
Environmental Quality
Council on Environmental Quality, Washington, DC

Cranor, C. F. (1987)
Regulating Pesticides in Food: The Delaney Paradox
National Academy Press, Washington, DC

Dadd, D. L. (1990)
Non-Toxic, Natural & Earthwise: How to Protect Yourself & Your Family from Harmful Products & Live in Harmony with the Earth
Putnam Publishing Group, New York

Dashefsky, H. S. (1993)
Environmental Literacy: Everything You Need to Know to Save the Planet
Random House, New York

Davidson, A. (1989)
In the Wake of the Exxon Valdez: The Devastating Impact of the Alaska Oil Spill
Sierra Club Books, San Francisco

Davis, C. E (1988)
Dimensions of Hazardous Waste Politics and Policy
Greenwood Press, New York

De Grazia, A. (1985)
A Cloud Over Bhopal
Popular Prakashan Private, Bombay, India

Deal, C. (1993)
The Greenpeace Guide to Anti-Environmental Organizations
Odonian, Berkeley, CA

Dembo, D. (1990)
Abuse of Power: Social Performance of Multinational Corporations—The Case of Union Carbide
New Horizons, New York

Dennis, E. (Ed.) (1991)
Media and the Environment
Island Press, Washington, DC

Diamond, A. (1990)
The Bhopal Chemical Leak
Lucent, San Diego

DIANE Publishing (1994)
Household Hazardous Waste Management: A Manual for One-Day Community Collection Programs
DIANE Publishing Company, Upland, PA

Dudley, N. (1991)
The Pesticide Handbook
Routledge, Chapman Hall, New York

Dunlop, T. R. (1981)
DDT: Scientists, Citizens, and Public Policy
Princeton University Press, Princeton, NJ

Durning, A. B. (1997)
Action at the Grass Roots: Fighting Poverty and Environmental Decline
Worldwatch Institute, Washington, DC

Durning, A. T. (1996)
Guardians of the Land: Indigenous Peoples and the Health of the Earth
Worldwatch Institute, Washington, DC

Earth Works Group (1989)
50 Things You Can Do To Save the Earth
Earth Works, Berkeley, CA

Earth Works Group (1991)
Next Step: 50 More Things You Can Do To Save the Earth
Earth Works, Berkeley, CA

Edelstein, M. R. (1988)
Contaminated Communities: The Social and Psychological Impacts of Residential Toxic Exposure
Westview, Boulder, CO

Eisenbud, M. (1993)
How Clean Is Clean How Safe Is Safe? A Review of Environmental Priorities
Medical Physics Publishers, Madison, WI

Emsley, J. (1996)
The Consumers Good Chemical Guide: A Jargon-Free Guide to the Chemicals of Everyday Life
W. H. Freeman, New York

Epstein, S. S. (1992)
Hazardous Waste in America: Our Number One Environmental Crisis
Sierra Club Books, San Francisco

Easterbrook, G. (1995)
A Moment on the Earth
Viking, New York

Eckholm, E. P. (1977)
The Picture of Health
WW Norton, New York

Everest, L. (1986)
Behind the Poisoned Cloud: Union Carbides Bhopal Massacre
Banner Press, Chicago, IL

Everest, L., and Beasley, J. D. (1991)
The Betrayal of Health: The Impact of Nutrition. Environment, and Lifestyles on Illness in America
Times Books, New York

Fagin, D., and Lavelle, M. (1996)
Toxic Deception: How the Chemical Industry Manipulates Science, Bends the Law, and Endangers Your Health
Carol Publishing Company, Secaucus, NJ

Feshbach, M., and Friendly, A. (1992)
Ecocide in the USSR
Basic Books, New York

Fior, R., and Pestalozza, G. (Eds.) (1993)
The Child and the Environment: Present and Future Trends
Elsevier Science, New York

Fred, S. M. (1998)
Inside the Hazardous World of Legal Drugs
Bantam Doubleday Dell, New York

Freudenberg, N. (1984)
Not in Our Backyards! Community Action for Health and the Environment
Monthly Review, New York

Freudenthal, R. I, and Freudenthal, S. L. (1989)
What You Need to Know to Live with Chemicals
Hill and Garnett, Green Farms, CT

Friede, A., O'Carrol, P. W., Nicola, R. M., Oberle, M. W., and Teutsch, S. M. (1996)
CDC Prevention Guidelines: A Guide for Action
Williams & Wilkins, Baltimore, MD (also available in CD-ROM format)

Fumento, M. (1993)
Science Under Siege
Morrow, New York

Garland, A. W. (1990)
For Our Kids Sake: How to Protect Your Child against Pesticides in Food
Sierra Club Books, San Francisco

Gay, K. (1988)
Silent Killers: Radon and Otner Hazards
Watts, New York

Geddes, R. (Ed.) (1997)
Cities in Our Future: Environmental Health and Social Equality
Island Press, Washington, DC

Gibbs, L. M. (ca. 1997)
Dying from Dioxin: A Citizens Guide to Reclaiming Our Health and Rebuilding Democracy
Citizens Clearinghouse for Hazardous Waste, Falls Church, VA

Gibbs, L. (1998)
Love Canal: The Story Continues
New Society Publishers, Story Creek, CT

Gilman, A. P., Tremblay, N., and Haines, D. (Eds.) (1997)
Human Health and Environmental Pollution in the Great Lakes
DIANE Publishing Company, Upland, PA

Gips, T. (1988)
Breaking the Pesticide Habit: Alternatives to Twelve Hundred Pesticides
International Alliance for Sustainable Agriculture, Minneapolis, MN

Gofman, J. W. (1980)
Radiation and Human Health: A Comprehensive Investigation of the Evidence of Low-Level Radiation to Cancer and Other Diseases
Sierra Club Books, San Fracisco

Gofman, J. W., and O'Connor, E. (1984)
X-Rays: Health Effects of Common Exams
Sierra Club Books, San Francisco

Golden Empire Health Planning Center (1987)
Alternatives to Landfilling Household Toxics
Golden Empire Health Planning Center, Sacramento, CA

Goldman, B. A. (1992)
The Truth About Where You Live: An Atlas for Action on Toxins and Mortality
Random House, New York

Gore, A. Jr. (1992)
Earth in the Balance
Houghton Mifflin, Boston, MA

Gori, G. B., and Luik, J. C. (1999)
Passive Smoke: The EPA's Betrayal of Science and Policy
The Fraser Institute, Vancouver, British Columbia

Gottlieb, R. (Ed.) (1995)
Reducing Toxics: A New Approach to Policy and Industrial Decision-Making
Island Press, Covelo, CA

Gough, M. (1986)
Dioxin, Agent Orange: The Facts
Plenum Press, New York

Graham, J. D. (1991)
In Search of Safety: Chemicals and Cancer Risk, 2nd Ed.
Harvard University Press, Cambridge, MA

Graham J. D. (Ed.) (1991)
Harnessing Science for Environmental Regulation
Praeger, Westport, CT

Graves, P. E. (1981)
Health and Air Quality: Evaluating the Effects of Policy
American Enterprise Institute, Washington, DC

Green, N. S. (1991)
Poisoning Our Children: Surviving in a Toxic World
Noble Press, Chicago, IL

Greenberg, M. R. (Ed.) (1987)
Public Health and the Environment: The United States Experience
Guilford Press, New York

Greenfield, E. J. (1987)
House Dangerous
Vintage Books, New York

Gribble, G. W. (1995)
Chlorine and Health
American Council on Science and Health, New York

Grifo, E. (1996)
Biodiversity and Human Health
Island Press, Covelo, CA

Groenewegen, P., Fisher, K., Jenkins, E. G., and Schot, J. (1996)
The Greening of Industry: Resource Guide and Bibliography
Island Press, Covelo, CA

Gupta, A. (1991)
Ecological Nightmares and Management Dilemma: The Case of Bhopal
Ajanta, Delhi, India

Haas, E. M. (1996)
The Detox Diet: A How-to Guide for Cleansing the Body of Toxic Substances
Celestial Arts Publishing Co., Berkeley, CA

Hagen, E. W. and Worman, J. J. (1995)
An Endless Series of Hobgoblins: The Science and Politics of Environmental Health Scares
Foundation for Economic Education, Irving-on-Hudson, NY

Hall, R. H. (1990)
Health and the Global Environment
Policy Press, Oxford, UK

Hann, J. W. (1991)
Guide to the Management of Hazardous Waste: A Handbook for the Businessman and the Concerned Citizen
Fulcrum, Golden, CO

Harker, D. F., and Natter, E. U. (1994)
Where We Live: A Citizens Guide to Conducting a Community Environmental Inventory
Island Press, Covelo, CO

Harte, J. (1991)
Toxics A to Z: A Guide to Everyday Pollution Hazards
University of California Press, Berkeley, CA

Havender, W. R., and Coulombe, R. (1996)
Does Nature Know Best? Natural Carcinogens and Anticarcinogens in America's Food
American Council on Science and Health, New York

Hawley, T. M. (1992)
Against the Fires of Hell: The Environmental Disaster of the Gulf War
Harcourt Brace Jovanovich, New York

Hay, A. (1982)
The Chemical of Scythe: Lessons of 2,4,5-T and Dioxin—Disaster Research in Practice
Plenum Press, New York

Hazarika, S. (1987)
Bhopal: The Lessons of Tragedy
Viking/Penguin, New York

Health and Welfare Canada (1992)
A Vital Link: Health and the Environment in Canada
Health and Welfare Canada, Ottawa, Ontario

Hearn, S. (1984)
Harvest of the Unknown: Pesticide Contamination in Imported Foods
Natural Resources Defense Council, New York

Hofrichter, R., and Gibbs, L. M. (Eds.) (1993)
Toxic Struggles: The Theory and Practice of Environmental Justice
New Society, Philadelphia, PA

Holt, T. (1995)
Modernize Our Food Safety Laws: Delete the Delaney Clause
American Council on Science and Health, New York

Howell, D. J. (1994)
Ecology for Environmental Professionals
Quorum Books, Westport, CT

Hudd, N. (1987)
Island of Dreams: Environmental Crisis in Japan
Schenkman Books, Cambridge, MA

Hunter, B. T. (1981)
How Safe Is the Food in Your Kitchen?
Charles Scibners Sons, New York

Hurley, A. (1995)
Environmental Inequities
University of North Carolina Press, Chapel Hill, NC

Institutes for Southern Studies Staff (1991)
Green Index, 1991–1992: A State-by-State Guide to the Nation's Environmental Health
Island Press, Covelo, CA

Jaquith, E. B. (1997)
Allergic to the 20th Century
Little Brown, New York

Johnson, B. L. (1999)
Human Health Aspects of Hazardous Waste
Ann Arbor Press, Chelsea, MI

Jorgensen, E. P. (1989)
The Poisoned Well
Island Press, Covelo, CA

Juberg, D. R., Kleiman, C. F, and Kwon, C. (1997)
Lead and Human Health
American Council on Science and Health, New York

Kallet, A., and Schlink, F. J. (1933)
100,000,000 Guinea Pigs
Grosset & Dunlap, New York

Kammen, D. M. (1999)
Should We Risk It? Exploring Environmental, Health and Technology Problem Solving
Princeton University Press, Princeton, NJ

Kane, D. N. (1985)
Environmental Hazards to Young Children
Oryx Press, Phoenix, AZ

Kaura, S. R. (1991)
A Family Doctor's Guide to Understanding and Preventing Cancer: Environmental Risks and Solutions
Health Press, Santa Fe, NM

Kimmel, D. D. (1992)
Six Weeks to a Toxic-Free Body: A Step-by-Step Program on How to Achieve a Toxic-Free Body
Corbin House, New York

Kleiman, C. F., and the Staff of the American Council on Science and Health (1997)
Of Mice and Men: Animal Experiments, Human Cancer Risk, and Regulatory Policies
American Council on Science and Health, New York

Knowles, P. C. (1992)
Fundamentals of Environmental Science and Technology
Government Institutes, Rockville, MD

Koren, G. (1995)
The Parents' Guide to Poisons in the Home: The Essential Sourcebook on Toxic Household Products
Random House Value Publishing, Avenal, NJ

Kronenwetter, M. (1989)
Managing Toxic Wastes
Messner, Englewood Cliffs, NJ

Kruger, A. (1992)
H is for EcoHome: An A to Z Guide to a Safer, Toxin-Free Household
Avon Books, New York

Kurzman, D. (1987)
A Killing Wind: Inside Union Carbide and the Bhopal Catastrophe
McGraw-Hill, New York

Lappe, M. (1991)
Chemical Deception: The Toxic Threat to Health in Humans, Food, and the Environment
Sierra Club Books, San Francisco

Lave, L. B. and Upton, A. C. (1987)
Toxic Chemicals, Health, and the Environment
Johns Hopkins University Press, Baltimore, MD

Lash, J. (1984)
A Season of Spoils
Pantheon, New York

Lewis, S. A. (1995)
The Sierra Club Guide to Safe Drinking Water
Sierra Club Books, San Francisco

Lawson, L. (1993)
Staying Healthy in a Risky Environment: The New York University Medical Center Family Guide
Simon & Schuster, New York

Lawson, L. (1996)
Staying Well in a Toxic World: Understanding Environmental Illness, Multiple Chemical Sensitivities, Chemical Injury, and Sick Building Syndrome
Lynnwrd Press, Evanston, IL

le Riche, W. H. (1982)
A Chemical Feast
Facts on File, New York

Legator, M. S. (Ed.) (1993)
Chemical Alert: A Community Action Handbook
Austin University Press, Austin, TX

Legator, M., Harper, B. and Scott, M. (1985)
The Health Detectives Handbook: A Guide to the Investigation of Environmental Health Hazards by Nonprofessionals
Johns Hopkins University Press, Baltimore, MD

Lewith, G. T. (1985)
Clinical Ecology: A Therapeutic Approach to Understanding and Treating Food and Chemical Sensitivities
Thorsons, Rochester, VT

Lippman, M. (Ed.) (1992)
Environmental Toxicants: Human Exposures and Their Health Effects, 1992
Van Nostrand–Reinhold, New York

Lord, J. (1986)
Hazardous Wastes from Homes
Enterprise for Education, Santa Monica, CA

Lowe, C. (1990)
Toxic Food: What You Need to Know About Your Family Safety
Avon Books, New York

Mackarness, R. (1996)
Living Safely in a Polluted World: How to Protect Your Self and Your Children from Chemicals in Your Food and Environment
Berkeley Publishing Group, New York

Majumdar, S. K. (Ed.) (1984)
Hazardous and Toxic Waste: Technology, Management and Health Effects
Pennsylvania Academy of Science, Easton, PA

Maltoni, C., and Selikoff, I. J. (Eds.) (1988)
Living in a Chemical World: Occupational and Environmental Significance of Industrial Carcinogens
National Academy of Sciences, New York

Matthews, B. (1992)
Chemical Sensitivity: A Guide to Coping with Hypersensitivity Syndrome, Sick Building Syndrome, and Other Environmental Illnesses
McFarland, Jefferson, NC

Merrifield, J. (1990)
Putting Scientists in Their Place: Participatory Research in Environmental and Occupational Health
Highlander Center, New Market, TN

Millichap, I. G. (1993)
Environmental Poisons in Our Food
PNB Publications, Chicago, IL

Moeller, D. W. (1992)
Environmental Health
Harvard University Press, Cambridge, MA

Moore, C. C. (1997)
Haunted Housing: How Toxic Scare Stories Are Spooking the Public Out of House and Home
Cato Institute, Washington, DC

Morelli, J. (1997)
Poison! How to Handle the Hazardous Substances in Your Home
Andrews & McMeel, Kansas City, MO

Moses, M. (1995)
Designer Poisons: How to Protect Your Health and Home from Toxic Pesticides
Pesticide Education Center, San Francisco

Mott, L., and Broad, M. (1984)
Pesticides in Food: What the Public Needs to Know
Natural Resources Defense Council, San Francisco

Mott, L., and Snyder, K. (1987)
Pesticide Alert
RA Club Books, San Francisco

Moyers, B. (1990)
Global Dumping Ground: The International Traffic in Hazardous Waste
Seven Locks Press, Washington, DC

Nadavukaren, A. (1990)
Man and the Environment: A Health Perspective, 3rd ed.
Waveland Press, Prospect Heights, IL

Nader, R. (1991)
Toxic Truth and Consequences
U.S. Public Interest Research Group, Washington, DC

Napier, K. (1995)
Issues in the Environment
American Council on Science and Health, New York

National Academy of Science (1980)
Lead in the Human Environment: A Report
National Academy Press, Washington, DC

National Academy of Science (1986)
Hazards: Technology and Fairness
National Academy Press, Washington, DC

National Conference of State Legislators (1995)
Beyond Superfund: Voluntary Industrial Cleanup
National Conference of State Legislatures

National Institute of Environmental Health Sciences (1997)
Environmental Diseases from A to Z
National Institute for Environmental Health, Research Triangle Park, NC

National Institute of Environmental Health Sciences and the U.S. Department of Energy (1995)
Questions and Answers About EMF: Electric Magnetic Fields Associated with the Use of Electric Power (DOE/EE-0040)
U.S. Government Printing Office, Washington, DC

National Research Council (1991)
Animals as Sentinels of Environmental Health Hazards
National Academy Press, Washington, DC

National Research Council (1991)
Frontiers in Assessing Human Exposures to Environmental Toxicants
National Academy Press, Washington, DC

National Toxics Campaign Fund (1988)
Citizens Toxic Protection Manual
National Toxics Campaign, Boston, MA

National Toxics Campaign Fund
Fighting Military Toxics: A Citizen's Organizaing Manual
National Toxics Campaign, Boston, MA

Natural Resources Defense Council (1991)
The Right to Know More
Natural Resources Defense Council, New York

Needham, R. (1995)
Raising Children Toxic Free: How to Keep Your Child Safe from Lead, Asbestos, Pesticides . . .
Avon, New York

Needleman, H. I., and Landrigan, P. J. (1994)
Raising Children Toxic Free: Protecting Your Child from Common Environmental Health Threats
Farrar, Straus, and Giroux, New York

Needleman, H. L. (1998)
Raising Healthy Children
Farrar Straus & Giroux, New York

Nelkin, D. (1991)
Risk Communication and the Mass Media
The University of Tennessee, Knoxville, TN

Nelson, L., Kenen, R., and Klitzman, S. (1990)
Turning Things Around: A Women's Occupational and Environmental Health Resource Guide
National Women's Health Network, Washington, DC

New York State Health Department (1993)
Toxic Substances: How Toxic Is Toxic?
New York State Health Department, Albany, NY

Ney, R. E. (1996)
Chemicals: What You Need to Know
Chatelaine Press, Burke, VA

Norris-Hall, L. (1990)
Pollution Industries in the South and Appalachia: Economy, Environment, and Politics
Highlander Center, New Market, TN

Null, G. (1990)
Clearer, Cleaner, Safer, Greener: A Blueprint for Detoxifying Your Environment
Villard/Random House, New York

O'Brien, M.
On the Trail of a Pesticide: A Guide to Learning about the Chemistry, Effects, and Testing of Pesticides
Northwest Coalition for Alternatives to Pesticides, Eugene, OR

Office of Technology Assessment (1989)
Pesticide Residues in Food: Technologies for Detection
U.S. Congress Office of Technology Assessment, Washington, DC

Opposing Viewpoints (1986)
How Dangerous Are Toxic Wastes? In The Environmental Crisis Series
Greenhaven Press, St. Paul, MN

Opposing Viewpoints (1991)
Oil Spills
Greenhaven Press, San Diego

Opposing Viewpoints (1994)
Pollution
Greenhaven Press, San Diego

Opposing Viewpoints (1995)
Environmental Justice
Greenhaven Press, San Diego

Opposing Viewpoints (1995).
Pesticides
Greenhaven Press San Diego

Opposing Viewpoints (1996)
Animal Rights
Greenhaven Press, San Diego

Ottoboni, M. A. (1991)
The Dose That Makes the Poison
Van Nostrand, New York

Owen, O. S. (1972)
Eco-Solutions
Schenkman, Cambridge, MA

Pausenback, D. J. (Ed.) (1989)
The Risk Assessment of Environmental Hazards: A Textbook of Case Studies
John Wiley & Sons, New York

Peters, G. A., and Peters, B. J. (1980)
Sourcebook on Asbestos Diseases: Medical, Legal, and Engineering Aspects
Garland STPM Press, New York

Payne, M.
Super Health in a Toxic World: The Complete Environmental Medicine Health Plan
Thorsons, San Francisco, CA

Piasecki, B. W., and Davis, G. A. (1987)
America's Future in Toxic Waste Management
Quorum Books, New York

Pick, M. (1992)
How to Save Your Neighborhood, City, or Town: The Sierra Club Guide to Community Organizing
Sierra Club Books, San Francisco, CA:

Pierce, J. C. Steger, M. A. E., Steel, B. S., and Lovrich, N. P. (1992)
Citizens, Political Communication, and Interest Groups: Environmental Organizations in Canada and the United States
Praeger, Westport, CT

Pringle, L. P. (1980)
Lives at Stake: The Science and Politics of Environmental Health
Macmillan, New York

Regenstein, L. (1986)
How to Survive in America the Poisoned
Acropolis, Washington, DC

Pohanish, R. P. and Greene S. A. (Eds.) (1993)
Hazardous Substances Resource Guide
Gale Research Company, Detroit, MI

Postel, S. (1987)
Defusing the Toxics Threat: Controlling Pesticides and Industrial Waste
Worldwatch Institute, Washington, DC

Postel, S. (1989)
The Dynamic Duo: RCRA and SARA Title III
Environmental Action Foundation, Washington, DC

Purdom, P. W. (1980)
Environmental Health
Academic Press, New York

Records, M. W. (1997)
Domestic 007: Eliminating Hidden Killers in Your Home, Ridding Your Home of Harmful Chemicals and Cancer-Causing Agents
Earth-Wise Publications, Silver Spring, MD

Repetto, R., and Baliga, S. S. (1996)
Pesticides and the Immune System: The Public Health Risks
World Resources Institute, Washington DC.

Rialp, V. (1993)
Children and Hazardous Work in the Philippines
International Labor Office, Washington, DC.

Richman, B., and Hassol, S. (1989)
Everyday Chemicals: 101 Practical Tips for Home and Work
Windstar Foundation, Snowmass, CO

Roaner, D. and Markowitz, G. (1991)
Deadly Dust: Silicosis and the Politics of Occupational Disease in the Twentieth Century
Princeton University Press, Princeton, NJ

Roberts, H. I. (1990)
Aspartame (NutraSweet): Is It Safe?
Charles Press, Philadelphia. PA

Rodale, J. I. (1964)
Our Poisoned Earth and Sky
Rodale Press, Emmaus, PA

Rodericks, J. (1994)
Calculated Risks: The Toxicity and Human Health Hazards of Chemicals in Our Environment
Cambridge University Press, London

Ross, S. (Ed.) (1980)
Toxic Substances Sourcebook
Environmental Information Center, New York

Rousseau, D. (1996)
Healthy by Design: Building and Remodeling Solutions for Creating Healthy Homes
Hartley & Marks, Point Roberts, WA

Rowland, A. J. (1983)
Environment and Health
E. Arnold, London

Ryan, W., and Shrader, R. (1993)
An Ounce of Toxic Pollution Prevention: Rating States Toxic Use Reduction Laws
National Environmental Law Center and Center for Policy Alternatives, Washington, DC

Sachs, A. (1997)
ECO-Justice: Linking Human Rights and the Environment
Worldwatch Institute, Washington, DC

Samuels, M. (1983)
Well Body, Well Earth: The Sierra Club Environmental Health Sourcebook
Sierra Club Books, San Francisco

Sapolsky, H. M. (Ed.) (1990)
Consuming Fears: The Politics of Product Risks
Basic Books, New York

Sarokin, D. J. (1986)
Cutting Chemical Wastes: What Twenty-Nine Organic Chemical Plants Are Doing to Reduce Hazardous Wastes
INFORM, New York

Satterwaite, D., Hart, R., Levy, C., Mitlin, D., Ross, D., Smit, R., and Stephens, C. (1996)

The Environment and Children: Understanding and Acting on the Environmental Hazards That Threaten Children and Their Parents
Island Press, Covelo, CA

Schnare, D. W., and Katzman, M. T. (Eds.) (1989)
Chemical Contamination and Its Victims: Medical Remedies, Legal Redress, and Public Policy
Quorum New York

Schweitzer, G. E. (1991)
Borrowed Earth, Borrowed Time: Healing America's Chemical Wounds
Plenum Press, New York

Science Education for Public Understanding Program (SEPUP) (1995)
Understanding Environment Health Risks
University of California, Berkeley, CA

Sellers, C. (1997)
Hazards of the Job: From Industrial Disease to Environmental Health Science
University of North Carolina Press, Chapel Hill, NC

Setterberg, F. (1993)
Toxic Nation: The Fight to Save Our Communities from Chemical Contamination
John Wiley & Sons, New York

Shannon, S. (1994)
Good Health in a Toxic World: The Complete Guide to Fighting Free Radicals
Warner Books, New York

Sheilds, J. (1990)
Environmental Health: New Directions
Princeton Scientific, Princeton, NJ

Sherry, S. (1985)
High Tech and Toxics: A Guide for Local Communities
Golden Empire Health Planning Center, Sacramento, CA

Shrivastava, P. (1993)
Bhopal: Anatomy of a Crisis, 2nd ed.
P. Chapman, Bristol, PA

Shoemaker, J. M., and Vitale, C. Y. (1991)
Healthy Homes, Healthy Kids: Protecting Your Children from Everyday Environmental Hazards
Island Press, Covelo

Shulman, S. (1992)
The Threat at Home: Confronting the Toxic Legacy of the U.S. Military
Beacon Press, Boston, MA

Shulman, S. (1994)
The Threat of Home: Confronting the Toxic Legacy of the U.S. Military
Beacon Press, Boston, MA

Silver, C. S. and Rothman, D. S. (1995)
Toxics and Health: The Potential Long-Term Effects of Industrial Activity
World Resources, Institute, Washington, DC

Skjei, E. and Whorton, M. D. (1983)
Of Mice and Molecules: Technology and Human Survival
Dial Press, New York

Smeh, N. J. (1996)
Save the Children and Yourself! Guide to a Healthier Future Generation by Avoiding Toxins in Today's Food and Waters
Alliance Publishing Company, Alliance, VA

Spitz, A. H. (1996)
What's Hazardous in My Home?
Tyris Environmental, Tuscon, AZ

Stabile, T. (1984)
Everything You Want to Know About Cosmetics: Or What Your Friendly Clerk Didn't Tell You
Dood, Mead, New York

Stein, D. (1991)
Least Toxic Home Pest Control: Dan's Practical Guide
Hulogosi Communications, Inc., Eugene, OR

Stein, D. (1994)
Least Toxic Home Pest Control
The Book Publishing Co., Summertown, TN

Steingraber, S. (1997)
Living Downstream: An Ecologist Looks at Cancer and the Environment
Addison-Wesley, New York

Steingraber, S. (1998)
Living Downstream: A Scientist's Personal Investigation of Cancer and the Environment
Vintage Books, New York

Steinman, D. (1996)
Living Healthy in a Toxic World: Simple Steps to Protect You & Your Family from Everyday Chemicals, Poisons & Pollution
Berkeley Publishing Group, New York

Stewart, J. C. (1990)
Drinking Water Hazards: How to Know If There Are Toxic Chemicals in Your Water and What to Do if There Are
Envirographics, Hiram, OH

Sufrin, S. C. (1985)
Bhopal: Its Setting, Responsibility, and Challenge
Ajanta (South Asia Books), Delhi, India

Szasz, A. (1994)
Ecopopulism: Toxic Wasteland the Movement for Environmental Justice
University of Minnesota Press, Minneapolis, MN

Tartakow, I. J. (1981)
Foodborne and Waterborne Diseases: Their Epidemiological Characteristics
AVI, Westport, CT

Texas Learning Tech (1996)
Health Risk: Incident at Elk Run
Texas Learning Tech, Austin, TX

Texas Learning Tech (1996)
Health Risk: Shadow Over Crystal City
Texas Learning Tech, Austin, TX

Timbrell, J. A. (1995)
Introduction to Toxicology, 2nd ed.
Taylor and Francis, Washington, DC

Turkington, C. (1995)
The Home Health Guide to Poisons and Antidotes
Facts on File, New York

Trager, O. (1989)
Our Poisoned Planet: Can We Save It?
Facts on File, New York

Trost, C. (1984)
Elements of Risk
Times Books, New York

Tyson, R. (1995)
Kid Safe: Everything You Need to Know to Make Your Child's Environment Safe
Random House (Times Books), New York

(U.S.) Department of the Interior (1984)
Handbook of Toxic Pesticides to Wildlife
Department of the Interior, Washington, DC

(U.S.) Environmental Protection Agency (1988)
Pesticide Fact Handbook
U.S. EPA, Washington, DC

(U.S.) Environmental Protection Agency (1988)
Toxics in the Community: National and Local Perspectives
U.S. EPA, Washington, DC

(U.S.) Environmental Protection Agency
The Toxic Release Inventory: A National Perspective
Washington, DC, Environmental Protection Agency, 1991.

(U.S.) Environmental Protection Agency (1995)
EPA Air Quality Trends EPA-454/F-95-003
U.S. EPA. Washington, DC

(U.S.) Environmental Protection Agency (1995)
The Solid Waste Dilemma: An Agenda for Action
U.S. EPA, Washington, DC

(U.S.) Environmental Protection Agency (1997)
Endocrine Disrupters and the Endocrine Disrupter Screening and Testing Advisory Committee Report
U.S. EPA, Washington, DC

(U.S.) Fish and Wildlife Service (1998)
Beyond Cleanup: Restoring Americas Heritage—Facts About Superfund's Natural Resource Damage Assessment and Restoration Program
Department of Interior, Washington, DC

(U.S.) Fish and Wildlife Service (1998)
Ensuring Quality Habitat for Fish and Wildlife: The Environmental Contaminants Program
U.S. Department of Interior, Washington, DC

Van Den Bosch, R. (1978)
The Pesticide Conspiracy
New York Doubleday

Van Doren, Peter (1999)
Chemicals, Cancer, and Choices; Risk Reduction through Markets
Cato Institute, Washington, DC

Van Strum, C. (1994)
A Bitter Fog: Herbicides and Human Rights
Sierra Club Books, San Francisco

Vaughn, E. (1990)
Some Factors Influencing the Nonexperts' Perception and Evaluation of Environmental Risk
Garland, New York

Varrett, J., and Carper, J. (1974)
Eating May be Hazardous to Your Health: How Government Fails to Protect You from the Dangers in Your Food
Simon & Schuster, New York

Vivek, P. S. (1990)
The Struggle of Man against Power: Revelation of the 1984 Bhopal Tragedy
Himalaya, Bombay, India

Vyner, H. M. (1988)
Invisible Trauma: The Psychological Effects of Invisible Environmental Contamination
Lexington, Lexington, MS

Wade, R. C. (1996)
Joining Hands Community Service-Learning Resources Kit: Animals, Environmental, Intergenerational, Poverty/Hunger, School Community Health/Safety Set
University of Iowa, Iowa City

Wagner, T. P. (1994)
The Complete Guide to Hazardous Waste Regulations: The Comprehensive Step-by-Step Guide to Regulation of Hazardous Waste Under RCRA, TSCA, HMTA, OSHA, and Superfund
Van Nostrand Reinhold, New York

Wandersman, A. (Ed.) (1985)
Beyond the Individual: Environmental Approaches and Prevention.
Haworth, New York

Wargo, J. (1996)
Our Children's Legacy: How Sicence and Law Failed to Protect Us From Pesticides
Yale University Press, New Haven, CT

Webster, J. (Ed.) (1987)
Toxic and Hazardous Materials: A Sourcebook and Guide to Information Sources
Greenwood Press, Westport, CT

Wedeen, R. P.(1993)
Toxic Circles: Environmental Hazards from the Workplace in the Community
Rutgers University Press, New Brunswick, NJ

Weir, D. (1988)
The Bhopal Syndrome: Pesticides, Environment, and Health
Sierra Club Books, San Francisco

Wier, D., and Shapiro, M. (1981)
Circle of Poison: Pesticides and People in a Hungry World
Institute for Food and Development Policy, San Francisco

Weisman, J. D. (1988)
Choose to Live
Grove Press, New York

Weiss, L. (1983)
How to Live with the New 20th Century Illness: A Guide to Petrochemical- and Food-Sensitive Sufferers
Weiss Publishing, Franklin, MI

West, B. Sandman, P. M., and Greenberg, M. R. (1994)
The Reporter's Environmental Handbook
Rutgers University Press, New Brunswick, NJ

Whelan, E. (1985)
Toxic Terror
Jameson Books, Ottawa, IL

Whitmore, T. (1991)
Toxic Chemical-Free Living and Recovering from ME/CFS
S. Milner, Birchgrove, NSW, Australia

Whitmore, T. (1992)
Toxic Chemical-Free Pregnancy and Child-Rearing
Sterling Publishing Company, New York

Wilcox, F. (1983)
Waiting for an Army to Die: The Tragedy of Agent Orange
Vintage Books, New York: (reprinted with updated introduction by Seven Locks Press, 1989).

Wildavasky, A. (1997)
But Is It True: A Citizen's Guide to Environmental Health and Safety
Harvard University Press, Cambridge, MA

Wilson, C. (1993)
Chemical Exposure and Human Health: A Reference to 314 Chemicals with a Guide to Symptoms and a Directory of Organizations
McFarland and Company, Jefferson, NC

Winter, C. K. (1990)
Chemicals in the Human Food Chain
Van Nostrand–Reinhold, New York

Winter, R. (1992)
A Consumer's Dictionary of Household, Yard, and Office Chemicals
Crown, New York

Wolf, A. M. (1998)
Oue Es Peligroso en Nuestro Hogar? (What's Hazardous in Our Home?)
Sonora Environmental Research Institute, Tuscon, AZ (available in both English and Spanish editions)

World Health Organization (1972)
Health Hazards of the Human Environment
World Health Organization, Geneva

World Resources Institute (biennial)
World Resources
Oxford Univ. Press, New York

World Wildlife Federation (1998)
Persistent Organic Pollutants: Hand-Me-Down Poisons That Threaten Wildlife and People
(http://www.worldwildlife.org/toxics)
World Wildlife Foundation, Washington, DC

Worldwatch Institute (annual)
State of the World
Norton, New York

Worldwatch Institute (annual)
Vital Signs
Norton, New York

Wyne, B. (1987)
Risk Management and Hazardous Waste: Implementation and the Dialects of Credibility
Springer-Verlag, Berlin

Young, A. L. and Reggiani, G. M. (Eds.) (1988)
Agent Orange and its Associated Dioxin: Assessment of a Controversy
Elsevier Science, New York

Ziff, S. (1984)
Silver Dental Fillings: The Toxic Time Bomb
Aurora Press, Santa Fe, NM

Zipko, S. J. (1986)
Toxic Threat: How Hazardous Substances Poison Our Lives
Julian Messner, New York

Zonderman, J., and Shader, L. (1993)
Environmental Diseases
21st Century Books, New York

This Page Intentionally Left Blank

CHAPTER

6

Internet and Other Digital Resources

PHILIP WEXLER, P. J. (BERT) HAKKINEN, AND FREDERICK W. STOSS

Continual dreams of junk: I am looking for a poppy field . . . Moonshiners in black Stetsons direct me to a Near East cafe. . . . One of the waiters is a connection for Yugoslav opium. . . .

Buy a packet of heroin from a Malay Lesbian in white belted trenchcoat. . . . I cop the paper in Tibetan section of a museum. She keeps trying to steal it back. . . . I am looking for a place to fix. . . .

(William S. Burroughs, *Naked Lunch*)

The variety of computerized sources potentially relevant to toxicology, environmental health, risk, and hazardous chemicals is staggering, and separating the wheat from the chaff is no mean feat. It may be good to first define some terms.

Electronic or digital information resources are those accessible/readable via computer. They can take the form of online access (using a dial-up modem or the Internet), CD-ROMs, diskettes, and magnetic tape, to name the most common. The Internet is but one medium (though increasingly the most prevalent) for presenting electronic information.

The *Internet* grew out of work initiated by the U.S. Department of Defense in the late 1960s to protect computer networks in the event of wars. Vint Cerf and Bob Kahn, who defined Internet Protocol (IP) by which packets are sent from one computer to another until they reach their destination, are generally acknowledged as the key players in the original design of the Internet. It has evolved into a worldwide collection of computer networks used for a variety of purposes, such as sending electronic mail messages, accessing databases, and serving as a publication and distribution device for textbooks, journals, newsletters, and other sets of information. The company NUA (http://www.nua.ie) estimated that there were about 179 million Internet users worldwide as of June 1999. Network Wizards (http://www.nw.com) estimated 43,230,000 domain hosts as of January 1999.

The *World Wide Web* (WWW or the Web) is the dominant and continually evolving part of the Internet. Tim Berners-Lee, Director of the World Wilde Web Consortium, is considered the primary force behind the emergence of the World Wide Web. The Web includes a collection of documents (text, graphic, video, and audio files) through which users can navigate with browser software programs and *hypertext* links. Hypertext enables users to highlight (by clicking with a mouse) certain pictures, words, or phrases, on a page and thereby move to other pages that provide additional information on whatever subject was clicked. Hypertext files are usually moved across the Internet by use of HyperText Transfer Protocol (HTTP), software programs that are part of the user's computer and the Web site computer. Alternately, users can home in on a particular site, or home page, if they know its address, also known as a Uniform Resource Locator (URL). The ''domain'' portion of this URL consists of (usually) alphabetic characters separated by dots and/or slashes. The National Library of Medicine's URL, for example, is http://www.nlm.nih.gov. ''Gov,'' standing for ''government,'' is a domain type. Other domain types are ''com'' for commercial organizations,

''edu'' for educational institutions, ''mil'' for military sites, ''net'' for Internet gateways or administrative hosts, and ''org'' for nonprofit organizations. Outside the United States, domain names end with a country code (e.g., jp = Japan). E-mail addresses are formatted in a similar manner. For example, Professor Tyrannasaurus Rex, stationed at the University of Jurrasic, might have an e-mail address such as trex@ujurras.edu.

Because of the levels within a given site and the preponderance of links from site to site, it is a challenge to compile lists of Web sites. In selecting which precise sites to present here, we have sometimes gone for the broader, sometimes the narrower, and sometimes opted for redundancy, listing both the broader organizational site and its ''subsites.'' Although a variety of search engines (described later in this chapter) can be used to locate information across the Internet, some of the larger Web sites have their own site-specific search engines to aid in navigation. The summaries provided in this section emphasize the contents of the sites, not the activities of the sponsoring groups, which for certain sites are more fully explored in Chapter 15, ''Organizations.'' Web site addresses are also included in that chapter, as they are, where available, in Chapter 4, ''Newsletters''; Chapter 9, ''Publishers''; and other chapters. Additional Internet, Web, and other computer resources may be located by consulting Chapter 11, ''Toxicology Data and Information Management.'' The sites highlighted below were chosen based on their containing important and substantial information (i.e., not just another pretty site). A less discriminating list of all Web sites covering the subject matter of this book could easily be ten times as large. Note that URLs are very much subject to change and you may need to use search engines to locate a current URL in the event that the one provided is no longer operational. At times, Web sites are temporarily unavailable due to technical problems or vandalization by computer hackers.

WEB SITES

Agency for Toxic Substances and Disease Registry (ATSDR)
http://www.atsdr.cdc.gov

This site's home page contains an extensive table of contents representing ATSDR's numerous activities, including ATSDR contacts and announcements, a large array of datasets/resources (e.g., ToxFAQs, Public Health Statements, ATSDR/EPA Top 20 Hazardous Substances, HazDat, and software), and good links to related organizations and Internet resources.

Air and Waste Management Association (AWMA)
http://www.awma.org

Provides information on membership, publications, employment, staff, international activities, certification, news, meetings, education, links, products/services, and public outreach.

Altweb
http://altweb.jhsph.edu

Intended to foster the development of scientifically acceptable in vitro and other alternatives to animal testing. Provides news, information, discussion, and resources. A collaborative effort developed by the Johns Hopkins University in collaboration with the Altweb Project team.

American Association of Poison Control Centers (AAPCC)
http://www.aapcc.org

Provides a complete list of AAPCC Poison Centers, news and information, educational materials, technology issues and software, center certification issues, information from the Toxic Exposure Surveillance System (TESS), and links to Web sites.

American College of Toxicology (ACT)
http://actox.org

Contains information about the mission of the American College of Toxicology, membership, publications, links to other toxicology sites, and contents pages from the ***International Journal of Toxicology,*** and the ***American College of Toxicology Newsletter***.

American Industrial Hygiene Association (AIHA)
http://www.aiha.org

Offers information on member services, scientific affairs (including white papers and lab accreditation), professional development, products and publications, other resources, and news.

American Type Culture Collection (ATCC)
http://www.atcc.org

This independent, nonprofit organization is dedicated to the acquisition, preservation, and distribution of microorganisms, viruses, cell cultures, fungi, yeasts, protozoa, plant tissue culture, and recombinant DNA materials. Its site allows the user to search ATCC catalogs for these materials and offers information on new products, workshops, patent and contract services, etc.

American Water Works Association (AWWA)
http://www.awwa.org

This site is divided into various areas, including events/calendar, publications/products, What's New, and a broad range of technical resources—networking, programs, government affairs, and water topics.

Association of Occupational and Environmental Clinics
http://152.3.65.120/oem/aoec.htm

Includes AOEC Board of Directors, AOEC Exposure Codes, a resource library, occupational and environmental medicine residencies list, pediatric environmental health speciality units, database of occupational and environmental cases, a comprehensive occupational and environmental exposure database, and a newsletter.

Association of University Environmental Health Sciences Centers
http://www.envmed.rochester.edu/wwwrlp/niehsc

An independent consortium of research institutions supported by grants from the **National Institute of Environmental Health Sciences**. This site describes the program, and provides contact information for all the centers and links for all those with Web sites.

Biological Effects of Low-Level Exposure (BELLE)
http://www.belleonline.com

The focus of this site is to consider dose-response relationships to toxic agents, pharmaceuticals, and natural products over wide dosage ranges in in vitro and in vivo systems, including human populations, with an emphasis on low-level effects. The BELLE program itself is overseen by an advisory committee. The site includes BELLE newsletters, and upcoming events.

California Environmental Protection Agency (Cal/EPA)
http://www.calepa.ca.gov

Offers information on the organization and programs of Cal/EPA, such as the environmental technology program and the environmental enforcement program, press releases and publications, legislation, and California Government On Line.

Canadian Centre for Occupational Health and Safety (CCOCHS)
http://www.ccohs.ca

Contains occupational safety and health and related information from CCOHS. Includes information about and access to some of its publications, databases, and other services, such as Canadian Health and Safety Legislation, their CCINFOweb databases, and an extensive list of health and safety related Internet resources (http://www.ccohs.ca/resources). Web access to some of these services is restricted to subscribers.

Centers for Disease Control and Prevention (CDC)
http://www.cdc.gov

Lists information about CDC and links to its 11 centers, institutes, and offices, among them the National Center for Environmental Health, the National Institute for Occupational Safety and Health (NIOSH), and the Agency for Toxic Substances and Disease Registry (ATSDR) (see above).

ChemFinder
http://www.chemfinder.com

A unique Web-based chemical search engine. Put in a chemical or CAS Registry Number and Chemfinder pulls back information form hundreds of chemical-related sites. Chemfinder also provides direct links to these sites, covering subjects such as health, medications, MSDS, pesticides/herbicides, physical properties, regulations, and structures.

Chemical Industry Home Page
http://www.neis.com

Maintained by the National Environmental Information Service, this site provides information on chemical industry associations, chemical sales resources, chemical companies' Web sites, chemical industry-specific search engines, and links to a broad array of environmental resources related to news, EPA, environmental law, books, EPA regional offices, state environmental agencies, and other environmental organizations.

Chemical Industry Institute of Toxicology (CIIT)
http://www.ciit.org

CIIT's site describes its operation, goals and research objectives, staff and facility, technology transfer, publications such as *CIIT Activities*, *CIIT Impact*, and *CIIT Insights*, and upcoming scientific presentations.

Chemical Manufacturers Association (CMA)
http://www.cmahq.com

Offers information about CMA, membership, the Responsible Care program, news and issues, the CHEMTREC (Chemical Transportation Emergency Center) program for chemical emergency response, CHEMSTAR (Chemical Self-Funded Technical Advocacy and Research), and the CHEMECOLOGY education center.

(U.S.) Chemical Safety and Hazard Investigation Board
http://www.chemsafety.gov

This independent federal agency's mission is to provide industries that use chemicals with information

to enable identification and mitigation of operational conditions that compromise safety. A well-designed Web site with reviews on past chemical accidents, information on reporting chemical accidents, and news about recent chemical accidents and their investigations.

Children's Environmental Health Network
http://www.cehn.org

Includes a comprehensive resource guide on children's environmental health. Covers health effects of toxicants, research initiatives, databases, and other Web sites.

clay.net Environmental Professional's Homepage
http://www.clay.net

Provides rapid information retrieval for environmental consultants and remediation professionals. A thorough compilation of linked federal and state agencies, legislation and regulations, associations, conference bulletins, and search interest, many of which are highly pertinent to toxicology.

Committee for the National Institute for the Environment
http://www.cnie.org

A potpourri of information and links of value to the toxicologist and environmental professional. This committee has proposed the creation of a nonregulatory science institute. Includes environmental journals on the Web, a virtual library of biodiversity and ecology, environmental news, congressional research service reports, and a population and environment database.

(U.S.) Consumer Product Safety Commission (CPSC)
http://www.cpsc.gov

Provides information on various CPSC activities, including reaching the National Injury Information Clearinghouse which maintains data sources such as the National Electronic Injury Surveillance System (NEIS), Death Certificate File, In-Depth Investigations (INDP) File, and Injury/Potential Injury Incident File (IPII).

Council on Environmental Quality (CEQ)
http://www.whitehouse.gov/CEQ

Includes news, the Adminstration's environmental record, search of the White House Virtual Library, and important links to NEPAnet (the National Environmental Policy Act Home Page), which includes the full text of the statute and Environmental Impact Analysis data links.

DAIN Metadatabase of Internet Resources for Environmental Chemicals
http://dino.wiz.uni-kassel.de/dain/index.html

A resource designed to help in finding relevant databases for environmental chemicals worldwide.

(U.S.) Department of Labor Mine Safety and Health Administration (MSHA)
http://www.msha.gov

Features sections on MSHA education and training programs; mine accident, injury, and illness statistics; statutory and regulatory information; safety and health information; and silicosis prevention.

Duke Occupational and Environmental Medicine
http://gilligan.mc.duke.edu/oem

This is the World Wide Web home for the Occ-Env-Med-L electronic forum and for the Association of Occupational and Environmental Clinics (also see earlier entry). Includes AOEC Exposure Cases; articles from *MMWR* (*Morbidity and Mortality Weekly Report*); extensive links; and additional information. Sponsored by Duke University's Division of Occupational and Environmental Medicine.

Environet
http://www.enviro-net.com

Covers environmental industry news and offers a directory of environmental companies.

Environmental Chemicals Data and Information Network (ECDIN)
http://ecdin.etomep.net

Compiled by the Commission of the European Communities' Joint Research Centre in Ispra, Italy, this databank provides a vast amount of information on potentially hazardous chemicals—their uses, properties, toxicity, concentrations, and fate. Also available online through DIMDI (see ''Databases'').

Environmental Defense Fund (EDF)
http://www.edf.org

Includes the *EDF Newsletter,* news releases, annual reports, practical action, and program reports plus a link to the EDF Chemical Scorecard program (http://www.scorecard.org), making it easy to find information about chemicals released to communities.

Environmental Health and Safety Resources (University of Wisconsin, Milwaukee)
http://www.uwm.edu/People/rjg/ehslinks/ehslinks.html

One of the more extensive lists of resources and links to documents and Internet sites on environmental and

occupational health and safety, and risk management topics.

Environmental Information Center
http://www.envl-info.com

A portal to environmental law and general environmental information. Lists publications, government agencies, Web sites, organizations, and news services, and covers various environmental media (e.g., air, water), business, energy, and pollution prevention issues.

Environmental Journalism Home Page
http://www.sej.org

The online home of the Society of Environmental Journalists and the International Federation of Environmental Journalists. Covers upcoming conferences, publications, job links, business notes, and other information useful to the environmental journalism community.

Environmental Organization Web Directory—Pollution
http://www.webdirectory.com/Pollution

Provides inventories of Internet resources and Web sites for major pollution topics, including contaminated soil and groundwater, hazardous waste, oil spills, pollution databases, publications, and toxicology.

(U.S.) Environmental Protection Agency (EPA)
http://www.epa.gov

A valuable site describing EPA's many programs and activities. Includes information on EPA news, regulations, contracts and grants, and publications. Links to many EPA database systems (including the Toxic Release Inventory, the Integrated Risk Information System [http://www.epa.gov/iris/], and the Pesticide Product Information System), as well as to software from groups such as the Center for Exposure Assessment Modeling (http://www.epa.gov/software.html) and the Center for Subsurface Modeling. EPA's databases, including the ENVIROFACTS system, can be reached by clicking on the ''Databases and Software'' button on the EPA home page. Among the many other EPA databases and programs that can be accessed through EPA's home page search engine are:

Consumer Labeling Initiative
Environmental Data Registry
EPA Chemical Testing and Information
EPA's Extremely Hazardous Substances (EHS) Chemical Profiles and Emergency First Aid Guides
Health Effects Notebook for Hazardous Air Pollutants
OPPT Chemical Fact Sheets
OPPT Harmonized Test Guidelines
Pesticidal Chemicals Classified as Known, Probable, or Possible Human Carcinogens
Safe Drinking Water Health Fact Sheets
Unified Air Toxics Website

E-TIP
http://ecologia.nier.org

Searchable database for technical information available on topics such as waste management, toxicology, environmental health, radiation, and energy.

Eurotox
http://www.uta.fi/eurotox

The home page of the Association of European Toxicologists and the European Societies of Toxicology. Includes statutes and bylaws, executive committee, member societies, specialty sections, publications, awards, and upcoming congresses.

Extension TOXicology NETwork (EXTOXNET)
http://ace.orst.edu/info/extoxnet

Cooperative effort by a number of universities to stimulate dialog on toxicology issues and to make toxicology information more widely available. Includes newsletters, fact sheets, chemical profiles, etc. EXTOXNET is searchable by keywords or partial words.

Federal Emergency Management Agency (FEMA)
http://www.fema.gov

A number of FEMA documents on this site discuss potential chemical threats related to stockpiles, chemical weapons, hazardous household substances, etc. Includes a well-designed Virtual Library and Electronic Reading Room.

Federation of American Societies for Experimental Biology (FASEB)
http://www.faseb.org

A coalition of member societies serving the interests of biomedical and life scientists. FASEB's Web site offers information on FASEB's member societies, its public affairs office, Life Sciences Research Office, *FASEB Journal*, meetings and conferences, and career resources.

FedWorld
http://www.fedworld.gov

From the U.S. Department of Commerce, FedWorld is a gateway to U.S. government information, offering access to information from over 50 agencies, with the ability to locate and order reports, studies, and other information. Includes access to FedWorld File Libraries with more than 14,000 files, covering such information as health and safety and the environment. FedWorld

hosts the **National Technical Information Service (NTIS)** Web site.

(U.S.) Food and Drug Administration (FDA)
http://www.fda.gov

Covers all the operations of the FDA. Of particular interest for toxicology is the link to FDA's **National Center for Toxicological Research (NCTR)**. Also included is information related to biologics, cosmetics, foods, medical devices/radiological health, field operations/imports, human drugs, animal drugs, and children and tobacco.

(U.S.) Geological Survey—Environmental Themes
http://www.usgs.gov/themes/environ.html

Provides information on the USGS' many environmental activities—data collection, long-term assessment, ecosystem analysis, predictive modeling, and process research on the occurrence, distribution, transport, and fate of contaminants, as well as the impacts of contaminants on biota.

Global Information Network on Chemicals (GINC)
http://www.nihs.go.jp/GINC

A worldwide information network for the safe use of chemicals, maintained by the National Institute of Health Sciences (NIHS) of Japan. Provides information about the GINC project, tutorial sessions, directory of information sources, GINC Search, and links to useful Web sites on chemical safety information.

(U.S.) Government Printing Office (GPO)
http://www.gpo.gov

Serving the information dissemination needs of the federal government, GPO offers many publications in electronic format and makes available searchable databases, including the **Federal Register**, on WAIS (Wide Area Information Server), free to the public. A good source for technical documents related to toxicology and the environment.

Grey Net (Grey Literature Network Service)
http://www.konbib.nl/infolev/greynet

A resource from the Netherlands of grey (or fugitive) literature, defined by Grey Net as ''that which is produced at all levels of government, academics, business and industry in print and electronic form, but which is not controlled by commercial publishers.'' The home page is categorized by newsletters, bibliography, conferences, R&D, publications, and guide.

Greenpeace
http://www.greenpeace.org

Greenpeace's goals are to expose global environmental problems and force solutions. Its home page provides links to its various campaigns (toxics, nuclear, climate, oceans, forests, genetic engineering, ocean dumping) and services.

(U.S.) House of Representatives Internet Law Library
http://law.house.gov

Provided by the Office of the Law Revision Counsel of the U.S. House. This site's goals are to provide free public access to the basic documents of U.S. law and to provide access to the other law resources of the Internet. It provides full-text searchable copies of the U.S. Code and Code of Federal Regulations, as well as links to **Federal Register** sites. Valuable for all interested in environmental statutes and regulations. Although the Internet Law Library was discontinued at this federal Web site on May 28, 1999, the site provides links to many other groups that currently host the Libarary. The content of the site will become freely available to whoever would like to host and maintain it. The Office of The Law Revision Counsel will continue to host only the United States Code portion of the site at a new address—http://uscode.house.gov.

International Agency for Research on Cancer (IARC)
http://www.iarc.fr

Provides information about IARC and its research units, its publications series—including the IARC Monographs and IARC Scientific Publications, fellowships, training courses, vacancies, and press releases as well as databases such as the IARC Cancer Epidemiology Database and the IARC p53 Database.

International Association of Forensic Toxicologists' TIAFTnet
http://www.cbft.unipd.it/tiaft/

Describes TIAFT and its membership and lists meetings, continuing education programs, and links to other relevant toxicology sites.

International Life Sciences Institute (ILSI)
http://www.ilsi.org

Advancing the understanding of scientific issues related to nutrition, food safety, toxicology, and the environment, ILSI is headquartered in Washington, DC and has branches worldwide. Their Web site provides information on the ILSI Research Foundation, Human Nutrition Institute, Nutrition and Health Promotion Program, Risk Sciences Institute, upcoming meetings and the ILSI Press.

International Occupational Safety and Health Information Centre (ILO-CIS)
http://www.ilo.org/public/english/90travai/cis/

This site includes CIS products and services, national and collaborating centres, ILO publications, databases and CD-ROMs, free materials, an occupational safety and health glossary, a bulletin board, and conferences.

International Programme on Chemical Safety (IPCS)
http://www.who.ch/pcs

A site composed of cooperating organizations, participating institutions, national focal points, publications, and activities (e.g., evaluation of chemical risks to human health and the environment, methodologies for evaluation of hazards and risks, and chemical risk communication).

International Society of Exposure Analysis (ISEA)
http://www.iseaweb.org

Provides information on the society's publications, news and announcements, the ISEA Newsletter Archive, and additional links.

International Toxicity Estimates for Risk (ITER)
http://www.tera.org/iter

Supported by the nonprofit group Toxicology Excellence for Risk Assessment (TERA). Summarizes peer-reviewed toxicity values for use in performing risk assessments. Values are from government agencies—including the U.S. EPA and Health Canada—and international health organizations, such as the World Health Organization.

International Union of Toxicology (IUTOX)
http://www.toxicology.org/iutox

Serving as an online newsletter, this site presents reports from IUTOX executives, news about the society and its triennial International Congress of Toxicology, IUTOX member societies, etc.

IPCS INTOX Project
http://www.intox.org

The objective of this project is to assist Poison Centers in the prevention of poisoning and to minimize adverse health effects resulting from toxic exposures. Undertaken by IPCS in cooperation with the Canadian Centre for Occupational Health and Safety.

Junk Science Home Page
http://www.junkscience.com

Focuses on ''junk science'' issues with a special emphasis on developments in public health research. Takes a humorous but sound approach to serious issues.

Kemikalieinpektionen (KEMI) National Chemicals Inspectorate of Sweden
http://www.kemi.se

The National Chemicals Inspectorate of Sweden is the central supervisory authority for Swedish chemicals control. Contains information on KEMI, Swedish exemption substances, legislation, and the Products Register.

Library of Congress Catalogs
http://lcweb.loc.gov/catalog

An absolute treasure house of information, the Library of Congress's collections, including those in toxicology, are now accessible through a variety of search interfaces available at this site.

Love Canal Collection
http://ublib.buffalo.edu/libraries/projects/lovecanal

The State University of New York University at Buffalo University Archives has developed a unique Internet resource describing its ongoing efforts to archive the materials provided from the Ecumenical Task Force of the Niagara Frontiers' Love Canal Collection. Site includes inventories of the collection's contents, online formats of a portion of the archive (text, maps, aerial photos, ground photos, and more), and links to other Love Canal Internet resources. Includes many Love Canal Internet resources (images, full-text articles, technical reports, and other commentaries).

Material Safety Data Sheets
http://www.chem.uky.edu/resources/msds.html

From the University of Kentucky's Department of Chemistry, one of the more extensive listings of MSDS links, plus some general information about MSDSs.

Mayo Clinic Health Oasis
http://www.mayohealth.org

A good source for drug information including cautions for allergies, pregnancy, breast feeding, children, older adults, general precautions, interactions, dosing, and side effects.

MedPharm: Toxicology Resources
http://www.medfarm.unito.it/toxicol/toxicol1.html

From the University of Torino (Italy) Medical School, a list of toxicology resources on the Internet. Classified by general resources, poisons information, clinical toxicology, drug and alcohol abuse, and teaching education.

MedWeb
http://www.medweb.emory.edu

This extensive site from Emory University Health Sciences Center Library offers a formidable potpourri of medical links to academic departments, clinical practice, conferences and calendars, consulting, educational resources, lists of Internet resources, societies and associations, and other medical links. Search for ''toxicology'' or other topics.

MedWebPlus Toxicology
http://www.medwebplus.com/subject/Toxicology.html

A large variety of toxicology links, provided by y-DNA, a biomedical information technology company.

National Agricultural Library
http://www.nal.usda.gov

Offers extensive information on pesticides and other topics of agricultural interest, many related to toxicology. Includes access to AGRICOLA, NAL's Online Public Access Catalog and Journal Article Citation Index. The Water Quality Information Center (http://www.nal.usda.gov/wqic/) provides access to information related to water quality and agriculture.

National Association of Physicians for the Environment (NAPE)
http://www.napenet.org

Covers information on NAPE, what's new, documents (including its conference reports, UV index, and brochures), news/announcements, and educational materials.

National Center for Environmental Health (NCEH)
http://www.cdc.gov/nceh

This CDC center's activities include investigations on air pollution and respiratory health, radiation studies, and lead poisoning. Its Web pages have a calendar of events, training and employment, and publications and products.

National Center for Toxicological Research (NCTR)
http://www.fda.gov/nctr

The Web site for this, FDA's primary toxicological unit in Little Rock, covers strategic research goals, phytoestrogen information, technology transfer, and NCTR-sponsored symposia.

National Environmental Data Index
http://www.nedi.gov

Provides direct access to environmental data and information from agencies such as the Department of Agriculture, the Environmental Protection Agency, the National Science Foundation, and the Department of the Interior. A good searchable entrance to the myriad of environmental resources available through the U.S. government. Plans are to ultimately include international coverage.

National Environmental Health Association (NEHA)
http://www.neha.org

NEHA's home page links to information about the association, its upcoming events, publications, credentialing and certification, news, and job openings.

National Institute of Environmental Health Sciences (NIEHS)
http://www.niehs.nih.gov

NIEHS' home page will lead you to facts about its history, research highlights, news and publications, grants and contracts, scientific programs, employment and training opportunities, community outreach, and centers. Provides selected text of NIEHS's monthly journal, ***Environmental Health Perspectives*** and access to the subscription-based Environmental Health Information Service (EHIS). Also includes a kid's page.

National Institutes of Health (NIH)
http://www.nih.gov

The NIH home page is a starting point for a vast array of information in medical and health-related areas, with links to NIH health resources, grants and contracts, scientific resources, and the individual institutes constituting NIH.

National Institute for Occupational Safety and Health (NIOSH)
http://www.cdc.gov/niosh

The NIOSH home page leads to NIOSH database information, the NIOSH Directory and publications, the National Occupational Research Agenda, meetings and symposia, NIOSH respirator information, the Health Hazard Evaluation Program, and much more.

National Institute for Working Life (Arbetslivsinstitutet)
http://www.niwl.se

Represents Sweden's R&D center for occupational health and safety, working life, and the labor market. Links to the National Library for Working Life catalog, the Swedish Occupational Safety and Health Administration, and other Swedish resources.

National Library of Medicine (NLM)
http://www.nlm.nih.gov

NLM's site offers news, publications, consumer health (via MEDLINEPlus), research program and grant information, and access to NLM's many databases and electronic information sources, including the services of the **Toxicology and Environmental Health Information Program (TEHIP)**.

National Pesticide Information Retrieval System (NPIRS)
http://www.ceris.purdue.edu/npirs

A subscription-based set of pesticide-related databases developed from data provided by the U.S. EPA (under the Federal Insecticide, Fungicide, Rodenticide Act) and maintained by the Center for Environmental and Regulatory Information Systems (CERIS).

National Safety Council's Environmental Health Center
http://www.nsc.org/ehc.htm

Links to CAMEO (described under ''Software'' later) and related software, hazardous chemical backgrounders, National Lead Information Center, mobile source emissions, radon, environments, indoor air, etc. The National Safety Council Site also provides access to the NSC's Chemical Backgrounders, profiles of environmentally significant chemicals, and Chemical Emergency Management Crossroads (http://www.nsc.org/xroads.htm).

National Technical Information Service (NTIS)
http://www.ntis.gov

Includes products, information tools, news, ordering, and services for federal agencies. A useful site for searching for thousands of federal government business, technical, and scientific publications. NTIS' ''Environment Highlights'' catalog is available here online.

National Toxicology Program (NTP)
http://ntp-server.niehs.nih.gov

Offers information about NTP, testing and study results, chemical health and safety information, how regulatory agencies use NTP data and NTP Participating Agencies, plus the *NTP Management Status Report* highlighting progress of toxicology and carcinogenesis studies.

New Jersey Division of Epidemiology, Environmental and Occupational Health
http://www.state.nj.us/health/eoh

One of a number of valuable state sites. Provides a variety of information in areas such as consumer and environmental health services and occupational disease and injury services. The division's Right-to-Know program includes access to New Jersey's Hazardous Substance Fact Sheets (http://www.state.nj.us/health/eoh/rtkweb/rtkhsfs.htm)—summaries describing possible routes of entry of chemicals into the body and major health effects that may result from exposure.

New York Online Access to Health (NOAH)
http://www.noah.cuny.edu/environment/environ.html

NOAH is a project implemented by four partners: The City University of New York, The Metropolitan New York Library Council, The New York Academy of Medicine, and The New York Public Library. NOAH provides access to quality full-text health information for consumers that is accurate, timely, relevant, and unbiased. The environmental health page is just one of the many topics in the NOAH series and offers links to nearly 200 full-text government, academic, and association reports and other resources available on the Internet.

Oak Ridge National Laboratory (ORNL)
http://www.ornl.gov

ORNL's home page leads to many programs relevant to risk and toxicology, including its Environmental Sciences Division (http://www.esd.ornl.gov) and Ecological Risk Analysis (www.hsrd.ornl.gov/ecorisk/ecorisk.html) which contains ecological risk analysis tools and applications, background information and guidance on ecological risk assessment, examples of completed risk assessments, and some ORNL ecotoxicology benchmark reports.

Occupational Safety and Health Administration (OSHA)
http://www.osha.gov

The contents of OSHA's home page list: media releases, publications, programs and services, compliance assistance, OSHA software/advisors, Federal Register notices, safety and health Internet sites, etc.

Organisation for Economic Co-operation and Development (OECD)'s Environmental Health and Safety
http://www.oecd.org/ehs

Contains extensive information on OECD activities in environmental health and safety, with links to their Chemicals Programme (including the High Production Volume chemicals), Chemicals Accidents Programme, Pesticide Programme, Pollutant Release and Transfer Registers, etc.

OSHWEB (Index of Occupational Safety and Health Resources on the Internet)
http://oshweb.me.tut.fi/cgi-bin/oshweb.pl

A broad-based site looking at chemical safety (including MSDS and pesticide information), occupational medicine, products and radiation safety, risk and safety management, software listing, and more.

Pan American Health Organization (PAHO)
http://www.paho.org

Provides broad services and resources for the public health concerns of Latin America and the Caribbean region. Links from the PAHO Home Page provide as wealth of access to data, information, and other resources including those related to environmental health concerns.

PharmInforNet
http://pharminfo.com

Drug database searchable by generic or trade name. Provides links to substantive reviews from the Medical Sciences Bulletin and other sources. Includes information on intended and side effects of drugs.

Radiation Effects Research Foundation (RERF)
http://www.rerf.or.jp/eigo/experhp/rerfhome.htm

The Web site for this important research center (formerly the Atomic Bomb Casualty Commission) studying the effects of radiation on humans includes information on radiation effects, scientific archives, news, science briefs, history, the future, and related links.

Risk Assessment and Policy Association (RAPA)
http://www.fplc.edu/tfield/rapa.htm

Lists the association's goals, charter, officers, etc., and provides access to its official journal, ***Risk: Health, Safety and Environment*** (http://www.fplc.edu/tfield/rskindx.htm)

Risk Assessment Information Systems (RAIS)
http://risk.lsd.ornl.gov/rap_hp.htm

Contains risk assessment tools and information. The tools include: risk-based preliminary remediation goal (PRG) calculations, a toxicity database, risk calculations, and ecological benchmarks. Sponsored by the U.S. Department of Energy.

RiskWorld
http://www.riskworld.com

A product of Tec-Com Inc., this site presents a rich offering of news stories, Web sites, reports and papers, new books, organizations, events calendar, courses/workshops, grants/fellowships, jobs, risk software, and links.

RTK NET (The Right-to-Know Network)
http://www.rtknet.org

Operated by two nonprofit organizations, OMB Watch and the Unison Institute, this computer network provides free access to databases, text files, and conferences on the environment. Among these are the Toxic Release Inventory, Canadian Pollutant Releases, IRIS, New Jersey Health Fact Sheets, and CERCLIS.

RxList—The Internet Drug Index
http://www.rxlist.com

Offers summaries of drugs, their actions/clinical pharmacology, indications and usage, precautions, warnings, interactions, adverse reactions, and dosage and overdosage.

Scorecard
http://www.scorecard.org

Produced by the Environmental Defense Fund and based partially on EPA's Toxic Chemical Release Inventory, the Scorecard goes beyond providing release data, by offering maps, pollution rankings, information about the health effects of the chemicals, and regulatory data.

SeafoodNIC
http://www-seafood.ucdavis.edu

Seafood Network Information Center of the Sea Grant Extension Program, University of California, Davis, provides information concerning health risks associated with consuming fish. Guidelines, regulations, symposia and conferences, and information resources related to the FDA's Hazard Analysis and Critical Control Point (HACCP) program are provided.

Society for Risk Analysis (SRA)
http://www.sra.org

Lists information about SRA, its chapters and sections, membership, events, news, risk science, opportunities, and risk-related sites.

Society of Environmental Toxicology and Chemistry (SETAC)
http://www.setac.org

Provides membership information, *SETAC NEWS*, activities and meetings, publications, awards and fellowships, history and governance.

Society of Forensic Toxicologists (SOFT)
http://www.soft-tox.org

Includes the quarterly newsletter, information on SOFT's Educational Research Award, Forensic Toxicology Laboratory Guidelines, requirements for the American Board of Forensic Toxicology, and information about the annual meeting and about the Joint Committee on Education and Training in Toxicology.

Society of Toxicologic Pathologists (STP)
http://www.toxpath.org

Offers abstracts from the society's journal, ***Toxicologic Pathology,*** membership and meetings information, information on other STP publications, and links to allied societies.

Society of Toxicology (SOT)
http://www.toxicology.org

Lists information about SOT, awards, career opportunities, the SOT newsletter (*The Communique*), appointed committees, SOT media experts, membership information, products and services, educational opportunities in toxicology, annual meeting news, the SOT Long Range Plan, other toxicology sites of interest, and more.

State Public Interest Research Groups (PIRGs)
http://www.pirg.org

A national, nonprofit, nonpartisan network of state-based, member-supported public interest watchdogs. Offers links to the U.S. and State PIRGs. Web site provides information on their campaigns, reports, congressional scorecards, and links to other Internet resources.

Toxikon: Medical Toxicology On-Line
http://toxikon.er.uic.edu

A clinical toxicology site, with toxicology cases and discussion groups, critical reviews of topics in toxicology, Toxin of the Week, research interests, *Toxidrome Review*, toxicology links on the Internet, and antidotes to common poisons. Sponsored by the University of Illinois at Chicago Program in Emergency Medicine.

Toxicology and Environmental Health Information Program (TEHIP)
http://sis.nlm.nih.gov/tehip.htm

From the National Library of Medicine's Division of Specialized Information Services. Offers publications, tutorials, toxicology news, outreach, web links, chemical information, and access to a variety of toxicology databases.

TOXNET (Toxicology Data Network)
http://toxnet.nlm.nih.gov

A valuable, free-of-charge, U.S. government compendium of toxicological and environmental health databases, including the Hazardous Substances Data Banks and access to the TOXLINE bibliographic file. *See also* **Toxicology and Environmental Health Information Program.**

United Nations Environment Programme (UNEP) Geneva Executive Center
http://www.unep.ch

Maintained by UNEP's Information Unit for Conventions. Provides information on the Basel Convention on Transboundary Movements of Hazardous Wastes, the Convention on Climate Change, the Convention on Biological Diversity, and others. Also has links to other useful environmental and chemistry sites, particularly to UNEP's own **International Register of Potentially Toxic Chemicals (IRPTC)** (available directly on the **UNEP Chemicals Home Page** at http://irptc.unep.ch/irptc/) (see below).

United Nations Environment Programme (UNEP) Chemicals—IRPTC
http://irptc.unep.ch/irptc

This home page for the International Register of Potentially Toxic Chemicals includes information on the Inventory of Information Sources on Chemicals, the Internet Guide to Finding Information on Chemicals, publications, access to the IRPTC-PC database via telnet, persistent organic pollutants, and the Screening Information Data Set (SIDS) for High Production Volume chemicals.

Water Environment Web
http://www.wef.org

This official Web site of the Water Environment Federation (WEF), a professional association dedicated to preserving and enhancing the global environment, includes the *WEF Reporter*, regulations and legislation, conferences, technical discussions, and public information.

World Health Organization (WHO)
http://www.who.ch

Covers a broad array of health-related topics, with descriptions of WHO's many programs. Includes a link to the **International Programme on Chemical Safety (IPCS)**, a joint program of WHO, UNEP, and ILO, and other specific WHO Environmental Health Programmes.

World Wide Web Virtual Library: Environment
http://earthsystems.org/Environment.shtml.

Part of the broader Virtual Library Project coordinated by Stanford University, this list of lists presents a vast array of environmental resources. It is searchable or can be viewed in its entirety alphabetically or by subject (general atmosphere, biosphere, hydroshere, lithosphere, civilization).

World Wildlife Fund—Toxic Chemicals
http://www.worldwildlife.org/frame__toxics.htm

Provides information and resources about toxic chemicals in the environment. Major program areas are re-

lated to endocrine disruptors, persistent organic chemicals, and agricultural pesticides.

BROWSERS

Browser—Defined in the Microsoft Network Glossary as ''Application software that gives you a graphical interactive interface for sending, finding, viewing, and managing information over a network.'' Netscape and Microsoft Explorer are the two most popular browsers.

Netscape
http://www.netscape.com

Internet Explorer [by Microsoft]
http://www.microsoft.com

SEARCH TOOLS

Search engines—Programs that allow you to enter one or more subjects and retrieve information from the Web on these subjects. These engines are also sometimes known as ''crawler,'' ''robot,'' or ''spider'' programs. There is considerable variance in the number of Web sites indexed and searched by any given search engine; in how the data are compiled; in how the data can be searched (e.g., via keywords, phrases, free-text, question form, etc.); and in how results are presented. Metasearch engines permit simultaneous searching of several search engines. A good source for finding out more about search engines and finding more search engines is Search Engine Watch (http://www.searchenginewatch.com). AltaVista, HotBot, and InfoSeek are some good general-purpose search engines.

Directories—Sites listed in these programs are collated by humans, often with comments. They are then arranged by subject. Yahoo is a major search directory. Sometimes the line between search engines and directories blurs. *Search engine* tends to be the generic term used for both concepts.

AltaVista
http://www.altavista.com

Amazing Environmental Organization Web Directory
http://www.webdirectory.com

Chemfinder
http://chemfinder.camsoft.com

Excite
http://www.excite.com

Google
http://www.google.com

HotBot
http://www.hotbot.com

Infoseek
http://www.infoseek.com

Lycos
http://www.lycos.com

Magellan
http://www.mckinley.com

Northern Light
http://www.northernlight.com

Note: NTIS and Northern Light are beta-testing a Web site database of U.S. federal government information called gov.search to provide comprehensive one-step access to federal information, with dynamic links to NTIS bibliographic files and full-text access to periodicals and technical reports.

Webcrawler
http://www.webcrawler.com

Yahoo
http://www.yahoo.com

Metasearch Engines

These tools allow searches to be sent to several search engines at one time.

Go2Net/MetaCrawler
http://www.go2net.com

Dogpile
http://www.dogpile.com

Mamma
http://www.mamma.com

Profusion
http://www.profusion.com

MAILING LISTS

Mailing lists—Groups of people using e-mail to exchange messages on the Internet. Listserv is the most widely available list manager. Majordomo and Listproc are other list managers.

It is best to find out about a mailing list before joining. Some of these groups are private and not intended for the general public. For more information about mailing lists—what they are, what they do, how to subscribe and unsubscribe, etiquette, and locating

lists on a given subject—consider **Liszt**, the Mailing List Directory (http://www.liszt.com/) or **Publicly Accessible Mailing Lists** (http://www.neosoft.com/internet/paml/). In each case in this section, the mailing list name and description is followed by the listserver address in brackets. You can generally obtain more information about a given mailing list by sending an e-mail to the listserver address with ''info'' in the body of your message, filling in the blanks with the mailing list name. Broader information on the particular listserver you are inquiring about is usually available by simply entering ''help'' in the body of your message.

aeroso-l—Health effects of aerosols.
[http://LISTSERV@NIC.SURFNET.NL]

air pollution-biology—Biological effects of air pollution, including air toxics.
[mailbase@mailbase.ac.uk]

airtoxics—Regional Airtoxics inventory & RAPIDS development.
[majordomo@cedar.cic.net]

altertox—Less toxic alternatives.
[LISTSERV@PLEARN.EDU.PL]

amalgam-1—Mercury dental amalgams.
[listserv@listserv.gmd.de]

arsenic—Health effects of arsenic.
[listserv@uci.edu]

biosafty—Biohazards.
[listserv@mitvma.mit.edu]

cancer-1—Carcinogenicity, including environmental carcinogens.
[LISTSERV@WVNVM.WVNET.EDU]

ccohs-users and **ccohs-news**—Occupational and environmental health and safety.
[MAJORDOMO@CCOHS.CA]

chemrank—Forum for chemical ranking and scoring.
[listserv@dome.ra.utk.edu]

chlorine-news—Nontoxic alternatives to chlorine.
[Majordomo@igc.apc.org]

chminf-1—General discussions on chemical information.
[listserv@iubvm.ucs.indiana.edu]

combitox—Synergism and combined effects.
[LISTSERV@HEARN.NIC.SURFNET.NL]

combust-1—Incineration of solid and chemical wastes.
[combust-1-request@viswiz.ensr.com]

cons-eq-hormone-mimics—Endocrine disruptors and hormone mimicking chemical discussions.
[listserv@lists.sierraclub.org]

cons-eqst-envirojustice-comm—Environmental justice discussion list.
[listserv@lists.sierraclub.org]

cyan-tox—Cyanobacterial toxins and effects.
[LISTSERV@VM.EGE.EDU.TR]

dioxin—Toxicology and health effects.
[majordomo@igc.apc.org]

doe-atcs—U.S. Department of Energy Action Team for Chemical Safety discussions.
[listserv@listserv.pnl.gov]

ecojustice—Environmental justice and equity.
[majordomo@igc.apc.org]

ecotox-1—Ecotoxicology and pest management.
[majordomo@cardiff.ac.uk]

ecotoxicology-1—Discussions pertaining to ecotoxicology and risk assessment.
[listserv@listserv.vt.edu]

ehos-mail—Environmental health officers discussion forum.
[listserv@home.ease.lsoft.com]

ehs-bc—Environmental health and safety-Boston Consortium.
[listserv@mitvma.mit.edu]

ehs-1—Environmental health sciences discussion group.
[listserv@uga.cc.uga.edu]

ejclass—Environmental justice.
[listserv@list.uvm.edu]

emer-mgt—Emergency management and planning discussions.
[maiser@rmgate.opo.indiana.edu]

envcee-1—Environmental issues and concerns for Eastern Europe (has useful discussions for other areas as well).
[listserv@rec.org]

envhs—General discussion on environmental health.
[listserv@nic.surfnet.nl]

envhth-1—Environmental information resources and discussions.
[listserv@qucdn.queensu.ca]

enviro-newsbrief—Summarizes news affecting EPA and interagency activities.
[listserver@unixmail.rtpnc.epa.gov]

envinfo-1—Environmental information resources and discussions.
[listserv@nic.surfnet.nl]

envpubs-1—Environmental publications and Internet resources forum.
[listproc@environment.harvard.edu]

envst-1—Environmental studies list, includes issues related to environmental health, risk communication, and toxicology.
[listserv@brownvm.brown.edu]

eohsi—General discussions on environmental and occupational health.
[listserv@uci.edu]

epa-pest—U.S. EPA pesticide documents.
[listserv@unixmail.rtpnc.epa.gov]

epa-tox—U.S. EPA Federal Register toxic documents.
[listserv@unixmail.rtpnc.epa.gov]

epa-tri—U.S. EPA Federal Register Toxic Release Inventory documents.
[listserv@unixmail.rtpnc.epa.gov]

epidemio-1—General discussions on epidemiology and public health.
[LISTPROC@CC.UMONTREAL.CA]

epiworld—General discussions on epidemiology, including environmental health.
[LISTSERV@UNIVSCVM.CSM.SC.EDU]

ermd—Special Libraries Association, Environment and Resource Management Division, includes SLA/ERMD Toxicology Roundtable.
[listserv@mail.auburn.edu]

estiv-1—In vitro toxicology.
[listserv@ahearn.nic.surfnet.nl]

firetox—Fire Toxicology List.
[listserv@vm1.mcgill.ca]

ftss-info—MSDS information and resources.
[majordomo@ccohs.ca]

fwim-1—Discussion list from the Organization of Fish and Wildlife Information Managers; includes ecotoxicology topics.
[listserv@listserv.vt.edu]

gaea—Environmental justice.
[listproc@ecosys.drdr.virginia.edu]

hazards—Discussions on natural and environmental hazards.
[lisproc@lists.colorado.edu]

hazmat-1—Hazardous material discussions.
[listserv@cc.colorado.edu]

hazmatmed—Medical aspects of hazardous materials.
[listserv@mediccom.norden 1.com]

health-and-safety—General discussions on environmental health and safety.
[mailbase@mailbase.ac.uk]

healthe—Discussions on general aspects of environmental health.
[listserv@home.ease.lsoft.com]

hg-list—Environmental aspects of mercury.
[listproc@soils.umn.edu]

hmep—FEMA's Hazardous Materials Emergency Planning discussion list.
[majordomo@fema.gov]

hs-Canada—Health and safety issues for Canada.
[majordomo.ccohs.ca]

immunotox—U.S. EPA Immunotoxicology Listserver at EPA, Research Triangle Park, N.C.
[listserv@unixmail.rtpnc.epa.gov]

infoterra
[listproc@pan.cedar.univie.ac.at]

intox-plants—INTOX toxic plants discussions.
[majordomo@kate.ccohs.ca]

intox-toxicovigilance—INTOX discussions regarding toxicovigilance.
[majordomo@kate.ccohs.ca]

lead-poison-surv—Lead poisoning surveillance discussions.
[listserv@listserv.cdc.gov]

lepc—Hazardous materials and emergency response management.
[listproc@moose.uvm.edu]

mcs-immune-neuro—Discussions on immune and neurologic response to chemicals in the environment.
[LISTSERV@HOME.EASE.LSOFT.COM]

mcs-immune-neuro—Multiple chemical sensitivity, immune response, and neuropathology discussions.
[listserv@maelstrom.stjohns.edu]

mercury—Mercury in the environment.
[listserv@unixmail.rtpnc.epa.gov]

msds-info—General and technical discussions on MSDS notification.
[majordomo@ccohs.ca]

napiap—National Agricultural Pesticides Impact Assessment Program discussion list.
[napiap@reeusda.gov]

nbtox-1—Discussion list for neurobehavior toxicology.
[listserv@listserv.navy.al.wpafb.af.mil]

niosh-casc—NIOSH Chemical Analytical Services discussion list.
[listserv@listserv.cdc.gov]

niosh-casc-proj—NIOSH Chemical Analytical Services Special Projects discussions.
[listserv@listserv.cdc.gov]

nrlib-1—Forum for Natural Resources Librarians, includes ecotoxicology.
[listserv@Library.lib.usu.edu]

occ-env-med-1—Occupational & Environmental Medicine List, a moderated forum.
[majordomo@list.mc.duke.edu]

occskin-1—Dermal exposure assessment.
[listserv@listserv.cdc.gov]

ohn-list—Occupational health nursing discussion list.
[listserv@oise.utoronto.ca]

opt-newsbreak—U.S. EPA Office of Prevention, Pesticides, and Toxic Substances daily news resources.
[listserv@unixmail.rtpnc.epa.gov]

ototoxnet—U.S. EPA Ototoxicity Listserver.
[listserv@unixmail.rtpnc.epa.gov]

panups - Pesticide Action Network, North America.
[panups@igc.apc.org]

pesticide—U.S. Department of Agriculture's Agricultural Research Service discussion list on pesticides research.
[listserv@tifton.cpes.peachnet.edu]

pesticide—Pesticide Action Network of North America discussion list.
[majordomo@igc.apc.org]

psst—General discussions in pharmacology and toxicology.
[listserv@listserv.arizona.edu]

public-he—General discussions related to U.S. public health issues.
[listserv@listserv.arizona.edu]

public-health—Public and environmental health discussions.
[mailbase@mailbase.ac.uk]

risk—General discussions on risk management and communication.
[mailbase@mailbase.ac.uk]

riskanal—Risk Analysis, affiliated with the Columbia-Cascades chapter of the Society of Risk Analysis and the Pacific Northwest Laboratory.
[listserv@listserv.pnl.gov]

riskrom—European Risk Communication Network general discussion list.
[mailbase@mailbase.ac.uk]

risks—Discussion lists on risk assessment and risk management.
[listserv@ubvm.cc.buffalo.edu]
[listserv@uga.cc.uga.edu]
[listserv@vm.marist.edu]

safety—Safety and environmental health issues.
[listserv@uvmvm.uvm.edu]

techdirect—EPA Office of Technical Innovation related to hazardous waste site remediation.
[listserv@valley.rtpnc.epa.gov]

tfoe—Open list from the American Library Associations Task Force on the Environment.
[listserv@host.ciesin.org]

tox—Integrated Toxicology Program list.
[majordomo@acpub.duke.edu]

toxlink—A forum for the exchange of toxicology information.
[listserv@uci.edu]

toxlist—Generating discussions and disseminating information in toxicology.
[listserv@cornell.edu]
[listserv@esc.syrres.com]

transderm—General and technical discussions related to dermal toxicology.
[mailbase.ac.uk]

tws-wtwg—Toxicology Working Group, Wildlife Society.
[majordomo@mail.orst.edu]

uctoxics—General information and announcements from the University of California, Davis, Toxics Program.
[listproc@ucdavis.edu]

uhsph-1—Discussions on public health.
[listproc@hawaii.edu]

watertox-cl—Water Toxicology Research Discussion Forum.
[listproc@internet.idrc.ca]

NEWSGROUPS

Usenet newsgroups—Usenet is defined by Internet Literacy Consultants as ''a world-wide system of discussion groups, with comments passed among hun-

dreds of thousands of machines. Not all USENET machines are on the Internet, maybe half. USENET is completely decentralized, with over 10,000 discussion areas, called newsgroups.'' Each newsgroup emphasizes a particular theme or subject. A good Web tool for searching for newsgroups, as well as posting articles and replies, is **deja.com** (http://deja.com). **Liszt,** the Mailing List Directory (http://www.liszt.com), also provides a newsgroup directory.

bionet.toxicology—Research in toxicology.

misc.industry.safety.personal—General discussions related to health and safety.

sci.engr.safety—Discussions related to process safety and industrial safety.

sci.environment—Discussions about the environment and ecology.

sci.environment.waste—Discussions on waste management issues.

sci.med.diseases.cancer—General discussions on cancer and causes of cancer.

sci.med.occupational—General discussions on occupational medicine.

ELECTRONIC BULLETIN BOARD SYSTEMS (BBSs)

In the early days of electronic communication, electronic bulletin board systems (BBSs) were an effective way to provide current environmental information to a broad constituency of information seekers. See Alsten, G., and Stoss, F. W. (1994). Environment online: The greening of databases, part 3. Business and regulation information. *In*: ''Environment Online: The Greening of Databases—The Complete Environmental Series from Database Magazine'' (Paula Hane, Ed.), pp. 35–51. Eight Bit Books (Online, Inc.) Wilton, CT.

The reader should note that many of the BBSs mentioned in earlier articles and inventories have or are being converted to World Wide Web formats and are being provided in many instances exclusively on the Internet. The federal government is, as of this writing, still maintaining BBSs as a viable means for disseminating critical toxicology-related information.

The U.S. federal government has been one of the leading producers of these electronic communication systems, filling another niche in online access.

''Internet and Electronic Dial-Up Bulletin Board: Information Reported by Federal Organizations, GAO/GGD-97-86, June 1997'' was issued as a report to the Chair on the U.S. Senate's Committee on Appropriations and Committee on Governmental Affairs by the U.S. General Accounting Office. A supplement to this report provides a summary of nearly 4,300 World Wide Web sites sponsored by the U.S. Government (http://www.gao.gov/cgi/bin/getrpt?GGD-97-86s), and 215 dial-up BBSs. Following are a few BBSs.

Animal (guides, legislation, publication on laboratory use)
National Institutes of Health
301-402-2221

ATTIC
Air Toxics Technical Information Center
U.S. Environmental Protection Agency
513-569-7272
513-569-7610

CDC Wonder
Centers for Disease Control
800-232-4636

CEAM
Center for Exposure Assessment Modeling
U.S. Environmental Protection Agency
706-355-8328

Cleanup Information
U.S. Environmental Protection Agency
301-589-8366

DRGLINE (Grant Line for PHS Program Information)
National Institutes of Health
301-402-2221

Emergency Management Institute
Federal Emergency Management Agency
301-447-1259

FDA BBS
Food and Drug Administration
800-222-0185

Federal Register
Department of Commerce
301-713-4200

FedWorld BBS
National Technical Information Service
703-321-3539

HMIX (Hazardous Materials Information Exchange)
Department of Transportation (Research and Special Programs)
603-252-3275

Federal Emergency Management Agency
800-874-2884

INTERFAC
National Institutes of Health
800-402-2221

Manuals
National Institutes of Health
301-402-2221

NIHLIB (library tutorials and classes
National Institutes of Health
301-402-2221

NMFS-NOAA
National Oceanic and Atmospheric Administration/ National Marine Fisheries Service
206-526-6405

Pesticide Information Network
U.S. Environmental Protection Agency
703-305-7499

RADSAF
National Institutes of Health
301-402-2221

SAFETY37
National Institutes of Health
301-402-2221

COMPUTER DATABASES

Database—A loosely and variously defined term that, ideally, should stand for a structured aggregation of data on a specified topic. Too often the term is applied to any bunch of information thrown together. Many of the listed databases that were once available strictly through dial-up modem connections are now also, and in some cases exclusively, Internet accessible, either via direct Telnet access or, more likely, through the World Wide Web. Some are also available on CD-ROM. The list does not claim to be exhaustive nor do the vendors listed necessarily represent all the vendors offering the files. The reader should realize that computer databases and Web sites are not mutually exclusive terms. Many of the databases listed are accessible through the Web, and some of the Web sites listed earlier in this chapter also include database access. Typically, one organization is responsible for actually creating or putting the data together (the producer), and another organization makes it available, frequently at a price (the vendor). More and more, no-cost databases are showing up on the Web sponsered by government agencies and not for profit groups. Occasionally, a single organization is both producer and vendor. A good source for finding out recent information about databases is the printed two-volume ''**Gale Directory of Databases**'' (Gale, Detroit, MI), itself available as an online database through various vendors (call 800-877-GALE for more information). Find out more about databases and information research on the Web in general, through the SPIRE project (http://cn.net.au).

Databases—Core

The following databases emphasize broad or specific areas of toxicology, environmental health, and ancillary subjects, or else contain a fair share of information on these subjects.

Acid Rain
Produced by: Congressional Information Service, Inc.
Available from: DIMDI (online), ESA/IRS (online)

Bibliographic references to scientific literature on acid rain and its environmental and health effects.

AGRICOLA
Produced by: National Agricultural Library
Available from: DIALOG (online), OVID (online), Silver-Platter (CD-ROM)

Contains millions of references to journals, monographs, government reports, theses, patents, and audiovisuals in the broad scope of agriculture and related disciplines.

Agrochemicals Handbook
Produced by: The Royal Society of Chemistry
Available from: DIALOG (online)

Lists active ingredients in pest control and crop protection chemicals. Identifying information is provided, as well as chemical and physical properties, analytical and toxicity data, uses, and manufacturer.

Analytical Abstracts (AA)
Produced by: The Royal Society of Chemistry
Available from: DataStar (online), DIALOG (online), ORBIT/QUESTEL (online), STN (online)

Contains citations to the literature on analytical chemistry, including environmental chemistry.

Aquatic Sciences and Fisheries Abstracts (ASFA)
Produced by: United Nations Food and Agriculture Organization
Available from: CAMBRIDGE (online), DIALOG (online), DIMDI (online), STN (online), OVID (online)

Citations and abstracts on literature related to marine and freshwater environments. Includes aquatic pollution and environmental quality.

AQUIRE
Produced by: U.S. Environmental Protection Agency, NHEERL, MED
Available from: Chemical Information Systems, Inc. (CIS) (online), EPA Web Site (http://www.epa.gov/ecotox)

Part of EPA's ECOTOX system, Aquire contains aquatic toxicity test results for thousands of chemicals and species reviewed from the worldwide scientific literature.

Ariel Internet
Produced by: Ariel Research Corporation
Available from: Ariel Research Corporation (Internet)

Presents references to regulations on over 100,000 chemicals. Regulatory and advisory programs covered include the Clean Air Act, the Clean Water Act, TSCA, RCRA, and OSHA. Includes carcinogen designations assigned by the International Agency for Research on Cancer and the National Toxicology Program.

BAKER
Produced by: Mallinckrodt Baker Inc.
Available from: CIS (online)

Complete texts of over 1,800 Material Safety Data Sheets, listing product identification and safety data for chemicals.

Beilstein Online/Beilstein Commander-Crossfire
Produced by: Beilstein Informationssystem
Available from: Beilstein (CD-ROM)

Contains data on carbon compounds from the ''Beilstein Handbook of Organic Chemistry Basic Series H (1830–1909),'' ''Supplementary Series E I-IV (1910–1959)'', and materials abstracted from primary literature that will be published in ''Supplementary Series E V (1960–1979)''. Beilstein Crossfire/Commander is current up to the previous year. This major source or organic chemical data includes physical and chemical data and information related to the physiological behavior and application of organic chemicals, such as use, toxicity, biological function (effects), and ecological data.

BIOSIS Previews
Produced by: BIOSIS
Available from: DIALOG (online), OVID (online), STN (online)

Containing nearly 11 million citations, many with abstracts, this database covers a broad array of the world's literature in the biosciences. Corresponds to the hard copy sources. *Biological Abstracts* and *Biological Abstracts/RRM (Reports, Reviews, Meetings).*

BNA Daily News from Washington
Produced by: BNA
Available from: DIALOG (online)

Full text of some two dozen publications, including *California Daily, Chemical Regulation Daily, International Environment Daily, National Environment Daily, Occupational Safety and Health Daily, State Environment Daily,* and *Toxics Law Daily.*

BNA (other documents)
Produced by: BNA
Available from: LEXIS (online), NEXIS (online), WESTLAW (online)

Other full-text databases covering toxicology and the environment from BNA include *Chemical Regulation Reporter, Environmental Law Database, International Environment Reporter,* and *Toxics Law Reporter.*

Business Publishers Inc. (Newsletters)
Produced by: Business Publishers Inc.
Available from: NewsNet (online)

Contains the complete texts of a variety of newsletters related to toxicology and other issues. Some of these are *Air/Water Pollution Report, Asbestos & Lead Abatement Report, Ground Water Monitor, Hazardous Waste News, Hazmat Transport News, Medical Waste News, Nuclear Waste News, Occupational Health and Safety Letter, Sludge, Solid Waste Report,* and *World Environment Report.*

CA (Chemical Abstracts)
Produced by: Chemical Abstracts Service
Available from: STN (online), CA SEARCH version from DataStar (online), DIALOG (online), ORBIT/QUESTEL (online), OVID (online), ESA-IRS (online)

Bibliographic citations in applied, macromolecular, organic, physical, inorganic, and analytical chemistry and biochemistry.

CancerChem: Survey of Compounds Which Have Been Tested for Carcinogenic Activity (PHS-149)
Produced by: National Cancer Institute
Available from: GMA Industries (CD-ROM)

Presents carcinogenesis data extracted from the scientific literature. It is an electronic version of the contents of ***U.S. Public Health Service Publication Number 149*— Survey of Compounds Which Have Been Tested for Carcinogenic Activity**. Provides name and number of animals in test group, preparation and dose, route and site, pathology examination level, animals with tumors, survival, duration of experiment, and references.

Cancer Genome Anatomy Project
Produced by: National Cancer Institute
Available from: National Cancer Institute http://www.ncbi.nlm.nih.gov/CGAP

An interdisciplinary program to establish the information and technological tools needed to decipher the molecular anatomy of the cancer cell.

CANCERLIT
Produced by: National Cancer Institute
Available from: NLM (online), DataStar (online), DIMDI (online), STN (online), Silver Platter (CD-ROM)

Covers information on biomedical and other aspects of cancer. Sources used include journals, books, conference proceedings, government reports, and research reports.

Carcinogenic Potency Database
Produced by: NIEHS Center, University of California at Berkeley
Available from: http://potency.berkeley.edu/cpdb.html

A widely used resource on the results of chronic long-term animal cancer tests.

CCINFOweb
Produced by: Various
Available from: CCINFOweb (Web)

A wide variety of databases in the areas of toxicology, health, safety, and the environment. Includes CHEMINFO, MSDS, FTSS, RTECS, NIOSHTIC, and HSELINE.

CERCLIS Database of Hazardous Waste Sites
Produced by: U.S. Environmental Protection Agency
Available from: CIS

Data on releases of hazardous substances, as reported to the EPA, involved in chemical spills and hazardous waste sites under the Superfund law (CERCLA) and its reauthorization (SARA).

Chem Finder
Produced by: Cambridge Soft Corporation (CamSoft)
Available from: CamSoft (http://www.chemfinder.com)

A Web-based search engine that retrieves information from hundreds of chemical-related sites.

Chemical Carcinogenesis Research Information System (CCRIS)
Produced by: NCI (National Cancer Institute)
Available from: NLM/TEHIP (http://toxnet.nlm.nih.gov), CIS (online)

CCRIS contains scientifically evaluated data derived from carcinogenicity, mutagenicity, tumor promotion, and tumor inhibition studies. It contains over 7,300 chemical records.

Chemical Evaluation Search and Retrieval System (CESARS)
Produced by: Michigan State Department of Environmental Quality
Available from: CCINFOLINE (online), CIS (online)

Data includes chemical and physical properties, toxicity, carcinogenicity, mutagenicity, and genetic toxicology.

Chemical Hazards Response Information System (CHRIS)
Produced by: U.S. Coast Guard (formerly—no longer being updated)
Available from: CIS (online), CCINFOLINE (online)

Information that can assist in spill situations. Chemical identification information, chemical and physical properties, transport.

Chemical Safety NewsBase (CSNB)
Produced by: The Royal Society of Chemistry
Available from: DIALOG (online), ORBIT/QUESTEL (online), STN International (online)

Citations and abstracts of literature covering occupational hazards in the chemical industry.

Chemical Information System (CIS)
(See contact information under vendors—CIS)

A service of Oxford Molecular Group, CIS offers a variety of databases in areas related to site assessment, hazmat and MSDS, chemical/physical properties, biodegradation/bioremediation, toxicology and carcinogenicity regulations, etc.

ChemID
Produced by: National Library of Medicine
Available from: National Library of Medicine (http://igm.nlm.nih.gov)

Serves as an authority file for the identification of chemical substances cited in NLM databases. One record per chemical substance for some 300,000 compounds cited in the NLM databases. ChemID provides registry numbers, molecular formulas, systematic names, synonyms, formula fragments, and more. Includes the Superlist, a collection of Lists of chemical substances maintained by key federal and state regulatory agencies.

ChemIDplus
Produced by: National Library of Medicine
Available from: National Library of Medicine (http://chem.sis.nlm.nih.gov/chemidplus)

An enhanced version of ChemID (above) offering numerous chemical synonyms, structures, regulatory list information, and links to other databases containing information about the chemicals.

CHEMINFO/INFOCHIM
Produced by: Canadian Centre for Occupational Health and Safety
Available from: CCINFOLINE (online)

Contains data on chemicals and chemical mixtures, including physical properties, reactivity, human health effects, and occupational control measures. Available in English and French.

CHEMLIST (Regulated Chemicals Listing)
Produced by: Chemical Abstracts Service (CAS)
Available from: STN (online)

Provides data on chemicals on regulatory or guidance lists, such as the Canadian Domestic Substances List, the Toxic Substances Control Act Inventory, the Korean Existing Chemicals List, etc.

CHEMSAFE
Produced by: DECHEMA
Available from: STN (online)

Includes evaluated data on safety values of combustible materials. Useful for determining potential fire and explosion hazards.

CHEMSEARCH
Produced by: Chemical Abstracts Service
Available from: DIALOG

Contains over 14 million records representing chemical substances cited in ''Chemical Abstracts.'' A nomenclature directory, CHEMSEARCH includes names, synonyms, substructure searching, and molecular formulas.

CHEMTOX
Produced by: Resource Consultants, Inc.
Available from: DIALOG (online), DataStar (online), Resource Consultants (CD-ROM)

Contains information on regulated toxic chemicals covered by laws such as the Clean Air Act, the Safe Drinking Water Act, RCRA, CERCLA, etc. Includes nomenclature information, physical and chemical properties, toxicity, regulatory information, transport, and emergency response.

CIS Abstracts
Produced by: International Labour Office
Available from: CCINFOLINE (online), QUESTEL/ORBIT (online), MIC (online), and as a subfile of **TOXLINE**

Focuses on the literature of occupational safety and health, with citations of books, journals, and reports and reviews legal documents, dissertations, etc.

Clinical Toxicology of Commercial Products (CTCP)
Produced by: Corresponds to text of same name by Gosselin et al.
Available from: CIS (online)

Information on commercial products. Searchable by manufacturer, trade name, usage, CAS registry number. Includes toxic effects, symptoms, and therapy.

CRISP (Computer Retrieval of Information on Scientific Projects)
Produced by: NIH Office of Extramural Research
Available from: NIH Office of Extramural Research (onlinegopher, CD-ROM)

A biomedical database system with information on research projects and programs supported by the Department of Health and Human Services, funded largely by the National Institutes of Health and to some extent by other agencies. These projects may be extramural projects, grants, contracts, and cooperative agreements. There are plans to eventually publish CRISP on the World Wide Web.

Current Contents Search
Produced by: Institute for Scientific Information
Available from: DIALOG (online), DataStar (online), DIMDI (online), OVID (online)

A current awareness service that keeps users up to date by providing bibliographic information, including abstracts, for articles appearing in the tables of contents of journals in the sciences and other subjects. Toxicology and environmental sciences are among the many areas covered.

DART/ETICBACK (Developmental and Reproductive Toxicology Database/Environmental Teratology Information Center Backfile)
Available from: NLM/TEHIP

These federally funded files are bibliographic databases containing citations to publications concerning teratology and developmental toxicology. DART covers publications from 1989 to the present. Earlier years are covered in ETICBACK.

Dermal Absorption
Produced by: U.S. Environmental Protection Agency
Available from: CIS

Subject scope concerns the qualitative and quantitative health effects of chemicals dermally administered to humans and laboratory animals.

Derwent Crop Protection File (PESTDOC)
Produced by: Derwent Information Ltd.
Available from: ORBIT/QUESTEL (online)

Covers the literature of pesticides, plant protection, and agricultural chemicals.

Derwent Drug File (RINGDOC)
Produced by: Derwent Information Ltd.
Available from: DIALOG (online), ORBIT/QUESTEL (online), STN (online), DataStar (online)

This large abstracted bibliographic file covers the worldwide pharmaceutical literature, including the areas of chemistry, biochemistry, pharmacology, therapeutics, and toxicology. Note: Derwent also produces other files of relevance to toxicology, including their Biotechnology Abstracts, Crop Protection File, Crop Protection Registry, Drug Registry, Patents Citation Index, and Veterinary Drug File, available variously from the vendors listed above.

DHHS-HEF
Produced by: Great Britain Department of Health
Available from: DataStar (online)

A bibliographic file covering environmental, chemical, toxicological, and microbiological safety of food, water, and the environment. Subject coverage includes pesticides, radiation, noise, general toxicology, microbiology, smoking, and industrial chemicals.

The Dictionary of Substances and Their Effects
Produced by: The Royal Society of Chemistry
Available from: DIALOG (online)

Includes data from worldwide literature on over 4,000 chemicals that affect the environment, covers data from toxicological studies and carcinogenicity and mutagenicity tests.

Dissertation Abstracts
Produced by: University Microforms, Inc. (UMI)
Available from: OVID (online), DIALOG (online), STN (online), DataStar (online)

Provides international coverage (200 non-U.S. institutions) of doctoral dissertations and masters theses from 1861 to the present. Includes topics related to toxicology, environmental health, ecotoxicology, occupational health, and medicine.

DRUGLINE
Produced by: Drug Information Centre
Available from: Information Nordic

Database of more than 8,000 records of professional evaluations of specific drug reactions and side effects in human patients. Produced by the Drug Information Centre of the Department of Clinical Pharmacology at Huddinge University Hospital in Stockholm, Sweden.

ECOTOXICOLOGY (ECOTOX) databases
Produced by: U.S. Environmental Protection Agency/ Mid-Continent Ecology Division
Available from: U.S. EPA's Mid-Continent Ecology Division (online)

The ECOTOX system, through its databases AQUIRE, PHYTOTOX, and TERRETOX, provides chemical-specific toxicity values for aquatic life, terrestrial plants, and wildlife, respectively. ECOTOX is Web accessible at http://www.epa.gov/ecotox.

ECDIN (Environmental Chemicals Data and Information Network) *see* **Web Sites**

EMBASE
Produced by: Elsvier Science
Available from: DataStar (online), DIALOG (online), DIMDI (online), OVID (online), STN (online); also available as CD-ROM through some of these vendors and Silver Platter

Covers a vast array of the worldwide biomedical literature. Corresponds to the ''Excerpta Medica'' series of printed abstracts. Of particular interest to toxicologists are the ''Toxicology'' and ''Pharmacology and Toxicology'' sections. DIMDI offers this toxicology subset as **EMTOX** and another specialty section called **EMFORENSIC**.

EMIC/EMICBACK (Environmental Mutagenic Information Center-Front and Back Files)
Produced by: Oak Ridge National Laboratory, Human Genome and Toxicology Program
Available from: NLM/TEHIP (online)

These are bibliographic databases on chemical, biological, and physical agents that have been tested for genotoxic activity. EMIC covers publications from 1991 to the present. Earlier years are covered in EMICBACK.

Enviroline
Produced by: Congressional Information Service
Available from: DataStar (online), DIALOG (online), DIMDI (online) ESA/IRS (online), ORBIT/QUESTEL (online)

Bibliographic citations and abstracts on issues related to the environment and the management and use of natural resources. Online version of the printed publication **Environment Abstracts**.

Environmental Bibliography
Produced by: International Academy at Santa Barbara
Available from: DIALOG

Provides citations of literature dealing with water, air, soil, solid waste, noise, health hazards, and other issues relating to the environment.

Environmental Chemicals Data and Information Network (ECDIN)
Produced by: Commission of the European Communities Joint Research Centre
Available from: DIMDI (online) and at http://ecdin.etomep.net (*see* ''Web Sites'')

A database on chemical substances in the environment, covering some 122,000 substances. Data include toxicity, chemical structure, environmental fate, legislation, relation to occupational health, and classification under the EU Directive on Dangerous Substances Hazard.

Environmental Contaminants Encyclopedia
Produced by: National Park Service
Available from: National Park Service (http://www.aqd.nps.gov/toxic)

Summarizes data and information related to fish, wildlife, invertebrates, and other non-human living resources. This product differs from existing databases in that it has an environmental toxicology emphasis, and it summarizes information on these issues into a single, easily searchable source. Some human information also included.

Environmental Fate (ENVIROFATE)
Produced by: U.S. Environmental Protection Agency
Available from: CIS

Contains over 13,000 records with information on the environmental fate of some 800 chemicals released to the environment.

Environmental Fate Data Bases
Produced by: Syracuse Research Corporation
Available from: Syracuse Research Corporation (online)

A suite of files—DATALOG, CHEMFATE, BIOLOG, BIODEG—containing information on the fate or organic chemicals released into the environment.

Environmental Health News (EHN)
Produced by: MDL Information Systems
Available from: MDL (online), DIALOG (online), CSA (online)

Full text of news stories on the environment and occupational health: enforcement actions, court decisions, chemical leaks and spills, health and safety studies, etc.

Federal Register
Produced by: U.S. Government Printing Office
Available from: DIALOG (online), LEXIS/NEXIS (online)

Full text of the daily **Federal Register**, including presidential documents, proposed rules, rules and regulations, and Sunshine Act information.

Federal Research in Progress (FEDRIP)
Produced by: U.S. National Technical Information Service
Available from: DIALOG (online)

Describes research, both in progress and recently completed, by federal agencies. Data include title of project, principal investigator, and performing and sponsoring organizations. Includes NIH's CRISP (Computer Retrieval of Information on Scientific Projects) system, as well as data from agencies such as USDA, DOE, EPA, and NIOSH.

First Search
Available from: First Search (OCLC)

Offers databases such as WorldCat (a catalog of books and other materials worldwide), Article1st, Contents1st, NetFirst, Books In Print, ERIC, GPO, and MEDLINE.

Food Additives: Toxicology, Regulation, and Properties
Produced by: Food and Drug Administration Center for Food Safety and Applied Nutrition
Available from: CRC Press (CD-ROM)

CD-ROM version of the Priority-Based Assessment of Food Additives (PAFA) database used by the FDA's Center for Food Safety and Applied Nutrition (FDA/CFSAN). Summarizes toxicological effects and contains regulatory information and property data for the compounds. Also includes the EAFUS database (Everything Added to Foods in the United States).

Gastrointestinal Absorption Database (GIABS)
Produced by: U.S. Environmental Protection Agency
Available from: CIS (online)

No longer updated, this file still contains a solid body of references to studies in gastrointestinal absorption, distribution, metabolism, and excretion of chemicals.

Genetic Toxicology (GENE-TOX)
Produced by: U.S. EPA
Available from: NLM/TEHIP (online)

Contains genetic toxicology (mutagenicity) data on some 3,000 chemicals, resulting from expert review of the open scientific literature. GENE-TOX is a multiphase effort to review and evaluate the existing literature and assay systems available in the field of genetic toxicology.

Global Information Network on Chemicals (GINC)
Produced by: NIHS
Available from: NIHS (http://www.nihs.go.jp/GINC)

Offers integrated searching across a number of international databases.

Government Institutes (various products)
Produced by: Various (Government Institutes included)
Available from: Government Institutes (CD-ROM)

Known for its publications and course offerings, Government Institutes has moved into electronic products with CD-ROMs, including: CFR Chemical Lists, Environmental Statutes, Environmental Regulatory Glossary, Directory of Environmental Information Sources, and EPA's IRIS.

Hazardline
Produced by: MDL Information Systems, Inc.
Available from: MDL Information Systems, Inc. (online and CD-ROM)

Regulatory, health, and safety data on over 4,000 hazardous substances. Includes Material Safety Data Sheet information, as well as emergency management, accident cleanup procedures, symptoms, and certifications.

Hazardous Substances Data Bank (HSDB)
Produced by: NLM/TEHIP
Available from: NLM/TEHIP-online (http://toxnet.nlm.nih.gov)

The flagship file of the National Library of Medicine's TOXNET system, this factual data bank focuses on the toxicology of over 4,500 potentially hazardous chemicals. In addition to toxicity data, it carries information in such areas as emergency medical treatment, safety and handling, environmental fate, exposure potential, and regulatory requirements. Data are derived from a core set of standard texts and monographs, government documents, technical reports, and the primary journal literature, and the file is fully referenced. HSDB undergoes a high level of peer review by a panel of expert toxicologists, the Scientific Review Panel (SRP).

HazDat (ATSDR's Hazardous Substance Release/ Health Effects Database)
Produced by: ATSDR
Available from: ATSDR (http://www.atsdr.cdc.gov/hazdat.html)

A scientific and administrative database providing access to information on the release of hazardous substances from Superfund sites or emergency events and on the effects of hazardous substances on the health of human populations. Also see ***Agency for Toxic Substances and Disease Registry*** in ''Web Sites.''

Health and Safety Science Abstracts (HSSA)
Produced by: Cambridge Scientific Abstracts
Available from: ORBIT/QUESTEL (online), STN (online), Silver Platter (CD-ROM)

Citations of the health and safety science literature, including environmental safety, pollution, toxicology, genetics, etc.

HSELiNE
Produced by: Great Britain Health and Safety Executive
Available from: DataStar (online), Orbit/Questel (online)

Citations, with abstracts, of the world literature on occupational safety and health. Covers UK Health and Safety commissions, Health and Safety Executive publications, and other periodicals books, reports, and legislation.

Information System for Hazardous Organics in Water (ISHOW)
Produced by: U.S. Environmental Protection Agency
Available from: CIS

Covers chemicals used or manufactured in the Great Lakes Watershed. Contains information on chemical properties.

Integrated Risk Information System (IRIS)
Produced by: U.S. Environmental Protection Agency
Available from: NLM/TEHIP (http://toxnet.nlm.nih.gov), EPA (http://www.epa.gov/iris), Government Institutes (CD-ROM)

IRIS contains EPA health risk and regulatory information on nearly 600 chemicals. Both carcinogenic (e.g., unit risks) and non-carcinogenic (e.g., reference doses) risk assessment data is provided for the oral and inhalation routes of exposure.

International Pharmaceutical Abstracts (IPA)
Produced by: American Society of Health-System Pharmacists
Available from: DATASTAR (online), DIALOG (online), DIMDI (online), OVID (online) STN (online), Silver-Platter (CD-ROM)

IPA includes information from over 750 worldwide pharmaceutical, medical, and health-related journals published since 1970. Covers the full range of drug therapy and pharmaceutical information, including toxicity.

International Uniform Chemical Information Database (IUCLID)
Produced by: European Chemicals Bureau
Available from: European Chemicals Bureau (CD-ROM)

A basic tool for priority setting and risk assessment within the European Union Risk Assessment Program. IUCLID contains nonconfidential data that have been

reported during Phase 1 of the data collection following Council Regulation (EEC) 793/93 on the Evaluation and Control of the Risks of Existing Substances. The data have been submitted by European industry for the high-production volume chemicals listed in Annex 1 of the Regulation.

IPCS INCHEM
Produced by: Various
Available from: CCOHS (on the Web and CD-ROM) [see CCINFOLINE under Vendors listing]

Consolidates a wide variety of information produced by a number of international bodies, in order to assist in the sound management of chemicals. Includes Environmental Health Criteria monographs, International Chemical Safety Codes, Pesticide Data Sheets, etc.

Kirk–Othmer Encyclopedia of Chemical Technology Online
Produced by: John Wiley & Sons, Inc.
Available from: DIALOG (online)

Contains the full text of the eponymous books. Chemical technology is broadly defined and covers many areas of interest to those working in the fields of toxicology and the environment.

Major Hazard Incident Data Service (MHIDS)
Produced by: AEA Technology
Available from: ESA-IRS (online and CD-ROM)

A database of over 6,000 incidents involving hazardous materials around the world that have resulted in public evacuations or were otherwise serious. Data on the incidents include data, place, type of hazard, name of material involved, United Nations code, type of incident, origin, causes, number of people killed, injured, or evacuated, a description of the event, etc.

Martindale Online
Produced by: Royal Pharmaceutical Society of Great Britain
Available from: DATASTAR (online)

Corresponding to **Martindale: The Extra Pharmacopoea**, this database contains information on drugs and ancillary substances—drug names and synonyms, manufacturers' names and addresses, description, uses, preparations, metabolism and excretion, precautions, adverse effects, etc.

Material Safety Label Data and Summary Sheets
Produced by: MDL Information Systems
Available from: DIALOG (online)

Container label data is covered in the first of these databases. Summaries of material safety data sheets, with chemical safety and hazard information, are covered in the other.

MEDLINE
Produced by: National Library of Medicine
Available from: National Library of Medicine (http://www.nlm.nin.gov), DIALOG (online), QUESTEL/ORBIT (online), STN (online), OVID (online)

Approaching 10 million references to the literature from 1966 to the present, this groundbreaking multidisciplinary biomedical database includes toxicology within its scope.

Merck Index Online
Produced by: Merck & Co. Inc.
Available from: CIS (online), DIALOG (online), QUESTEL/ORBIT (online), STN (online)

Covers preparation, chemical and physical properties, principal pharmacological action, and toxicity of substances. Updated with varying frequencies according to vendor.

MICROMEDEX Databases
Produced by: Various sources
Available from: MICROMEDEX (CD-ROM and online)

MICROMEDEX offers a large array of databases to meet clinical information needs, including toxicology, emergency and acute care, occupational medicine, chemical safety, and industrial regulatory compliance. Its worldwide editorial board consists of 450 practicing experts. In addition to **POISINDEX, REPRORISK,** and **TOMES-PLUS,** listed separately, it offers many other databases relevant to toxicology in the areas of health care (e.g., DRUGDEX, EMERGINDEX, IDENTIDEX, MARTINDALE, Material Safety Data Sheets, Reactions Database) and environmental health and safety (e.g., Hazardtext, Meditext).

MSDS
Produced by: Canadian Centre for Occupational Health and Safety
Available from: CCINFOline (online), STN (online)

With data in such areas as emergency response, first aid, safety and handling, storage, cleanup and disposal, this file contains nearly 100,000 Material Safety Data Sheets.

National Pesticide Information Retrieval System (NPIRS)
Produced by: Purdue University
Available from: Purdue University (online), Silver Platter (CD-ROM, called **PEST-BANK**)

Contains information on some 60,000 pesticides, including names, manufacturers, active ingredients, formulations, type of pesticidal activity, toxicity, etc.

National Library of Medicine

NLM offers a wide array of databases in the biomedical sciences and toxicology. These are available through their Web sites: TOXNET (http://toxnet.nlm.nih.gov), Internet Grateful Med (http://www.nlm.nih.gov) and Pubmed (http://www.nlm.nih.gov). They are also listed elsewhere in this section.

NIOSHTIC
Produced by: National Institute for Occupational Safety and Health (NIOSH)
Available from: CCINFOLINE (online), ORBIT/QUESTEL (online), NLM (as a subfile of the **TOXLINE** database); also available through some vendors as a CD-ROM

A bibliographic file with some 200,000 citations and abstracts to literature in occupational safety and health from the turn of the century to today.

NTIS Bibliographic Database
Produced by: U.S. National Technical Information Service
Available from: DATASTAR (online), DIALOG (online), QUESTEL/ORBIT (online), STN (online)

Close to 3 million citations to government-sponsored technical reports are included in this database.

PHYTOTOX
Produced by: University of Oklahoma, Department of Botany and Microbiology
Available from: CIS (online), forthcoming on EPA's Web site at http://www.epa.gov/ecotox

Offers data extracted from articles on the toxic effects of organic chemicals on terrestrial vascular plants. Records describe chemical tested and plant species, dosage level, method of application, and test results. Part of EPA's ECOTOX system.

POISINDEX System
Produced by: MICROMEDEX
Available from: MICROMEDEX (CD-ROM)

Identifies ingredients for hundreds of thousands of commercial, pharmaceutical, and biological substances. Each substance is linked to one or more management documents providing information on clinical effects, range of toxicity, and treatment protocols for exposures involving the substances.

POLLUTION ABSTRACTS
Produced by: Cambridge Scientific Abstracts
Available from: STN (online) Silver Platter (CD-ROM)

A bibliographic database containing information on air, land, marine, and freshwater pollution, their sources, and control, plus water, sewage, and wastewater management.

POLTOX I: Pollution and Toxicology
Produced by: Various sources
Available from: Silver Platter (CD-ROM)

Provides access to some two million citations, including **TOXLINE, Food Science and Technology Abstracts,** and, from Cambridge Scientific Abstracts, **Pollution Abstracts, Toxicology Abstracts, Ecology Abstracts, Health and Safety Science Abstracts**, and portions of the **Aquatic Sciences and Fisheries Abstracts** series.

Registry of Toxic Effects of Chemical Substances (RTECS)
Produced by: National Institute for Occupational Safety and Health (NIOSH)
Available from: CIS (online), CCINFOWEB (online), STN (online)

RTECS contains toxic effects data on over 130,000 chemicals. Both acute and chronic effects are covered, including data on skin/eye irritation, carcinogenicity, mutagenicity, and reproductive effects.

REPRORISK
Produced by: Various sources
Available from: MICROMEDEX (CD-ROM)

Also known as the Reproductive Risk Information System and consisting of **REPROTEXT, SHEPARD's Catalog of Teratogenic Agents, TERIS,** and **REPROTOX**.

REPROTOX
Produced by: Columbia Hospital for Women
Available from: http://reprotox.org and MICROMEDEX (CD-ROM) as part of their REPRORISK system

Summarizes information on thousands of drugs and industrial and environmental chemicals, with regard to their effects on human fertility, pregnancy, and fetal development.

Resource Conservation and Recovery Information System (RCRIS)
Produced by: U.S. Environmental Protection Agency
Available from: CIS

Records describe the operations of generators and transporters of hazardous materials, as well as treatment, storage, and disposal facilities.

RISKLINE
Produced by: KEMI (Swedish National Chemicals Inspectorate)
Available from: MIC (of Karolinska Institutets) (online) and as a subfile of **TOXLINE** (online)

A bibliographic database covering the toxicology and ecotoxicology of chemicals. Each reference in Riskline is furnished with a critical evaluation that represents the unanimous opinion of a group of toxicological experts on the value of the research presented in the document.

RTK NET (The Right-to-Know Network)

Provides free access to many environmental databases. See description under ''Web Sites'' in this chapter.

SciSearch
Produced by: Institute for Scientific Information
Available from: DataStar (online), DIALOG (online), DIMDI (online), STN (online)

A multi-disciplinary scientific and technical database containing bibliographic information and cited references from 5,000 leading scientific, technical, and medical journals. Also available from ISI's enhanced Web-based database, the Web of Science (www.isinet.com).

Scorecard
Produced by: Environmental Defense Fund
Available from: Environmental Defense Fund

The Environmental Defense Fund provides a unique and comprehensive point of access to the EPA Toxic Release Inventory and other EPA data and reports. The unique feature of this toxic chemical data is its user interface which shows individuals from a geographical perspective what toxic chemical and chemical waste activities are taking place in their neighborhoods. Chemical data is displayed on maps of various scales, and comparative information related to potential health effects and exposures is presented.

SEDBASE
Produced by: Elsevier Science
Available from: DIALOG (online), DIMDI (online), SilverPlatter (CD-ROM)

Contains citations to the published literature covering adverse drug reactions and interactions. Includes drug name and classification, interacting drug, interacting classification, side effect factors, etc.

SOLV-DB
Produced by: National Center for Manufacturing Sciences
Available from: National Center for Manufacturing Sciences (http://solvdb.ncms.org)

The National Center for Manufacturing Sciences presents SOLV-DB, a one-stop source for solvents data. The purpose of SOLV-DB is to locate a wide variety of data on solvents quickly and easily. The development of this resource was funded under the Strategic Environmental Research and Development Program (SERDP) with funds received through the Environmental Protection Agency (EPA) and the Department of Energy (DOE) under a cooperative agreement with the DOE Office of Industrial Technologies (OIT).

System for Information on Grey Literature in Europe (SIGLE)
Produced by: European Association for Grey Literature Exploitation (EAGLE)
Available from: STN (online)

Grey or fugitive literature consists of various technical reports and conference papers published outside of usual channels. SIGLE tracks references to these in Europe with a strong focus on science and technology.

Teris [Teratogen Information System]
Produced by: University of Washington
Available from: University of Washington

A series of agent summaries, based on reviews of published clinical and experimental literature. Each summary includes a risk assessment derived by consensus of an Advisory Board comprising nationally recognized authorities in clinical teratology. Comes with an updated, automated version of Shepard's Catalog of Teratogenic Agents. Over 2,800 agents included.

TERRETOX
Produced by: U.S. EPA (maintained by Mid-Continent Ecology Division, Duluth)
Available from: Forthcoming on EPA's Web site at http://www.epa.gov/ecotox

A terrestrial wildlife toxicity database established to provide data links, quantified chemical exposure with observed toxic effects. Part of EPA's ECOTOX system.

TOMES Plus
Produced by: Various sources
Available from: MICROMEDEX (CD-ROM, online)

An extensive collection of proprietary and licensed databases giving access to medical, hazard, and environmental information for safe management and handling of chemicals. Consists of the following files: **MEDITEXT, HAZARDTEXT, First Medical Response, DOT Emergency Response Guides, Hazardous Substances Data Bank, OHM-TADS, Chemical Hazards Response Information System**, and **IRIS**. Now available interactively online through the World Wide Web.

Toxic Chemical Release Inventory (TRI)
Produced by: U.S. Environmental Protection Agency
Available from: NLM/TEHIP (online), EPA's Web site, RTK NET's Web site

Mandated by the Emergency Planning and Community Right-to-Know Act, this series of files contains data collected from industry by the EPA on the estimated releases of toxic chemicals to the environment (air, water, land, or underground injection), amounts transferred to waste sites, and, since TRI91, source reduction and recycling information.

Toxicology Abstracts
Produced by: Cambridge Scientific Abstracts
Available from: Cambridge Scientific Abstracts (online as part of their CSA Life Sciences Collection), SilverPlatter (CD-ROM as part of the CSA Life Sciences Collection)

Contains citations and abstracts to the worldwide literature on toxicology. Covers clinical toxicology (acute and chronic), drug poisonings, toxic hazards in the workplace, and environmental toxicology.

TOXLINE (Toxicology Literature Online)
Produced by: Various sources
Available from: NLM/TEHIP (http://igm.nlm.nih.gov)

The TOXLINE family of files contains nearly three million citations, most with abstracts to literature covering the pharmacological, biochemical, physiological and toxicological effects of drugs and other chemicals. TOXLINE data are drawn from the following subfiles: Aneuploidy, Developmental and Reproductive Toxicology, Environmental Mutagen Information Center File, Environmental Teratology Information Center File, Epidemiology Teratology Information Center File, Epidemiology Information System, Federal Research in Progress, Hazardous Materials Technical Center (HMTC), International Labour Office, International Pharmaceutical Abstracts, NIOSHTIC, Pesticides Abstracts (PESTAB), Poisonous Plants Bibliography, Toxic Substances Control Act Test Submissions, Toxicity Bibliography, Toxicological Aspects of Environmental Health, Toxicology Document and Data Depository, and Toxicology Research Projects.

TOXNET (Toxicology Data Network)
Produced by: Various sources
Available from: NLM/TEHIP (http://toxnet.nlm.nih.gov)

This wide-ranging system of databases covering such subjects as toxicology, hazardous chemicals, risk assessment, carcinogenesis, toxic chemical releases, and genetic toxicology, includes the **Hazardous Substances Data Bank,** the **Integrated Risk Information System,** the **Toxic Chemical Release Inventory,** and more, listed separately.

TSCA Chemical Substances Inventory
Produced by: U.S. Environmental Protection Agency
Available from: DIALOG (online)

Contains data on U.S. chemicals in commerce covered in the TSCA Initial Inventory and supplements. Includes CAS Registry Number, preferred name, formula, and synonyms.

TSCA Test Submissions
Produced by: U.S. Environmental Protection Agency
Available from: CIS (online), DIALOG (online), STN (online), NLM (part of TOXLINE)

Contains toxicological studies of chemicals described in unpublished health and safety reports submitted by chemical manufacturers, users, and importers to the EPA.

U.S. EPA Databases and Software
Produced by: EPA
Available from: http://www.epa.gov/epahome/Data.html

This web site offers access to EPA's exhaustive databases, including the ENVIROFACTS group.

Water Test Methods and Guidance
Produced by: U.S. Environmental Protection Agency
Available from: NTIS, EPA

Database produced by the EPA containing more than 350 drinking water and wastewater laboratory and field-testing methods and procedures for 776 analytes and guidance from more than 50 full-text EPA reports (with complete tables, diagrams, figures, flowcharts, and other illustrations).

Databases—General Interest

Public school and many community college (and two-year technical college) libraries, and the libraries of nonprofit groups may not have access to the more technical databases listed above. However these organizations may have available general-interest databases, such as those listed below. They may contain relevant, though in some cases, less technical toxocology information.

Academic Index (DIALOG)
Applied Science and Technology Index (Wilsonline)
A-V Online (DIALOG)
AVLINE (National Library of Medicine)
Book Review Index (DIALOG)
Books in Print (DIALOG, OVID)
British Books in Print (DIALOG)
Cumulative Book Index (Wilsonline)

Magazine ASAP (DIALOG, OVID)
Magazine Index (DIALOG)
Readers' Guide to Periodical Literature (Wilsonline)

Databases—Conferences and Meetings

A number of online databases provide information related to conferences, exhibitions, trade fairs, symposia, meetings, workshops, and other events. Most of these databases provide comprehensive coverage in the science, engineering, and technology disciplines, including those related to toxicology, environmental and occupational health, and medicine. Databases for identifying forthcoming conferences, as well as those providing bibliographic information about individual papers and presentations, are included below. Newsletter and meetings sections of technical journals and trade magazines frequently list the dates, locations, availability of proceedings or papers, and points of contact for meetings.

Conference Papers Index (Cambridge Scientific Abstracts, STN)
Directory of Published Proceedings (Data-Star)
EDVENT/Educational and Training Course Database (CompuServe Information Service)
EventLine (DIALOG, STN, QUESTEL/ORBIT)
FAIRBASE (DATA-STAR)
Global Meeting Line (Global Meeting Line)
ISTP (Index to Scientific and Technical Proceedings) Search (DIMDI)
MEETING AGENDA (QUESTEL/ORBIT)

Databases—News and Current Awareness

The issues of toxicology and environmental health are prone to newsworthy coverage, often featuring catastrophic episodes. Keeping track of news coverage from the issuance of press releases to headlines in major international papers is achieved through numerous electronic resources. The advent of electronic publishing has resulted in scores of international, national, regional, and local newspapers now available in full-text electronic formats. Stories from such newspapers and other media coverage may be found in the following databases.

AP News (DIALOG)
BNA Daily News from Washington [see ''Databases—Core'' (high relevance to toxicology)]
Burrelles Broadcast Database (Burrelles)
Chemical Business Newsbase (DIALOG, STN)
Data Times Corporation (a vendor providing access to numerous newspapers)
National Newspaper Index (DIALOG, DATASTAR)
Newsletter Database (DIALOG, STN)
Newspaper Abstracts (DIALOG)
Newspaper and Periodical Abstracts (DIALOG)
Newswire ASAP (DIALOG)
Reuter TEXTLINE (DIALOG, DATASTAR)
UPI News (DIALOG, NEXIS)

Databases—Miscellaneous

On top of the core and other databases listed earlier, there remain a fair number of others that may yield fruitful information related to toxicology, although their emphases lie elsewhere. A handful are listed here.

ABI/INFORM (DIALOG, ORBIT/QUESTEL, OVID)—business and management
Compendex Plus (DIALOG, ORBIT/QUESTEL, OVID, DIALOG, STN)—engineering
Encyclopedia of Associations (DIALOG)—listing of organizations
Japanese Government and Public Research in Progress (STN)
Library of Congress Catalogs—see ''Web Sites'' section

***Producers* (*Produced by*)**

AEA Technology
Consultancy Services
Thomson House
Risley
Warrington WA3 6AT, England
Phone: 192-5-254486
Fax: 192-5-254537
Web: http://www.aeat.co.uk

American Society of Health-System Pharmacists (ASHP)
7272 Wisconsin Ave.
Bethesda, MD 20814
Phone: 301-657-3000
Fax: 301-657-1641
Web: http://www.ashp.com

Ariel Research Corporation
7910 Woodmont Ave.
Bethesda, MD 20814-3015
Phone: 800-982-0064
Fax: 301-907-7773
E-mail: ariel@arielres.com/
Web: http://www.arielresearch.com

ATSDR (Agency for Toxic Substances and Disease Registry)
1600 Clifton Rd.
Atlanta, GA 30333
Phone: 404-639-0700

Fax: 404-639-0744
Web: http://www.atsdr.cdc.gov

Beilstein Informationssysteme GmbH
Varrentrappstr. 40-42
D-60486 Frankfurt am Main, Germany
Phone: 069-7917410
Fax: 4969-7917321
E-mail: bis_info@beilstein.com
Web: http://www.beilstein.com

BIOSIS
2100 Arch St.
Philadelphia, PA 19103-1399
Phone: 800-523-4806
Fax: 215-587-2016
Web: http://www.biosis.org

BNA (Bureau of National Affairs)
1231 25th St. NW
Washington, DC 20037
Phone: 800-372-1033
Fax: 202-452-4062
Web: http://www.bna.com

Business Publishers, Inc.
8737 Colesville Rd, Suite 1100
Silver Spring, MD 20910-3925
Phone: 800-274-6737
Fax: 301-589-8993
E-mail: bpinews@bpinews.com
Web: http://www.bpinews.com

Cambridge Scientific Abstracts (CSA)
7200 Wisconsin Avenue, Suite 601
Bethesda, MD 20814
Phone: 301-961-6700
Fax: 301-961-6720
Web: http://www.csa.com

Cambridge Soft Corporation
875 Massachusetts Ave.
Cambridge, MA 02139
Phone: 800-315-7300
E-mail: store@camsoft.com
Web: http://www.camsoft.com

Canadian Centre for Occupational Health and Safety (CCOHS)
250 Main St., E.
Hamilton, ON, Canada L8N 1H6
Phone: 905-570-8094
Fax: 905-572-2206
Web: http://www.ccohs.ca

Chemical Abstracts Service (CAS)
2540 Olentangy River Rd.
PO Box 3012
Columbus, OH 43210
Phone: 614-447-3600
Fax: 614-447-3713
E-mail: helpw@cas.org
Web: http://info.cas.org

Columbia Hospital for Women
Reproductive Toxicology Center (RTC)
2440 M St., NW, Suite 217
Washington, DC 20037-1404
Phone: 202-293-5137
Fax: 202-778-6199
Web: http://www.reprotox.org/rtc.html

Commission of the European Communities (CEC)
Joint Research Centre (JRC)
T. P. 290
21020 Ispra (VA)
Italy
Phone: +39-332-78-99-81
Fax: +39-332-78-56-31
Web: http://www.jrc.cec.eu.int/jrc

Congressional Information Service, Inc. (CIS)
4520 East-West Highway
Bethesda, MD 20814-3389
Phone: 800-638-8380
Fax: 301-654-4033
E-mail: cisinfo@lexis-nexis.com
Web: http://www.cispubs.com

Derwent Information Ltd.
Derwent House
14 Great Queen St.
London WC2B 5DF, England
Phone: 171-3442800
In the U.S.: 1-800-337-9368
Fax: 171-3442972
E-mail: helpdesk@derwent.co.uk
Web: http://www.derwent.com

Environmental Defense Fund National Headquarters
257 Park Ave. South
New York, NY 10010
Phone: 212-505-2100
Fax: 212-505-2375
Web: http://www.scorecard.org.

(U.S.) Environmental Protection Agency
[ECOTOX, AQUIRE]
Mid-Continent Ecology Division (MED)
National Health and Environmental Effects Research Laboratory (NHEERL)
6201 Congdon Blvd.
Duluth, MN 55804-2595
Phone: 218-720-5602
Fax: 218-720-5539
Web: http://www.epa.gov/med

(U.S.) Environmental Protection Agency
[CERCLIS Database of Hazardous Waste Sites]

Office of Emergency and Remedial Response
Office of Program Management
401 M St., SW
MS-OS240
Washington, DC 20460
Web: http://www.epa.gov

(U.S.) Environmental Protection Agency
[RCRIS, ISHOW]
Office of Solid Waste and Emergency Response (OSWER)
Emergency Response Division
SE 360-5101
401 M St., SW
Washington, DC 20460
Phone: 202-260-3610
Fax: 202-260-3527
Web: http://www.epa.gov

(U.S.) Environmental Protection Agency
[ENVIROFATE, TSCA Inventory, TSCA Test Submissions, DERMAL, GIABS]
Office of Pollution, Prevention, and Toxics
401 M St., SW
Washington, DC 20460
Phone: 202-260-2320
Fax: 202-260-4659
Web: http://www.epa.gov

(U.S.) Environmental Protection Agency [IRIS]
National Center for Environmental Assessment
401 M St., SW
Washington, DC 20460
Phone: 513-569-7254 [EPA's Risk Information Hotline in Cincinnati]
Web: http://www.epa.gov/iris

European Association for Grey Literature Exploitation (EAGLE)
Postbus 90407
NL-2509 LK The Hague, Netherlands
Phone: 070-3140281
Fax: 070-3140493
Web: http://www.konbib.nl/sigle

European Chemicals Bureau
Joint Research Center
Via Fermi
Phone: 1-21020 Ispra (VA)
Italy
Web: http://www.ecb.ei.jrc.it

(U.S.) Government Printing Office (GPO)
Office of Electronic Information Dissemination Services
732 N. Capital St.
Washington, DC 20402
Phone: 202-512-1530
Fax: 202-512-1262
Web: http://www.gpo.gov/

Great Britain Department of Health
Health Aspects of Environment and Food Division
Room 531B, Skipton House
Elephant and Castle
London SE1 6TE, England

Great Britain Health and Safety Executive (HSE)
HSE Information Services
Broad Lane
Sheffield S3 7HQ, England
Web: http://www.open.gov.uk/hse

Institute for Scientific Information (ISI)
3501 Market St.
Philadelphia, PA 19104
Phone: 800-336-0100
Fax: 215-386-2911
E-mail: sales@isinet.com
Web: http://www.isinet.com

International Academy at Santa Barbara
Environmental Studies Institute
800 Garden St.
Santa Barbara, CA 93101-1552
Phone: 805-865-5010
Fax: 805-965-6071
Web: http://www.iasb.org

International Labour Office (ILO)
Centre International d'Informations de Securite et de Sante au Travail (CIS)
CH-1211 Geneva 22, Switzerland
Phone: 022-7996740
Fax: 022-7986253
Web: http://www.ilo.org

John Wiley & Sons, Inc.
Wiley Electronic Publishing
605 Third Ave.
New York, NY 10158-0012
Phone: 800-879-4539
Fax: 212-850-6220
Web: http://www.wiley.com

KEMI (Swedish National Chemicals Inspectorate)
PO Box 1384
S-171 27 Solna, Sweden
Phone: 46-8-730-57-00
Fax: 46-8-735-76-98
Web: http://www.kemi.se

Mallinckrodt Baker Inc.
222 Red School Lane
Phillipsburg, NJ 08865
Phone: 908-859-2151
Fax: 908-859-9318

E-mail: infombi@mkg.com
Web: http://www.mallbaker.com

MDL Information Systems, Inc.
14600 Catalina St.
San Leandro, CA 94577
Phone: 800-635-0064
Fax: 510-614-3652
Web: http://www.mdli.co.uk

Merck & Co., Inc.
One Merck Drive
P.O. Box 100
Whitehouse Station, NJ 08889-0100
Phone: 908-423-1000
Web: http://www.merck.com

Michigan Department of Environmental Quality
Surface Water Quality Division
Great Lakes and Environmental Assessment Section
PO Box 30273
Lansing, MI 48909
Phone: 517-373-6794
Fax: 517-373-9958
Web: http://www.deq.state.mi.us

MICROMEDEX, Inc.
6200 S. Syracuse Way, Suite 300
Englewood, CO
Phone: 800-525-9083
Fax: 303-486-6464
E-mail: info@mdx.com
Web: http://www.micromedex.com

National Cancer Institute (Cancer Genome Anatomy Project)
Web: http://www.nchi.mlm.nih.gov/CGAP

National Cancer Institute (NCI)
Division of Cancer Biology
6011 Executive Blvd., Suite 551
Bethesda, MD 20892
Phone: 301-496-1625
Fax: 301-496-1040
E-mail: vf6n@nih.gov
Web: http://www.nci.nih.gov

National Center for Manufacturing Sciences (SOLV-DB)
Corporate Office
3025 Boardwalk
Ann Arbor, MI 48108-3266
Phone: 734-995-0300
Fax: 734-995-4004
Web: http://www.ncms.org

National Institute for Occupational Safety and Health (NIOSH)
Education and Information Division
Information Resources Branch
4676 Columbia Parkway
Cincinnati, OH 45226
Phone: 513-533-8326
Fax: 513-533-8588
Web: http://www.cdc.gov/niosh

National Library of Medicine
Division of Specialized Information Services
8600 Rockville Pike
Bethesda, MD 20894
Phone: 301-496-1131
Fax: 301-480-3537
Web: http://sis.nlm.nih.gov

National Park Service
Water Resources Division
Water Operations Branch
1201 Oakride Drive, Suite 250
Fort Collins, CO 80525
Web: http://www.nps.gov

(U.S.) National Technical Information Service
5285 Port Royal Rd.
Springfield, VA 22161
Phone: 703-487-4650
Fax: 703-487-4134
Web: http://www.ntis.gov

NIH Office of Extramural Research
9000 Rockville Pike
Bethesda, MD 20892
Phone: 301-435-0656
Fax: 301-480-2845
E-mail: drt@cu.nih.gov
Web: http://www.nih.gov/grants/oer.htm

NIHS (National Institute of Health Sciences)
Kamiyoga 1-18-1, Setagaga-ku
Tokyo 158, Japan
Phone: 81-3-3700-1141
Fax: 81-3-3707-6950
Web: http://www.nihs.go.jp

Oak Ridge National Laboratory
Environmental Mutagen Information Center
1060 Commerce Park
Oak Ridge, TN 37831-6480
Phone: 423-574-7871
Fax: 423-574-9888
Web: http://www.ornl.gov

Purdue University
Entomology Hall
West Lafayette, IN 47907
Phone: 317-494-6616
Fax: 317-494-0535
Web: http://www.purdue.edu

Resource Consultants, Inc.
121 CrossRoads Blvd.
Brentwood, TN 37027
Phone: 800-332-2815
Fax: 615-370-4339

Royal Pharmaceutical Society of Great Britain
1 Lambeth High St.
London SE1 7JN, England
Phone: 171-7359141
Fax: 171-7357629
E-mail: enquiries@rpsgb.org.uk
Web: http://www.rpsgb.org.uk

The Royal Society of Chemistry
Information Services
Thomas Graham House
Science Park, Milton Rd.
Cambridge, Cambs. CB4 4WF, England
Web: http://www.rsc.org

Syracuse Research Corporation (SRC)
6225 Running Ridge Road
North Syracuse, NY 13212
Phone: 315-452-8000
Web: http://www.syrres.com

United Nations Food and Agriculture Organization (FAO)
Aquatic Sciences and Fisheries Information System
Via delle Terme di Caracalla
1-00100 Rome, Italy
Phone: 06-57971
Fax: 06-57973152
Web: http://www.fao.org

University Microforms/Bell & Howell Information & Learning
300 N. Zeeb Rd.
PO Box 1346
Ann Arbor, MI 48106
Phone: 800-521-0600
Fax: 800-864-0019
Web: http://www.umi.com

University of Oklahoma
Department of Botany and Microbiology
Norman, OK 73019
Phone: 405-325-4321

University of Washington
TERIS
PO Box 357920
Seattle, WA 98195-7920
Phone: 206-543-2465
Web: http://weber.u.washington.edu/~terisweb/teris

Vendors (*Available From*)

Ariel Research Corporation
7910 Woodmont Ave.
Bethesda, MD 20814-3015
Phone: 800-982-0064
Fax: 301-907-7773
Web: http://www.arielres.com

ATSDR [Agency for Toxic Substances and Disease Registry]
1600 Clifton Rd.
Atlanta, GA 30333
Phone: 404-639-0700
Fax: 404-639-0744
Web: http://www.atsdr.cdc.gov

BNA (Bureau of National Affairs)
1231 25th St., NW
Washington, DC 20037
Phone: 800-372-1033
Fax: 202-372-1033
Web: http://www.bna.com

Burrelles Information Services
75 E. Northfield Rd.
Livingston, NJ 07039-9873
Phone: 800-631-1160
Fax: 201-992-7675
Web: http://www.burrelles.com

Cambridge Soft Corporation
100 Cambridge Park Drive
Cambridge, MA 02140
Phone: 800-315-7300
E-mail: info@camsoft.com
Web: http://www.camsoft.com

CCINFOWeb (Canadian Centre for Occupational Health and Safety)
250 Main St., E.
Hamilton, ON, CANADA L8N 1H6
Phone: 905-570-8094
Fax: 905-572-4400
E-mail: custserv@ccohs.ca
Web: http://www.ccohs.cg

CIS (Chemical Information Systems, Inc.)
11350 McCormick Rd.
Executive Plaza III, Suite 1100
Hunt Valley, MD 21030
Phone: 800-247-8737
Fax: 410-527-4599
E-mail: eissupport@oxmol.com
Web: http://www.oxmol.com/prods/cis

Compuserve Information Service
5000 Arlington Center Blvd.,
PO Box 20212
Columbus, OH 43220

Phone: 800-848-8199
Fax: 614-457-0348
Web: http://www.compuserve.com

CRC Press LLC
2000 Corporate Blvd., NW
Boca Raton, FL 33431
Phone: 800-272-7737
Web: http://www.crcpress.com

DataStar
c/o DIALOG Corporation
11000 Regency Pkwy., Suite 10
Carey, NC 27511
E-mail: jackie_silvester@dialog.com
Web: http://www.oxmol.com/prods/cis

DataTimes Corporation
Parkway Plaza, Suite 450
1400 Quail Springs Parkway
Oklahoma City, OK 73134
Phone: 800-642-2525
Fax: 405-755-8028

DIALOG Corporation
11000 Regency Pkwy., Suite 10
Carey, NC 27511
Phone: 800-3-DIALOG
E-mail: customer@dialog.com
Web: http://www.dialog.com

DIMDI (Deutsches Institut fur Medizinische Dokumentation und Information)
Weisshausstr. 27
Postfach 420580
D-50899 Cologne, Germany
Phone: +49 222/472 4-1
E-mail: helpdesk@dimdi.de
Web: http://www.dimdi.de

ESA/IRS (European Space Agency/Information Retrieval Service)
ESRIN, Via Galileo Galilei
I-00044 Frascati
Rome, Italy
Phone: 39-6-94180
Fax: 39-6-94180280
E-mail: kspinzig@errin.bitnet
Web: http://www.esrin.esa.it

European Chemicals Bureau
Joint Research Center
Via Fermi
1-21020 Ispra (VA)
Italy
Web: http://ecb.ei.jrc.it

FirstSearch
OCLC Online Computer Library Center, Inc.
6565 Frantz Road
Dublin, OH 43017-3395
Phone: 614-764-6000
Phone: 800-848-5878
Fax: 614-764-6096
E-mail: oclc@oclc.org
Web: http://www.oclc.org/menu/home1.htm

Global Meeting Line Inc.
1345 Oak Ridge Turnpike, Suite 357
Oak Ridge, TN 37830
Phone: 423-482-6451
Fax: 423-483-7494

GMA Industries Inc.
2530 River Riva Rd., Suite 203
Annapolis, MD 21401
Phone: 410-571-0300
Fax: 410-571-0301
E-mail: cancerch@gmai.com

Government Institutes
4 Research Place, Suite 200
Rockville, MD 20850
Phone: 301-921-2300
Fax: 301-921-0373
E-mail: giinfo@govinst.com
Web: http://www.govinst.com

Information Nordic AB
Box 4
544 21 Hjo, Sweden
Web: http://www.infonordic.se

LEXIS-NEXIS
9393 Springboro Pike
Miamisburg, OH 45342
Phone: 800-543-6862
Web: http://www.lexis-nexis.com

MDL Information Systems, Inc.
14600 Catalina St.
San Leandro, CA 94577
Phone: 800-635-0064
Fax: 510-614-3652
Web: http://www.mdli.co.uk

MIC (Medical Information Center)
Karolinska Institute Library and Information Center
PO Box 200
S-171 77 Stockholm, Sweden
Phone: 46-8-728-80-00
Fax: 46-8-33-04-81
Web: http://www.kib.ki.se

MICROMEDEX, Inc.
6200 S. Syracuse Way, Suite 300
Englewood, CO
Phone: 800-525-9083
Fax: 303-486-6464

E-mail: info@mdx.com
Web: http://www.micromedex.com

NIHS (National Institute of Health Sciences)
Kamiyoga 1-18-1, Setagaga-Ku
Tokyo 158, Japan
Phone: 81-3-3700-1141
Fax: 81-3-3707-6950
Web: http://www.nihs.go.jp

National Cancer Institute (Cancer Genome Anatomy Project)
Web: http://www.ncbi.nlm.nih.gov/CGAP

NLM/TEHIP
National Library of Medicine
Toxicology and Environmental Health Information Program
8600 Rockville Pike
Bethesda, MD 20894
Phone: 301-496-6531
Fax: 301-480-3537
E-mail: toxmail@toxnetmail.nlm.nih.gov
Web: http://www.sis.nlm.nih.gov/tehip.htm

NewsNet, Inc.
945 Haverford Rd.
Bryn Mawr, PA 19010
Phone: 800-345-1301
Fax: 610-527-0338

NIH Office of Extramural Research
9000 Rockville Pike
Bethesda, MD 20892
Phone: 301-435-0656
Fax: 301-480-2845
E-mail: drt@cu.nih.gov
Web: http://www.nih.gov/grants/oer.htm

ORBIT/QUESTEL
8000 Westpark Drive, Suite 130
McLean, VA 22102
Phone: 800-456-7248
Fax: 703-556-7448
E-mail: wiand@questel.orbit.com
Web: http://www.orbit.com

OVID
333 7th Ave.
New York, NY 10001
Phone: 212-563-3006
Fax: 212-563-3784
E-mail: support@ovid.com
Web: http://www.ovid.com

Purdue University
Center for Environmental and Regulatory Information Systems
1231 Cumberland Ave., Suite A
West Lafayette, IN 47906
Phone: 765-494-6616
E-mail: info@ceris.purdue.edu
Web: http://www.ceris.purdue.edu

SilverPlatter Information, Inc.
100 River Ridge Rd.
Norwood, MA 02062-5043
Phone: 800-343-0064
Fax: 781-769-8763
E-mail: info@silverplatter.com
Web: http://www.silverplatter.com

STN International
[headquartered in Karlsruhe, Germany]
U.S. Branch Office - c/o Chemical Abstracts Service
2540 Olentangy River Rd.
Columbus, OH 43210-0012
Phone: 800-753-4227
Fax: 614-447-3713
E-mail: helpw@cas.org
Web: http://www.cas.org/stn.html

Syracuse Research Corporation (SRC)
6225 Running Ridge Road
North Syracuse, NY 13212
Phone: 315-452-8000
Web: http://www.syrres.com

University of Washington
TERIS
Box 357920
Seattle, WA 98195-7920
Phone: 206-543-2465
Web: http://weber.u.washington.edu/~terisweb/teris

Wilsonline
H.W. Wilson Company
950 University Ave.
Bronx, NY 10452
Phone: 800-367-6770
Fax: 718-538-2716
E-mail: custserv@hwwilson.com
Web: http://www.hwwilson.com

Software Programs

Software programs are available on CD-ROMs, on floppy disks, by downloading, or by accessing directly online. Among the functions performed by toxicology and risk assessment software are modeling, exposure analysis, risk estimation, structure-activity prediction, generation of graphical displays, etc. Sometimes the distinction between software programs and databases

is hazy, because some of these programs may not only operate with user-provided data, but may be bundled with databases of their own.

It is difficult to recommend specific software programs. Software ''ages,'' and what is state-of-the-art now may not be in the future. For example, some software programs periodically get revised (and hopefully improved) as ''new release'' versions. Also, software may get renamed and some inevitably dies. Software may not function as new computer operating systems replace those for which the software was originally developed.

Another general warning is that some software programs contain outdated exposure assessment and risk assessment values—e.g., ''Risk potency values'' for carcinogens or no-observable-effect levels for non-carcinogens—that have been superseded by values from more recent studies and/or from additional review and understanding of the original results. A further complication rarely noted is that software programs may contain default exposure parameter values and/or distributions (e.g., human body weight distributions) for a specific country, such as the United States, which may not be appropriate to use in an exposure or risk assessment for another country or area, or for a particular population being assessed.

That said, following is a brief list of some prominent software.

CAMEO
National Safety Council
Customer Service
PO Box 558
Itasca, IL 60143-0058
Phone: 800-621-7619
Fax: 708-285-1315
E-mail: cameo@nsc.org
Web: http://www.nsc.org/ehc/cameo.htm

CAMEO (Computer-Aided Management of Emergency Operations) was developed by the EPA and NOAA to help emergency managers in government and industry plan for and mitigate chemical accidents and to comply with SARA Title III. CAMEO is a suite of three separate, integrated software applications—Chemical Database and Information Modules, ALOHA (Air Dispersion Model), and MARPLOT (Mapping Application).

Derek
LHASA UK
Customer Services
School of Chemistry
University of Leeds
Leeds, LS2 9JT, UK
Phone: 44-113-233-6565
Fax: 44-113-233-6465
E-mail: lukinfo@mi.leeds.ac.uk
Web: http://www.chem.leeds.ac.uk/chemistry.html

DEREK is an expert system designed to assist chemists and toxicologists in predicting toxicological hazards based on analysis of chemical structure. It provides qualitative rather than quantitative predictions and does not rely on algebraic or statistical relationships.

Envirowin
Envirowin Software, Inc.
P.O. Box 18110
Chicago, IL 60618-0110
Phone: 800-454-0404
Fax: 312-225-8910
E-mail: support@envirowin.com
Web: http://www.envirowin.com

Producer and distributor of environmental and occupational health and safety software (many in CD-ROM formats), including applications of material safety data sheets, regulatory compliance, properties, safety and health monitoring, and training.

Green Suite
LFR Technologies
225 South Cabrillo Highway, Ste. 102-D
Half Moon Bay, CA 94019
Phone: 650-712-7470
Fax: 650-712-7479
Web: http://www.GreeNSuite.com

An integrated health and safety software system based on Internet technologies to integrate for a plant or site product and properties data, incident reporting and tracking, facilities management functions, health and safety data to produce customized reports, data queries, archives, management plans, and other environmental health records.

Safety Officer II
Van Nostrand Reinhold
115 Fifth Avenue
New York, NY 10003
Phone: 800-926-2665
Fax: 212-254-9499
Web: http://www.vnr.com

Converts chemical data into standard safety information for producing MSDS formats, chemical inventories, chemical safety forms, and compliance reports.

Syracuse Research Corporation (SRC)
Environmental Science Center
6225 Running Ridge Rd.
North Syracuse, NY 13212

Phone: 315-452-8000
Web: http://www.syrres.com

SRC has a fine reputation in scholarly research in environmental chemistry, toxicology, and risk assessment. It offers an array of estimation software, such as LogKow, AOP, Henry, KOC, Dermal etc., as well as such online databases as Ozone Depletion and Global Warming Potentials. Atmospheric Oxidation Rate Constants, and Experimental Octanol/Water Partition Coefficients (Log P).

TerraBase
3350 Fairview St., Suite 160
Burlington, ON, L7N 3L5, Canada
Phone: 905-634-4403
Fax: 905-527-0263
E-mail: terrabase@globalserve.net
Web: http://www.globalserve.net/~terrabase/

TerraBase produces the TerraTox Database and the TerraFit Data Analysis and Prediction System. These allow extraction, manipulation, analysis, and graphing of physico-chemical, structural, biological, and toxicological data for comopounds contained in the databases along with the user's own data. Includes TerraBase Selected References Database, with over 4,000 literature references on quantitative structure-activity relationships (QSARs) and related subjects.

TOPKAT
Health Designs, Inc.
183 East Main St.
Rochester, NY 14604
Phone: 716-546-1464
Fax: 716-546-3411
Web: http://ourworld.compuserve.com/homepages/HDi/

TOPKAT is a software-based system that computes and automatically validates assessments of toxic and environmental effects of chemicals from molecular structure. It uses Quantitative Structure Toxicity Relationships (QSTR) models for assessing various measures of toxicity.

Additional software/databases/computerized reference books follow:

ACSL Tox
MGA Software
200 Baker Ave.
Concord, MA 01742
Phone: 800-647-2275
Phone: 508-369-5115
E-mail: sales@mga.com
Web: http://www.pharsight.com/prod_tox.htm

ACSL Tox (trademarked) facilitates the construction of pharmacokinetic (PK) models and pharmacodynamic (PD) models in order to conduct toxicokinetic simulation studies.

ADL Transportation Risk Screening Program (ADLTRS)
Arthur D. Little, Inc.
20 Acorn Park
Cambridge, MA 02140-2390
Phone: 617-498-5476
Fax: 617-498-7161
E-mail: adl.information@adlittle.com
Web: http://www.adlittle.com

Software to facilitate modeling of hazardous and toxic chemicals in air, groundwater, surface waters, soils contingent to spills, or other accidental releases.

Air Force Toxic Chemical Dispersion Model (AFTOX)
EnvironWin Software, Inc.
2032 West Cullom Ave., Suite 1
Chicago, IL 60618-1702
Phone: 800-454-0404
Phone: 773-244-1900
Fax: 773-244-1922
E-mail: info@envirowin.com
Web: http://www.envirowin.com

A data management system for modeling release of air toxics. Related air-toxic databases from this producer include: Chemical Inventory System (CIS), Electronic Air Toxic Methods, eMSDS (electronic MSDS), Instant EPA Air Toxics and Instant EPA IRIS, solvent safety database, and TSCA Chemicals Inventory.

Air Toxic Emission Factor Database
Environmental Software & Systems, Inc.
802 Britany Rd., Suite 485
PO Box 1182
Bowling Green, OH 43402-1182
Phone: 419-353-8540
E-mail: envsoft@wcnet.org
Web: http://www.wcnet.org/~envsoft/envsoft.html

This is general environmental database providing chemical and physical properties data, primarily for risk assessment applications. Other air pollution and toxicology software from Environmental Software & Systems includes: ARCHIE-Chemical Hazard Incident Evaluation, CHEMDAT7, CHEMIX-Chemical Mixtures, Controlling Air Toxics, Emergency Call System, EPA Air Methods Database, FIRE, Food Chain, HAPPRO Hazardous Air Pollutant Program, LEAD-Uptake/Biokinetic Model for Lead, Pollutant Fate in Water, TOXLT-Toxic Modeling System, Long Term, and TOXST-Toxic Modeling System, Short-Term.

Asbestos Awareness CD-ROM
Long Island Productions, Inc.
1432 Kearney St.
El Cerrito, CA 94530
Phone: 800-397-5215
Fax: 510-232-5235
E-mail: lipmail@sirius.com
Web: http://www.lip-online.com

Environmental health and safety training CD-ROM for handling asbestos. Other toxicology-training CD-ROMs include: DOTs Hazardous Materials General Awareness, DOTs Hazardous Materials Safety Training, Emergency Planning, Lead Standard (OSHA Regulations), Right-to-Know Retraining, and Right-to-Know Update.

ARC/INFO, ARC/CAD, ARC/View
Environmental Systems Research Institute, Inc. (ESRI)
380 New York St.
Redlands, CA 92373-8100
Phone: 800-447-9778
Phone: 909-793-2853
Fax: 909-793-5953
E-mail: info@esri.com
Web: http://www.esri.com/

Comprehensive Geographic Information Systems (GIS) software with broad capabilities for toxic and hazardous waste applications in monitoring, modeling, and risk assessment settings.

AUDITProfiles
Environmental Profiles, Inc.
5570 Sterrett Place, Suite 208
Columbia, MD 21044-9948
Phone: 410-964-9900
E-mail: episvc@episervices.com
Web: http://www.episervices.com

A series of environmental and audit profiles for toxic materials and occupational health applications. Series includes a variety of data and information management functions related to OSHA and other site assessment applications.

BIOPLUME
Environmental Systems & Technologies (ES&T)
2608 Sheffield Drive
Balcksburg, VA 24060-8270
Phone: 540-552-0685
Fax: 540-951-5307
E-mail: admin@esnt.com
Web: http://www.esnt.com

Graphics modeling and data management system related to transport of chemicals into groundwater. Other related software by the same producer include: BioTrans, CHEMFLOW, Groundwater Vistas, Hydrocarbon Spill Screening Model, Regulatory and Investigative Treatment Zone Model, and SPILLCAD.

BNA's Environmental and Safety SmartCite
Bureau of National Affairs
Bureau of National Affairs, Inc.
1231 25th St. NW
Washington, DC 20037
Phone: 800-372-1033
Fax: 800-252-0332
Web: http://www.bna.com

Regulatory compliance software for mixed media applications including groundwater, surface waters, and waste water discharges.

Breathericks Reactive Chemical Hazards Database
American Chemical Society
PO Box 57136/West End Station
Washington, DC 20037
Phone: 800-227-5558
Phone: 202-872-4363
Fax: 202-872-6067
E-mail: software@acs.org
Web: http://www.acs.org

Provides numeric data on chemical reactivities for chemicals, many of which are frequently encountered in manufacturing and environmental settings.

BREEZE Software
Trinity Consultants, Inc.
12801 North Central Expressway, Suite 1200
Dallas, TX 75243-1720
Phone: 972-661-8100
Fax: 972-385-9203
E-mail: software@trinityconsultants.com
Web: http://www.trinityconsultants.com

A series of modeling software packages for risk assessment and emergency response activities. Individual BREEZE titles include: HAZ AFTOX, HAZ DEGADIS+, HAZ Hot Spills, HAZ INPUFF, and TRPUF.

CAMHealth Software
CamAxys, Ltd.
8 The Meadow, Meadow Lane
St. Ives Cambridgeshire PE17 4LG U.K.
Phone: +44-1480-497739
Fax: +44-1480-497759
E-mail: enquires@camaxys.ltd.uk
Web: http://www.camaxys.ltd.uk/camaxys

A series of environmental software packages for modeling the behavior of chemicals in the environment. Individual modules include: CAMHealth for COSHH,

CAM Health for Incidents and Accidents, CAMHealth for Materials Safety Data, CAMHealth for the Environment, and CAMHealth for Risk Assessment.

Canadian enviroOSH Legislation
Canadian Centre for Occupational Health and Safety
250 Main St. East
Hamilton, Ontario L8N 1H6 Canada
Phone: 800-668-4284
Fax: 905-572-2206
E-mail: custserv@ccohs.ca
Web: http://www.ccohs.ca

A series of regulatory software packages that include coverage of laws and regulation for hazardous and toxic chemicals for applications in eastern and western Canada, the Province of Ontario, and Canadian National legislation.

Chemical Compounds Databank
DYNACOMP, Inc.
4560 East Lake Rd.
Livonia, NY 14487
Phone: 800-828-6772
Phone: 716-346-9788

Physical and chemical properties data for hazardous and toxic materials; includes calculation features.

CHEMSource
Chempute Software
PO Box 870
Westville 3630, South Africa
Phone: +27-31-705-2494
Fax: +27-31-705-4989
E-mail: sales@chempute.com
Web: http://www.chempute.com

Chemical and physical properties software with applications for MSDS, right-to-know reporting, and label preparation. Other Chempute software includes HSDB and MSDS applications.

(U.S.) Coast Guard PC CHRIS Hazardous Chemical Database
HazMat Control Systems, Inc.
5199 East Pacific Coast Highway, Suite 500
Long Beach, CA 90804-3307
Phone: 562-597-7994
Fax: 562-985-0645
E-mail: hazmat@ix.netcom.com
Web: http://www.hmcs.net

Physical and chemical properties data useful for spills and other environmental incidents and accidental release scenarios, including chemical and physical properties data. 1996 North America Emergency Response Guidebook available separately.

Code of Federal Regulations
Government Institutes
Electronic Publishing Department
4 Research Place, Suite 200
Rockville, MD 20850
Phone: 301-921-2300
Fax: 301-921-0373
E-mail: giinfo@govinst.com
Web: http://www.govinst.com

This series of regulatory databases covers the U.S. Code of Federal Regulations from environmental and occupational settings. Individual CD-ROM titles include the 1996 Title 10 CFR and Title 21 CFR. Other CFR CD-ROM databases include The CFR Chemicals List, Environmental Health and Safety CFRs, and OSHA CFRs Made Easy. Additional regulatory compliance and tracking software includes Environmental Monitoring Methods Index, Environmental Statutes, the Government Institutes Environmental Database, the IRIS CD (Integrated Risk Information System), the OSHA Technical Manual, and the RCRA Hazardous Waste Source Disk.

Code of Federal Regulations, Commerce Business Daily, and the Federal Register
Counterpoint Publishing
84 Sherman St.
PO Box 928
Cambridge, MA 02140
Phone: 800-998-4515
617-547-4515
617-547-9064
E-mail: info@counterpoint.com
Web: http://www.counterpoint.com

Part of the extensive family of environmental safety and health data and information related to regulatory compliance. Provides access to the U.S. Code of Federal Regulations, The Commerce Business Daily, and the Federal Register on CD-ROM and via the Internet. Additional Counterpoint products include CD-ROM and Internet formats of standard toxicology reference sources such as the Environmental Contaminant Reference Databook, Handbook of Environmental Data on Organic Chemicals, Hawleys Condensed Chemical Dictionary, Saxs Dangerous Properties of Industrial Materials, and State Environmental Safety Regulations. Products are also offered as the EH&S Collection on CD-ROM

CompuDrug Software
CompuDrug Chemistry Ltd.
Holland E. Str. 5
Budapest, Hungary
Phone: +361-214-23-06

Fax: +361-214-23-10
E-mail: mktg@cdk-cgx.hu
Web: http://www.datanet.hu/compudrug

A series of computational-based software packages to use physical and chemical properties data for modeling and risk assessment functions. Individual software applications include: EluEx, Hazard Expert, Metab Expert, PALLAS Combi, pKalc, PrologD, PrologP, and Xpred.

Dakota Auditor
Dakota Software Corporation
7 Tobey Village Office Park
Pittsford, NY 14534-1746
Phone: 716-381-8710
Fax: 716-381-1614
E-mail: info@dakotasoft.com
Web: http://www.dakotasoft.com

Formerly Utilicom Based on the expertise of one of the oldest environmental software design companies, Dakota Software has expanded its capabilities into regulatory compliance and environmental auditing software products for PC, Macintosh, and UNIX applications. Comprehensive data management capabilities are provided for mixed media, including air, groundwater, surface waters, hazardous and toxic chemicals, and waste disposal and treatment. This modular system assists in conducting health, safety, and environmental audits, and is on the Audit Master software developed by Utilicom.

Eclipse Software
Eclipse Software, Inc.
2267 East Nine Mile Rd.
Warren, MI 48091
Phone: 800-520-2855
Phone: 810-754-3540
Fax: 810-754-6049
E-mail: info@eclipsesft.com
Web: http://www.eclipsesft.com

A family of environmental software providing data management functions, many with applications for transporting chemicals. Includes Eclipse CEIS (physical and chemical properties/inventory software), Electronic DOT Guide, MSDS and MSDS Maker, and Train+Track.

EDITS—Environmental Data and Information Tracking System
Envirochem Management Systems
310 East Esplanade
North Vancouver, BC V7L 1A4 Canada
Phone: 604-986-0233
Web: http://www.envirochem.com

Software provides coverage of hazardous and toxic materials for occupational and environmental health topics, including physical and chemical properties, MSDS, storage, and disposal functions.

EHS/Life Cycle Software
EIS International Corporation
1401 Rockville Pike, Suite 500
Rockville, MD 20852-1428
Phone: 800-999-5009
Phone: 301-738-6900
Fax: 301-738-1026
E-mail: info@eisint.com
Web: http://www.eisintl.com

Software modules for calculation, modeling, and assessment functions. Toxicology-related titles include: Hazard Assessment InfoBook, Health and Safety InfoBook, Library of Solutions, Regulations InfoBook, and Waste Management InfoBook.

Electric Power Software
Electric Power Software Center
11025 North Torrey Pine Rd., Suite 120
La Jolla, CA 92037
Phone: 800-763-3772
Fax: 619-453-4495
Web: http://epscweb.com

Software packages designed for electric power utilities. Toxicology-related titles have applications beyond the utilities industries and are primarily useful for environmental modeling purposes: Air Emissions Risk Assessment Model (AERAM), Air Toxic Risk Management Model (AIRTOX), Airborne Radionuclide Decision Tree (ARDT), ASK_PCB Economic Risk Management Model, Cluster Analyze in Time and Space (CAST), Soil Chromium Attenuation Evaluation Model (CHROMAT), Contaminated Mineral Oil Economic Risk Management (COIL), Mercury Concentration Model (MCM), Migration of Organic/Inorganic Chemicals (MYGRT), ORGRISK, PCB Fire Exposure Assessment (PCBFIRE), QuickTANKS, Remedial Options Assessment Model (ROAM), Contaminated Site Risk Management (SITES), Site Screening and Priority-Setting System (SSPS), and Transformer/Capacitor Risk Management (TRIM) databases.

Electronic EPA Methods
ChemSW, Inc.
420-F Executive Court North
Fairfiled, CA 94585
Phone: 800-536-0404
Phone: 707-864-0845
Fax: 707-864-2815

E-mail: info@windowchem.com
Web: http://www.chemsw.com

Regulatory-based software for specific EPA test methodologies, useful for a variety of data management applications including monitoring programs, regulatory compliance, and permit tracking. Software includes physical and chemical properties data. Series includes individual software packages for EPA 500 Series Methods, 600 Series Methods, CLP Methods, Metals in Environmental Samples Methods, Pesticide Methods, SW846 Series Methods, and Water and Waste Methods. NIOSH and OSHA methods are also provided, as are several of the Instant EPA software.

ENFLEX Environmental Software
IHS Environmental Information, Inc. (PA)
912 Springdale Drive
Exton, PA 19341-2859
Phone: 800-365-2146
610-594-4400
610-594-4481
E-mail: sales@ihsenv.com
Web: http://www.ihsenv.com

Environmental software for broad toxicology, environmental health, and occupation health applications; includes data management capabilities, MSDS management, and right-to-know information management. In-plant environmental auditing capability is also available. Individual ENFLEX modules include: EarthLaw (regulations) Federal and State Databases (regulations inventories), Military Publications, Register Tracking, and Standards.

Environmental Management System (EMS)
Chemical Safety Corporation
5901 Christie Ave. Suite 208
Emeryville, CA 94608-1932
Phone: 888-594-1100
Fax: 510-594-1000
E-mail: ems@chemicalsafety.com
Web: http://www.chemicalsafety.com

A series of environmental software applications, including the EMS Ad Hoc Management Reports, Chemical Inventory and MSDS Access, Human Resource Management, MSDS Management, Waste Management and Reporting, and Inventory Collection System (ICS)

Environmental Management Desktop
American Management Systems, Inc.
12601 Fair Lakes Circle
Fairfax, VA 22033
Phone: 703-227-6159
Fax: 703-227-6704
Web: http://www.amsinc.com

A comprehensive database management system for general environmental purposes, including hazardous and toxic chemicals.

Environmental Resources Databases
Environmental Resources Center
101 Center Pointe Drive
Cary, NC 27513-5706
Phone: 800-537-2372
Phone: 919-469-1585
Fax: 919-469-4137
E-mail: service@ercweb.com
Web: http://www.ercweb.com

Provides more than 20 databases with applications for data and information related to toxic and hazardous materials. Most have applications for occupational safety and health, including computer-based training and CD-ROM versions of standard reference resources: Environmental Compliance Reference Databook, Handbook of Environmental Data on Organic Chemicals, Hawleys Condensed Chemical Dictionary, Hazardous Materials Handbook, MSDS Chemical Collection, MSDS ExPress, MSDS Products Database, NIOSH IDLH Viewer, NIOSH Quick Guide, North American Emergency Response Guide, OSHA PPE Management System, Saxs Dangerous Properties of Industrial Materials, and State Environmental Regulations Database.

(U.S.) EPA Exposure Models Library
Versar, Inc. ESM Operations
9200 Rumsey Rd.
Columbia, MD 21045-1934
Phone: 410-964-9200
Fax: 410-964-5156
E-mail: westmad@versar.com
Web: http://www.versar.com

Risk assessment modeling software based on EPA exposure data. Related software from Versar includes the EPA Integrated Model Evaluation System, the SARA Compliance System, and the comprehensive Environmental Compliance Management System.

EPA STORET
U.S. Environmental Protection Agency
STORET HOTLINE
401 M St., SW
Washington, DC 20460
Phone: 800-424-9067
E-mail: STORET@epa.gov
Web: http://www.epa.gov/owow/STORET

On Sept. 3, 1998, EPA released its modernized version of the STOrage and RETrieval (STORET) water quality

database system (Phase 1). STORET serves as EPA's principal repository for marine, freshwater, and biological monitoring data. The original STORET was developed in the 1960s and operated for 33 years. Modernization of the system took seven years. Copies of the CD-ROM are available free of charge from EPA. Data stored in STORET will be accessible to the public on the Internet early in 1999 as part of the Phase 2 release.

FastSearch Software
FastSearch Company
PO Box 421057
Minneapolis, MN 55442
Phone: 800-232-4590
612-557-9917
Fax: 800 605-7244

Provides access to the U.S. Code of Federal Regulations, Federal Register, and Material Safety Data Sheets.

Flow Gemini
GRC International, Inc.
1900 Gallows Rd.
Vienna, VA 22182-3865
Phone: 800-934-5917
Phone: 703-506-5166
Fax: 703-760-8747
E-mail: flow-gemini@grci.com
Web: http://www.grci.com

Environmental software for air, groundwater, and surface waters for modeling and monitoring of hazardous chemicals and other toxic materials. Calculations and physical and chemical properties data provide additional capability for right-to-know issues, labels, MSDS preparation, and other reporting functions.

Genium Environmental Software
Genium Publishing Corporation
1 Genium Plaza
Schenectady, NY 12304-4690
Phone: 800-243-6486
Phone: 518-377-8854
Fax: 518-377-1891
E-mail: info@genium.com
Web: http://www.genium.com

Regulatory compliance and reference software including Brethericks Reactive Chemical Hazards (CD-ROM), EPA Methods, Gardners Chemical Synonyms and Trade Names (CD-ROM), MSDS Collection (CD-ROM), Reg-Trieve, and Saxs Dangerous Properties of Industrial Materials and Hawleys Chemical Dictionary.

HazWaste Environmental Databases
HazWaste Technologies Corporation
2995 Center Green Court
Court South Boulder, CO 80301-5412
Phone: 800-492-7832
Phone: 303-440-5664
Fax: 303-440-5731

Chemical inventory software providing comprehensive data management capabilities. Individual software modules include HazInfo-MSDS, HazTrac, HAZ-LABEL/NRMLABEL, HWTSAT, LabTrac, PCBTrac, and SARAlert.

Instant EPA
American Chemical Society
PO Box 57136/West End Station
Washington, DC 20037
Phone: 800-227-5558
Phone: 202-872-4363
Fax: 202-872-6067
E-mail: software@acs.org
Web: http://www.acs.org

A series of databases to facilitate hazardous waste management functions includes Instant EPA's Air Toxics and Instant EPA's Tox-Base. Instant EPA's Pesticide Facts and Instant EPA's Pesticide Methods cover groundwater contamination issues.

Instant EPA
Instant Reference Sources, Inc.
7605 Rockpoint Drive
Austin, TX 78731
Phone: 800-301-0359
512-345-2386

A series of hazardous waste management databases: Instant EPA's Air Toxics, Instant EPA's IRIS, Instant EPA's Pesticide Facts, Instant EPA's Pesticides Methods, and Instant EPA's Tox-Base.

International Toxicity Estimates for Risk (Toxicology Excellence for Risk Assessment and Concurrent Technologies Corporation)
Toxicology Excellence for Risk Assessment
4303 Hamilton Ave.
Cincinnati, OH 45223
Phone: 513-542-RISK (7475)
Web: http://www.tera.org/iter/

Toxicology Excellence for Risk Assessment (TERA) and Concurrent Technologies Corporation (CTC) expanded the International Toxicity Estimates for Risk (ITER) database in September 1998. The database, found on the Internet at http://www.tera.org/iter, is the only online source of compiled risk values that

provides side-by-side comparisons of risk values from federal and international agencies, as well as those developed by independent parties. It provides access to the scientific justification for each agency's values, and an explanation of how the values were derived and for any differences among values from the different sources.

Keller-Soft
J.J. Keller & Associates, Inc.
3003 West Breezewood Lane
PO Box 368
NeeNah WI 54957-0368
Phone: 800-327-8686
Phone: 414-722-2848
Fax: 414-727-7516
E-mail: sales@jjkeller.com
Web: http://www.jjkeller.com/toc.htm

Toxic and hazardous materials data management software providing regulatory information, reporting, and training functions. Individual software packages include Audit Plan Customizer, Chemical REG-A-DEX, Compliance Information Manager, DOT Hazmat Compliance, DOT safety, OSHA Workplace Safety, and Safety Plan Customizer.

Khem Software
Khem Products, Inc.
1217 Bush Rd.
PO Box 161
Abingdon, MD 21009
Phone: 410-679-6620
Fax: 410-679-6625
E-mail: info.@khem.com
Web: http://www.khem.com/khem/home.html

Data and information management software for monitoring (some with GIS capability) and reporting functions. Khem titles include individual programs for Labels, Regulatory Compliance/Waste Tracking, Report [preparations], Safety, Search, and Waste.

Lead Safety Awareness Training (LSATS)
EnviroWin Software, Inc.
2032 West Cullom Ave, Suite 1
Chicago, IL 60618-1702
Phone: 800-454-0404
Phone: 773-244-1900
Fax: 773-244-1922
E-mail: info@envirowin.com
Web: http://www.envirowin.com

Regulatory compliance and environmental health training software related to environmental lead exposures.

Material Inventory Report System (MIRS)
AV Systems, Inc.
4657 Platt Rd.
Ann Arbor, MI 48108-9726
Phone: 313-973-3000
Fax: 313-677-4480
E-mail: avsys@mich.com
Web: http://www.mich.com/~avsys/mirs.htm

A series of computer modules for data management of hazardous and toxic materials, including individual modules for Form R, MSDS, NODES, and other permit and regulatory compliance activities.

MCASE, META, and **ToxAlert**
MULTICASE, Inc.
22 Hyde Park
PO Box 22517
Beachwood, OH 44122
Phone: 216-831-5758
Fax: 216-831-5759
E-mail: gxk6@ho.cwru.edu

Software packages that predict behavior of organic compounds. Applications include carcinogenicity, reproductive toxicology, biodegradability, aquatic toxicity, contact dermatitis, sensory irritation, etc.

MIRS-Material Inventory Report System
AV Systems
4657 Platt Rd.
Ann Arbor, MI 48108-9726
Phone: 734-973-3000
E-mail: mirs@mirsinfo.com
Web: http://www.mirsinfo.com

A series of software modules, including those covering various aspects of chemical inventory applications related to SARA, air toxics, and MSDSs.

OncoLogic
LogiChem, Inc.
PO Box 357
Boyertown, PA 19512
Phone: 610-367-1636
E-mail: webinfo@logichem.com

Chemical screening and risk assessment for evaluation of carcinogenic potential of chemicals. Developed in cooperation with the U.S. EPA.

QuickReg
Radiation Safety Associates, Inc.
19 Pendelton Drive
PO Box 107
Hebron, CT 06248
Phone: 860-228-0824
Fax: 860-228-4402

Regulation-based software packages for COSHA, HAZMAT, NRC, OSHA, RCM, RCRA, SARA, and Water. Other radioactive waste data management and facility operation software is also provided.

RAD and Quick REGS
Radiation Safety Associates
19 Pendleton Drive
PO Box 107
Hebron, CT 06248
Phone: 860-228-0824

Compliance-oriented software for radioactive wastes and materials as described by various federal (U.S. and Canadian) statutes (e.g., COSHA, NRC, RCRA, SARA) and applications (e.g., leaks and spills, storage, and awareness).

RegScan
RegScan, Inc.
1 Executive Plaza, Suite 300
330 Pine St.
Williamsport, PA 17701
Phone: 800-734-7226
Phone: 717-323-1010
Fax: 717-323-8082
E-mail: info@regscan.com
Web: http://www.regscan.com

A series of regulatory software packages with applications specified for risk assessments, auditing and facility operations, right-to-know issues, and permit tracking. Specific RegScan titles include Linkit!, All 50 States Suite, Environmental Suite, Food and Drug Suite, Federal Register, Safety Suite, and Transportation Suite.

RiskAbate
Engineering Management Services, Inc.
4650 Shawnee Place
Boulder, CO 80303-3816
Phone: 303-494-8009
Fax: 303-494-3515
E-mail: gillandj@stripe.colorado.edu

Software package providing calculation and modeling applications for hazardous and toxic chemicals in occupational health and safety settings.

RISK* ASSISTANT
PO Box 1327
Alexandria, VA 22313-1327
Phone: 703-684-5203
Fax: 703-684-7704
Web: http://www.thistlepublishing.com

This software estimates exposure and human health risks based on current toxicity data, standards, and nomenclature. Supported by U.S. EPA, California EPA, and others.

SAFER
DuPont Safer Systems, Inc.
4165 East Thousand Oaks Blvd., Suite 350
Westlake Village, CA 91362
Phone: 800-621-7237
Phone: 805-446-2450
Fax: 805-446-2470

A series of data and information management software application programs for modeling and risk assessment applications: SAFERPLAN Process Hazards Analysis, SAFER Analysis Tools, SAFER Chemical Release Modeling Software, and the SAFER Real-Time System.

SARA!
Achieve! Technology, Inc.
PO Box 668
Amherst, NH 03031-0668
Phone: 800-477-3427
Phone: 603-595-1414
Fax: 603-595-0088
E-mail: achieve@achieve-tech.com
Web: http://www.mv.com/biz/achieve-tech/

Provides capabilities for data and information features related to hazardous waste management for Superfund, as stipulated by SARA requirements.

SiteManager
ConSolve, Inc.
297 Boston Post Rd., Suite 203
Wayland, MA 01778
Phone: 800-428-5547
Fax: 508-358-8065
E-mail: marketing@conslove.com
Web: http://www.consolve.com

Software to provide data and information related to hazardous-waste site monitoring activities. SiteView is a more comprehensive software package that includes computational capabilities related to physical and chemical properties and other features to model the behavior of chemicals in the environment.

SmartTOX
Pioneer Systems Development
12902 NE 91st Lane
Kirkland, WA 98033-5967
Phone: 206-822-4461
Fax: 206-822-4237
E-mail: pioneer@halcyon.com

Physical and chemical properties software with mixed-media (air, groundwater, surface waters) applications

for modeling, risk assessment, site assessment, and pollution prevention programs. Related software includes SmartRISK, Smart STAT, and SmartClean.

SOLV-DB
Syracuse Research Corporation
Chemical Hazard Assessment Division
Environmental Sciences Center
1 Merrill Lane
Syracuse, NY 13210-4080
Phone: 315-426-3200
Fax: 315-426-3429
E-mail: phoward@syrres.com
Web: http://www.esc.com

Physical and chemical properties of solvents commonly used in manufacturing and other industrial settings. Includes calculations capabilities.

Super CHEMS
Arthur D. Little, Inc.
20 Acorn Park
Cambridge, MA 02140-2390
Phone: 617-498-5476
Fax: 617-498-7161
E-mail: adl.information@adlittle.com
Web: http://www.adlittle.com

Calculation-based software for modeling and graphics output based on chemical and physical properties of hazardous chemical and other toxic materials.

THERdbASE (Total Human Exposure Risk Database and Advanced Simulation Environment)
Environmental Protection Agency
E-mail: THERdbASE@epamail.epa.gov
Web: http://www.epa.gov/nerlpage/heasd/therdhome.htm
http://www.therd.com

THERdbASE software assists the user in accessing data related to human exposure and in running computer models for estimating human exposure to environmental pollutants. Developed with support from the Human Exposure Research Branch of the Human Exposure and Atmospheric Sciences Division of the EPA's National Exposure Research Laboratory.

TOXCHEM and TOXCHEM+
Enviromega Ltd.
7 Innovation Drive
Hamilton, Ontario L9J 1K3 Canada
Phone: 905-689-4410
Fax: 905-689-7040

Physical and chemical properties data provided for modeling, pollution prevention, and risk assessment applications.

U.S. EPA SOFTWARE WITH APPLICATIONS FOR HAZARDOUS AND TOXIC MATERIALS

AQMG
U.S. Environmental Protection Agency
Office of Air Quality and Pollution Standards
AQMG (MD-14)
Research Triangle Park, NC 27711
Phone: 919-541-0518
Fax: 919-541-0044
Web: http://ttnwww.rtpnc.epa.gov
http://www.epa.gov/scram001

Software packages: DEGADIS (modeling), INTOXX (modeling), and TSCREEN (modeling).

CEAM
U.S. Environmental Protection Agency
Center for Exposure Assessment Modeling
National Exposure Research Laboratory-Ecosystem Research
960 College Station Rd.
Athens, GA 30605-2700
Phone: 706-355-8328
ftp://ftp.epa.gov/epa_ceam/wwwhtml/ceamhome.htm

CEAM Information System includes CORMIX (Cornell Mixing Zone Model), EXAMSII (Exposure Analysis Modeling System), FGET (Food/Gill Exchange of Toxic Substances), PATRIOT (Pesticide Assessment Tool-Transport), PRAM (Pesticide Root Zone Model), and WASP5/TOXI5/EUTRO5

CERI
U.S. Environmental Protection Agency
Center for Environmental Research Information
26 Martin Luther King Drive
Cincinnati, OH 45268
Phone: 513-569-7562
Fax: 513-569-7566

CERI includes BFSS (Bioremediation in the Field Search System) and RREL TDB (RREL Treatability Data Base).

CTC
U.S. Environmental Protection Agency
Control Technology Center (MD-12)
Research Triangle Park, NC 27711
Phone: 919-541-0800
Fax: 919-541-0242
Web: http://www.epa.gov/oar_ctc.html

Software includes HAP-PRO (Hazardous Air Pollutant Pogrom), SAGE (Solvent Alternatives Guide), and the Surface Impoundment Modeling System

DATABASES AND SOFTWARE AFTERWORD

Among the very few large-scale compendia of databases is the annual ''**Gale Directory of Databases**'' Gale Research, Detroit MI. ''Volume 1: Online Databases;'' ''Volume 2: CD-ROM, Diskette, Magnetic Tape, Handheld, and Batch Access Database Products'') with useful indexes by subject, vendor, and producer. Another potentially useful publication is **''World Databases in Biosciences and Pharmacology,''** edited by C.J. Armstrong and R.R. Fenton (Bowker-Saur, London, 1996). Among the handful of scientific journals that contain sections regularly devoted to announcements, listings, and reviews of software and databases in toxicology are the following.

Risk Analysis (Plenum Publishing, New York). This journal contains risk assessments performed using software and databases, regularly published reviews of software and, occasionally, listings and summaries of software and databases

Toxicology (Elsevier, Amsterdam). This journal's ''Toxicology Information and Resources'' section is devoted to advances in the handling and management of toxicological and environmental data, with an emphasis on computerized methods. Recent articles focused on the **Canadian Centre for Occupational Health and Safety** and **Toxicology Abstracts**.

Ashok Kumar and associates from the Department of Civil Engineering at the University of Toledo have spent nearly two decades in reviewing environmental software (and more recently Internet and other electronic data and information resources) in the featured ''Software Review'' articles in the quarterly journal ***Environmental Progress.*** Although the primary focus of these reviews is a more broadly defined environmental engineering and pollution prevention audience, many of the resources reviewed are directly related to the interests of toxicologists and environmental health professionals.

Chemical Engineering Progress (''Web Sights'') and ***Chemical Engineering*** (computer technologies and software reviews in the ''Information Technology'' section) reflect the attention to electronic information resources of the engineering profession and the cross-disciplinary data and information management needs of the scientific and technical communities in research, policy, and management settings. ***Chemical Engineering Progress*** also publishes an annual supplement as a comprehensive review of environmental software.

The American Chemical Society's journal ***Chemical Health and Safety*** provides occasional research articles on electronic resources related to computer simulations, modeling, and data and information management functions. ''CH&S Netways'' is a featured column devoted to specific topics of health and safety aspects of chemicals in the workplace and ambient environment.

Environmental Modeling and Software **(with Environment Data News)** is a journal published by Elsevier Science that publishes research articles, review papers, and short communications on recent advances in environmental modeling and software. All aspects of environmental science and policy are reviewed, including titles related to toxicology and environmental and occupational health.

Elizabeth Donley began publishing the **''Environmental Software Directory''** in 1988 (updated in 1993) followed by the serial *Environmental Software Report* in the same year. These publications have been followed by a series of additional environmental software reports published by Donley Technology (PO Box 152, Colonial Beach, VA 22443, 800-224-9427, http://www.donleytech.com): **''MSDS Software Report''** (1993); **''Environmental Code Book Software Report''** (1994), **''Environmental Management Information Systems Report''** (1995); **''Air Quality Data Management Software Report''** (1995); **''Waste Management Software Report''** (1996); **''Environmental Cost Estimating Software Report''** (1996), and **''Environmental Compliance Auditing Software''** (1997).

Pollution Engineering, one of the first trade publications to provide an annual review of environmental software (appearing in the January issue), continues to review environmental software, including many sources devoted wholly or in part to toxicology, environmental health, and occupational safety and health.

EM, the environmental manager magazine published by the Air and Waste Management Association, continues to provide the most comprehensive environmental software review. Last published in the October 1998 issue of *EM,* the ''1998 Guide to Environmental Software'' provided tabular overviews of more than 1,600 software products from 450 vendors (the article does not include information on more than 1,000 additional software products from an additional 450 vendors). For additional information related to the ''Environmental Software Resource Guide'' contact the Environmental Software Cooperative at 105 South Oak St., Ventura, CA 93001-2703; 805-642-4020; Email: info@envirosw.com.

The Directory of Health and Safety Software (Canadian Centre for Occupational Health and Safety) is a buyer's

guide for software in the areas of occupational and environmental health and medicine and for emergency response and planning activities.

Tom Parris (Harvard College Library, Harvard University) began a column, ''Enviro Bytes,'' in the Heldref journal ***Environment***. Though not specifically addressing toxicology-related topics in each installment, these overviews cover a broad spectrum of environmental issues that may be of a more general interest to toxicologist and environmental health specialists.

Environmental Protection (Stevens Publishing Co.) provided a tabular inventory of environmental software in its April 1999 issue.

The American Chemical Society's journal ***Environmental Science and Technology*** (*ES&T*) provides annotated lists of Web sites environmental software products related to the broad aspects of environmental science, engineering, and regulations.

JAMA: Journal of the American Medical Association (Journal of the American Medical Association, Chicago, IL). This journal contains regularly published reviews of software useful to physicians and others. It also has contained articles on how databases such as the National Library of Medicine's MEDLINE can best be used.

Among the journals devoted to computer topics, a few likely to present articles on databases and software are ***Database, Online, Online Access, and Online & CD ROM Review.*** Also of possible interest to readers is the free ***Software for Science*** catalog (Scitech International Inc., 2331 N. Clybourn Ave., Chicago, IL 60614-3011; 1-800-822-3345).

Users are also advised to consult Chapter 11, ''Toxicology Data and Information Management,'' for a list of relevant publications, most of which deal with computerized resources.

The **National Technical Information Service** (NTIS) provides one of the most comprehensive inventories of environmental software developed by, for, or under contract to U.S. (and some non-U.S.) research agencies. Consult http://www.fedworld.gov/ntis.

Another source for finding out about software and databases is professional society meetings.

Society of Toxicology
Annual meetings of this society include presentations of software programs and the use of the Internet.

International Congress of Toxicology
(http://www.toxicology.org/iutox) These triennial meetings have also featured presentations of software programs and the use of the Internet.

Society for Risk Analysis
This society has had ''Riskware'' exhibitions of software and databases as part of its annual meeting since 1991, which were actually begun as an activity of its Ohio chapter in 1990. Thus far, one review describing Riskware software and databases has been published (Marnicio et al., 1991), with more possible. Contact the Society, listed in Chapter 15, ''Organizations,'' for details about becoming a software and/or database exhibitor.

RiskWorld New Software
(http://www.riskworld.com/software/sw5sw001.htm) - Part of Risk World is described under ''Web Sites.'' Its New Software section offers descriptions of recently released software for risk analysis and associated applications, including contact and ordering information.

The world of bibliographic databases (i.e., databases containing references to literature) has changed radically over the past several years. Web access means not only using the Web to get to the information, but utilizing the many advanced features of the Web to improve and enhance access. Systems are beginning to offer links to the full text of articles. The National Library of Medicine (http://www.nlm.nih.gov) has made great strides in this effort with its PubMed system; and the American Chemical Society recently announced a new online Web service, Chemport (http://www.chemport.org), which also links to the full text of many scientific journals.

Much of the terminology used in this chapter—as in other sources discussing our electronic/computerized/digitized world—is arbitrary or, at best, inconsistent. The term *database* itself, as alluded to earlier, is hard to pin down. Saying that a database is an organized set of data paves the way for more questions. Does form matter? Must a database be electronic? Can a book be a database? What if it is not even technical, but a novel? Does putting it on a searchable CD-ROM then make it a database? Is a collection of information available online the same database if it also appears in identical CD-ROM form? Does a search engine form a part of a database, or is it essentially a separate entity? Is the World Wide Web just one big database? How do we differentiate a database from a databank from a file? As this is meant to be a practical book, we may be better off, ironically perhaps, not pondering these esoteric questions, and just using the terms fairly loosely, as we have all along. At least we know a rose is a rose, or something like it.

CHAPTER

7

Print Bibliographic Resources

LINDA MILLER POORE

"When you come to a patient's house you should ask him what sort of pains he has, what caused them, how many days he has been ill, whether the bowels are working and what sort of food he eats.'' So says Hippocrates in his work Affections. *I may venture to add one more question: What occupation does he follow?*

(Bernardino Ramazzini, *Diseases of Workers*)

The exciting promises of digital information tend to overshadow traditional paper sources for locating toxicology information. Yet in this transitional period, the reliability of bound books (''print'') still has a role in providing information to the researcher. After all, this mature (500+ years) information technology is stable, portable, and unlike a networked computer, can be utilized at a library reading table next to a window during the day when the electricity goes out!

Actually, online databases started as a by-product of trying to find more efficient and economical means of producing books and journals. Soon, it was realized that ease of manipulating bibliographic information electronically enabled the creation of new and improved indexing products, such as the citation index. Computerization has also shortened the production lag time between publication of the source document and its appearance in the traditional paper current-awareness, indexing, and abstracting literature that is covered in this chapter. The explosive growth of the Internet drives more and more publishers to create Web sites to provide access to their databases and to offer current-awareness services that also serve to highlight their products. This selective list features some of the more prominent titles from the diminishing number of paper products still finding their way onto traditional library shelves.

ATLA: Alternatives To Laboratory Animals
Publication type: Current awareness
Publisher: Fund for the Replacement of Animals in Medical Experiments
ISSN: 0261-1929
Frequency: 6 times per annum

European-based advocacy publication that includes editorials, news items, articles, conference reports, and toxicology book reviews.

Bibliography of Agriculture
Publication type: Index
Publisher: Oryx Press
ISSN: 0006-1530
Frequency: Monthly

Produced from data supplied by the National Agriculture Library. Useful for information on pesticides and herbicides, and other topics related to the food supply.

Biological Abstracts and ***Biological Abstracts/RRM***
Publication type: Abstracts
Publisher: BIOSIS (www.biosis.org)
ISSN: BA/RRM 0192-6985
Frequency: Semi-annual cumulative index

''Biological Abstracts'' focuses on the journal literature; ''Biological Abstracts/RRM'' covers reports, reviews, and meetings. Subject index based on keywords contained in authors' supplied title or added by BIOSIS.

Chemical Abstracts
Publication type: Indexes, abstracts
Publisher: Chemical Abstracts Service
ISSN: 0009-2258
Frequency: Two volumes per year

Subscriptions are available for either abstracts or indexes or both. There are three subject indexes: *Chemical Substance Index* (''specific substances identified and ordered by name''); *General Subject Index* (''classes of substances and general subjects''); and a *Formula Index* (''specific substances identified and ordered by molecular formula''). There are also an *Author Index* and a *Patent Index.* The most recent cumulative index covers 1992–1996.

Chemical Abstracts Service also publishes ''CA Selects/CA Selects Plus,'' including the following toxicology-related titles in the series:

''Air Pollution (Books and Reviews)'' (02B)
''Carcinogens, Mutagens, and Teratogens'' (070)
''Chemical Hazards Health, and Safety'' (023)
''Drug and Cosmetic Toxicity'' (090)
''Environmental Pollution'' (045)
''Food Toxicity'' (094)
''Forensic Chemistry'' (016)
''Fungicides'' (047)
''Herbicides'' (049)
''Indoor Air Pollution'' (07T)
''Insecticides'' (050)
''Molecular Modeling'' (08Z)
''Occupational Exposure and Hazards'' (07Y)
''Novel Pesticides and Herbicides'' (05N)
''Pesticide Analysis'' (08A)
''Pollution Monitoring'' (055)
''Structure-Activity Relationships'' (04S)

Chemical Hazards in Industry
Publication type: Current awareness abstracts
Publisher: Royal Society of Chemistry, United Kingdom
ISSN: 0265-5721
Frequency: Monthly

Available digitally online and CD-ROM as one-third of the basis of the Chemical Safety NewsBase (CSNB).

Chemical Titles
Publication type: Current awareness concordance
Publisher: The American Chemical Society
ISSN: 0009-2711
Frequency: Biweekly

Entries are arranged as table of contents but with author and keyword indexing. Keywords are words or fragments of words selected from article titles.

CLIN-ALERT
Publication type: Current awareness
Publisher: Technomic Publishing Co. Inc.
ISSN: 0069-4770
Frequency: Semi-monthly

''Information provided through CLIN-ALERT is intended to acquaint the physician and pharmacist with published data relevant to exceptional situations encountered in the use of modern therapeutic agents and procedures. The notations are for reference and general information.''

Counterpoise
Publication type: Abstracts, indexes
Publisher: Alternatives in Print Task Force (http://www.LibLib.com/Cpoise/Cpoise.html
ISSN: 1092-0714
Frequency: Quarterly

This indexing and abstracting service was initiated in 1997 as a publication of the Alternatives in Print Task Force, a component of the American Library Associations Social Responsibilities Round Table. Counterpoise provides a forum for the review, analysis, and identification of the grey literature and nontraditional forms of literature produced by small and alternative press publishers and independent producers of printed resources. Major subject areas include ecology and health. It is an excellent resource for locating nontraditional types of information and resources (e.g., booklets, pamphlets, white papers) and for information produced outside of the major publishers. The July 1998 issue (vol. 2, no. 3) is a special issue on the environment.

Current Contents: Clinical Medicine
Publication type: Current awareness
Publisher: ISI; Institute for Scientific Information (http://www.isinet.com)
ISSN: 0891-3358
Frequency: Weekly

Table of contents service that provides access through a title word index, an author index which includes author's address information, plus a publisher's address directory. Disciplines covered of particular interest: pharmacology/toxicology and environmental medicine & public health. Document delivery service available.

Current Contents: Life Sciences
Publication type: Current awareness
Publisher: ISI: Institute for Scientific Information (http://www.isinet.com)
ISSN: 0011-3409
Frequency: Weekly

Table of contents service that provides access through a title word index, an author index which includes author's address information, plus a publisher's address directory. Disciplines covered of particular interest: Multi-disciplinary, animal and plant science, and pharmacology & toxicology. Document delivery service avilable.

Environment Abstracts
Publication type: Abstracts
Publisher: CIS–Congressional Information Service Inc.
ISSN: 0093-3287
Frequency: Monthly

Covers all aspects of environmental science, including a Toxicology & Environmental Safety section. Available on CD-ROM. CIS also publishes the companion microfiche collection ''Envirofiche,'' which provides the fulltext of most articles and papers indexed. Documents on demand service also available. Besides journals, ''Environment Abstracts'' also indexes reports produced by universities, associations, corporations, and governments, as well as providing coverage of books, book chapters, and conference proceedings.

EPA Publications Bibliography, Quarterly Abstract Bulletin
Publication type: Abstracts
Publisher: U.S. Environmental Protection Agency (http://www.epa.gov) National Technical Information Service (NTIS) (http://www.ntis.gov)
ISSN: N/A
Frequency: Quarterly

The first three quarterly issues contain an indexed listing of all EPA technical reports and journal articles added to the NTIS collection during the preceding quarter. The fourth issue includes the cumulated indexes for the entire calendar year. Note that this is not a complete guide to all EPA publications.

Excerpta Medica Abstract Journals
Publication type: Current awareness abstracts
Publisher: Elsevier Science
ISSN: Various
Frequency: Varies by title

Published in sections, provides coverage of international literature. Some sections of particular interest: Section 4: Microbiology; Section 17: Public Health, Social Medicine and Epidemiology; Section 35: Occupational Health and Industrial Medicine (12 issues per year, ISSN: 0014-4398); Section 38: Adverse Reactions Titles; and Section 46: Environmental Health and Pollution Control (12 issues per year, ISSN: 0300-5194). Section 52: Toxicology (20 issues per year, ISSN: 0167-8353) includes pharmaceutical, occupational, predictive, and regulatory toxicology; information on laboratory methods and techniques; toxins and venoms; chemical teratogens, mutagens, and carcinogens; and toxicology of waste materials, food and food additives, cosmetics, and other consumer products. EMDOCS document delivery service offers full-text via mail, courier, fax, and Internet FTP.

Genetics Abstracts
Publication type: Abstracts
Publisher: Cambridge Scientific Abstracts
ISSN: 0016-674X
Frequency: Monthly.

Print subscription rate includes Internet access to the corresponding electronic file containing the current-year records and one year of back records.

Covers all aspects of genetics, including a section on chemical mutagenesis.

Health and Safety Science Abstracts
Publication type: Abstracts, indexes
Publisher: Cambridge Scientific Abstracts in association with the Institute of Safety and Systems Management of the University of Southern California
ISSN: 0892-9351
Frequency: ''Monthly in Feb., May, Aug., Nov., and Dec.'' Print subscription rate includes Internet access to the corresponding electronic file containing the current-year records and one year of back records.

Author and subject index. Abstracts grouped by general safety areas: ''Industrial and Occupational Safety'' has subcategories by industry types; ''Environmental and Ecological Safety'' includes pollution and pesticides categories; and ''Medical Safety'' has a section on environmental medicine.

Index Medicus, Abridged Index Medicus
Publication type: Index
Publisher: National Library of Medicine
ISSN: 0019-3879; Abridged: 0001-3331
Frequency: Monthly, nonabridged version cumulated annually

The core indexes for the medical profession. The print versions are created from the National Library of Medicine's MEDLARS databases. The abridged version is targeted to the practitioner and can function as a current awareness tool. Subject headings use NLM's controlled vocabulary called Medical Subject Headings, or MeSH® terms. Good introductory material. Note that the original ''Index-Catalogue of the Library of the Surgeon-General's Office, United States Army 1880,'' from which ''Index Medicus'' derives, was reprinted in 1972 by Johnson Reprint Corporation.

ISBC: Index to Scientific Book Contents
Publication type: Index
Publisher: ISI: Institute for Scientific Information
ISSN: 0884-8440
Frequency: Quarterly, cumulated annually

Indexes books down to the chapter level, making it a useful tool for locating the valuable information contained in multi-authored scientific monographs or monographic serial publications. ISBC indexes approximately 35,000 chapters from some 2,300 books, in five different ways: category (toxicology, etc.); contents of books; author/editor; subject; and corporate, which allows locating authors affiliated with particular organizations.

ISR: Index to Scientific Reviews
Publication type: Index, current awareness
Publisher: Institute for Scientific Information
ISSN: 0360-0661
Frequency: Semi-annual

Available only in print, the ISR is an excellent way to identify review articles that can be invaluable in getting a handle on a subject new to the researcher or to get an overview of the current status of a field. ISI manipulates their ''Science Citation Index'' files to identify the core literature of a field, supplementing the computer's algorithms with further intellectual analysis by information specialists. The result is access to reviews by source index, corporate index, subject index, and their unique research front specialty index (''a search by research front specialty is a citation search on the core literature of the specialty''). Source publications are also listed by arrangements by subject category, by country of origin, by title, and by publisher. A publisher address directory is included.

Industrial Hygiene Digest
Publication type: Abstracts, current awareness
Publisher: Information Health Foundation, Inc.
ISSN: 0019-8382
Frequency: Monthly

Abstracts literature in the fields of occupational health and safety and industrial hygiene. It also covers environmental issues and applicable regulatory information, including proposed and final rules. Reviews of books and pamphlets, and some news items.

International Pharmaceutical Abstracts
Publication type: Abstracts, current awareness
Publisher: American Society of Health-System Pharmacists
ISSN: 0020-8264
Frequency: 24 issues per year, author/subject indexes cumulated semi-annually

Sections of interest: adverse drug reactions, environmental toxicity, legislation, laws and regulations, microbiology (''effect of environmental conditions on micro-organisms''), and toxicity (''toxicology, poisoning, lethal dose studies of a drug or chemical''). Abstract citations include study and reprint addresses. An ''IPA Thesaurus and Frequency List'' publication is available that includes terms, synonyms, and cross-references, as well as information about term frequency and usage.

Neurosciences Abstracts
Publication type: Abstracts
Publisher: Cambridge Scientific Abstracts
ISSN: 0141-7711
Frequency: Monthly. Print subscription rate includes Internet access to the corresponding electronic file containing the current-year records and one year of back records.

Neurotoxicology and teratology section is broken down into general, invertebrates, non-mammalian vertebrates, mammals (except primates), and primates. Also provides book reviews and conference proceedings.

Oncogenes and Growth Factors Abstracts
Publication type: Abstracts
Publisher: Cambridge Scientific Abstracts
ISSN: 1043-8963
Frequency: Quarterly. Print subscription rate includes Internet access to the corresponding electronic file containing the current-year records and five years of back records.

''Covering worldwide research into the molecular basis of malignant transformation.'' Arranged by subject, each issue includes approximately 500 abstracts, along with book reviews, proceedings, and author and subject indexes.

Pollution Abstracts
Publication type: Abstracts
Publisher: Cambridge Scientific Abstracts
ISSN: 0032-3624
Frequency: Eleven issues plus a separate annual index volume. Print subscription rate includes Internet access to the corresponding electronic file containing the current-year records and one year of back records.

Abstracts are generally grouped by type of pollution, but also includes a toxicology and health section and an environmental action section that includes policy issues.

SCI: Science Citation Index
Publication type: Indexes

Publisher: ISI: Institute for Scientific Information
ISSN: 0036-827X
Frequency: Bi-monthly with an annual cumulation

A complex information tool to learn to use (read the good introductory material on usage), but invaluable for its depth and breadth of coverage of the scientific literature. Comprised of four parts: the *Source Index*, the *Corporate Index*, the *Permuterm® Subject Index*, and the unique *Citation Index*. The *Citation Index* allows one to trace scholarship backward and forward in time by using the references an author uses, or conversely, tracking who is referencing a particular author. Particularly valuable as a starting point for bibliographic citation verification of older (pre-1960s) research; even though full bibliographic information may not be available, one can often find at least a reference (author, date, source) with patient, systematic use of these volumes.

Toxicology Abstracts
Publication type: Abstracts
Publisher: Cambridge Scientific Abstracts
ISSN: 0140-5365
Frequency: Monthly. Print subscription rate includes Internet access to the corresponding electronic file containing the current-year records and one year of back records.

Each issue contains approximately 800 abstracts along with author and subject indexes. Major subject sections: pharmaceuticals; food, additives, and contaminants: agrochemicals; cosmetics, toiletries, and household products; industrial chemicals; metals; toxins and other natural substances; social poisons and drug abuse; polycyclic hydrocarbons; nitrosamines and related compounds; radiation and radioactive materials; methodology; legislation and recommended standards; reviews; books; and proceedings. The sections on pharmaceuticals, agrochemicals, industrial chemicals, and metals are further broken down into acute exposure, chronic exposure, metabolism, pathology, biochemistry, and environmental impact.

This Page Intentionally Left Blank

CHAPTER

8

Technical Reports and Government Documents

FREDERICK W. STOSS

No one should drink beer with henbane seeds except those who have forfeited their lives, because doing so results in frenzy of the brain, loss of reason, and sometimes sudden death. (Joacobus Theodorus Tabernaemontanus, *Kraeuterbuch*, 1664)

Technical reports are an accepted source of primary information that reflect the results of comprehensive research and development efforts. The technical report is typically associated with research conducted for a group sponsoring or funding a specific research and development effort. In many instances, the technical report is considered in several forms—draft, interim, and final—as a deliverable or measure of progress for a specific project or directive.

Technical reports have held a distinct advantage over other scientific literature because of their rapid publication and dissemination. The technical report serves as the vehicle for the first disclosure and archive of research results (especially in interim or periodic progress reports of large-scale research projects) and as the source for a more lasting body of journal literature. A recent trend has been the republication of government agency technical reports (i.e., those in the public domain) by for-profit publishing companies. This republication can be as books or, electronically, as CD-ROMs and World Wide Web documents. Also, government agencies themselves have been making full-text versions of their technical reports available on the World Wide Web. This trend will certainly assist in making state agency reports available to larger audiences in the future.

FEDERAL GOVERNMENT TECHNICAL REPORTS

The history of technical reports as a distinct body of scientific literature dates to the beginning of the twentieth century. In the United States, the earliest technical reports are attributable to the ''Professional Papers of the United States Geological Survey'' (1902) and the ''Technologic Papers of the National Bureau of Standards'' (1910). The ''Reports and Memoranda Series of the Advisory Committee for Aeronautics'' (1909) are among the earliest technical report series in the U.K. Documents that preceded the technical report are represented in various agency or bureau bulletins, which are terse descriptive documents on specific topics.

Much of the technical report literature is produced as a result of research and development activities sponsored by government agencies. The uneven quality of this literature has been a major issue in its bibliographic and scientific control and in part reflects the diverse nature of its contents. The preparation and submission of a report is facilitated through contractual arrangements between the project officer (representing the supporting or funding entity) and the principal investigator (senior representative from the performing organization).

World War II and the post-War era sparked a dramatic growth in government-sponsored research and development, paralleled by an increase in the technical report literature. The information from the war effort was managed by the Office of Scientific Research and Development (OSRD), which was created in 1941. OSRD required government-supported university and corporate research laboratories and facilities to submit progress reports to their respective sponsoring agencies. OSRD was eliminated at the close of the war, and a Cabinet-level committee, the Publications Board (PB), was established in 1945. Its first task was to declassify and release vast amounts of scientific and technical information (eventually from all sides of the conflict) generated during the war. PB numbers (still used by the National Technical Information Service for accession purposes) were assigned to reports. Also, a weekly ''Bibliography of Scientific and Industrial Reports,'' which evolved to the current ''Government Reports and Announcements Index'' (GRAI), began publication.

The Office of Technical Services (OTS) was created, in part from the PB, in 1946, within the Department of Commerce. The three national libraries (National Library of Medicine, National Agricultural Library, and Library of Congress) provided the technical services and storage for these reports. In 1964, the function of the OTS was transferred to the newly created Clearinghouse for Federal Scientific Information in the National Bureaus of Standards. In 1970, the clearinghouse evolved into the present-day National Technical Information Service (NTIS). A detailed history of the technical report may be found in the ''Technical Reports'' chapter appearing in Krishna Subramanyam's *Scientific and Technical Information Resources* (Dekker, New York, 1981).

As the volume and diversity of technical reports grew in the late 1950s and early 1960s, it became apparent to researchers and research administrators that technical reports should come under a systematic scrutiny equivalent to that of the scientific journal. The Weinberg Panel (chaired by Alvin Weinberg, then-director of Oak Ridge National Laboratory) was called by the President's Science Advisory Committee to provide a direction for technical report literature.

The Weinberg Report, ''Science, Government, and Information: The Responsibilities of the Technical Community and the Government in the Transfer of Information'' (report to the President's Science Advisory Committee, 1963), made a number of recommendations for improved quality controls for the technical literature produced by and for government agencies. Today's systematic review of government reports, their standardized bibliographic formats, and their established methods of distribution still reflect the recommendations and concerns of the Weinberg Panel.

Early technical report literature in the area of toxicology was derived from occupational health surveys in industries. The Federal Bureau of Labor (which later became the U.S. Department of Labor) was responsible for issuing the first series of technical reports or bulletins related to occupational toxicology and occupational health. Most notable are the works under the authorship of Alice Hamilton, M.D. (1869–1970), a pioneer in the field of industrial medicine and toxicology. Hamilton served as a special investigator in the Bureau of Labor Statistics (BLS) and initiated the first comprehensive studies of the health consequences of industrial exposure to toxic compounds. Among those early works published as the ''Industrial Accidents and Hygiene Series'' are:

Industrial poisoning in making coal-tar dyes and dye intermediates. *BLS Bull.* **28,** 1921

Industrial poisons used or produced in the manufacture of explosives. *BLS Bull.* **21,** 1917

Lead poisoning in potteries, tile workers, and porcelain enameled sanitary ware factories. *BLS Bull.* **104,** 1912

Women in lead industries. *BLS Bull.* **253,** 1919

Another historical thread of technical reports related to toxicology is found in issues related to water and air pollution. Many of these early studies and surveys reflected a growing concern about the environmental and public health effects of sewage in domestic water supplies. Many of these early reports are found in the holdings of the U. S. Public Health Service and include titles such as ''The Sewage Pollution of Streams: Its Relationship to the Public Health'' (Report No. 362, 1916).

One of the most comprehensive investigations seeking a species-specific toxicant was that for controlling the sea lamprey, primarily in the Great Lakes. The sea lamprey infested the waters of the Upper Great Lakes after construction of the Weland Canal between Lakes Erie and Ontario. The annihalation of commercial fish stocks, primarily lake trout, by the parasitic lampreys is legendary, and set forth a comprehensive research initiative to find an effective lampricide (see L. F. Erkkila, B. R. Smith, and A. L. McLain, 1956, Sea Lamprey Control on the Great Lakes [1953 and 1954], Special Science Report of the Fisheries Service #175). Eventually, six mononitrophenols containing halogens were found to be significantly more toxic to larval stages of sea lampreys than to other aquatic organisms. The V. C. Applegate *et al.* (1957) report of the U.S. Fish and Wildlife Service, Toxicity of 4,346 chemicals to Larval Lamprey and Fishes (U.S. FWS, Special Science Report,

Fisheries Service #207) remains a landmark publication in the field of aquatic toxicology.

These early federal reports, along with numerous state agency reports (see below), related to water quality issues led to the publication of ''Standard Methods for the Examination of Water and Sewage'' (American Public Health Association, New York, 1912), which was first published in 1905 as the ''APHA Report of the Committee on Standard Methods of Water Analysis to the Laboratory Section of the American Public Health Association.'' The 19th edition of this work (1996) represents a compendium of recognized laboratory and field methods for water quality analysis. It includes many water-quality tests and procedures related to aquatic toxicology, ecotoxicology, and environmental chemistry.

The Department of Interior's U.S. Geological Survey and the Fish and Wildlife Service (and its predecessor, the Bureau of Fisheries) have provided numerous reports on the pollutant status of U.S. streams and rivers for more than a century. Many of these stream surveys were published as a series of USGS water-supply papers under the generic titles of ''Water-Supply Papers'' (which ran from 1880–1950), ''Survey Publications on Stream Pollution,'' and ''Water Supply and Irrigation Papers.''

Bibliographic control of technical reports is not a primary function of many conventional abstracting and indexing services. Locating technical reports is facilitated by NTIS's ''Government Reports Announcement and Index'' and its online equivalent, the NTIS Bibliographic Database. Sears and Moody have provided a succinct description of government technical reports, including the bibliographic services of NTIS, in ''Using Government Information Sources: Print and Electronic'' (2nd ed., Oryx Press, Phoenix, AZ, 1994). Judith Schiek Robinson's ''Tapping the Government Grapevine: The User-Friendly Guide to U.S. Government Information Sources'' (Oryx Press, Phoenix, AZ, 1993) is another good source to assist in identifying resources for government information and data.

NERAC, Inc., produces for NTIS a bibliographic report series under the generic subtitle of ''Published Search.'' There are more than 1,000 titles in this current series and in preceeding compilations. Each bibliography contains 50 to 250 citations, and each bibliography is compiled from one of several indexing and abstracting services (e.g., Energy Science and Technology Database, Food Science and Technology Abstracts, Life Sciences collection, Pollution Abstracts, NTIS Database, and World Textile Abstracts). Bibliographies have been prepared for individual chemicals, classes of chemicals, other potentially toxic substances and agents, analytical methods, and testing procedures.

The Government Printing Office's (GPO's) ''Monthly Catalog'' overlaps rather substantially with NTIS information products. Technical report coverage tends to be more comprehensive with NTIS, but some essential information is still found exclusively in the ''Monthly Catalog.'' A distinct advantage of the GPO ''Monthly Catalog'' is its listings of SuDocs (Superintendent of Documents) numbers, which are needed to locate reports in many Federal Depository Library collections. Free access to the GPO ''Monthly Catalog'' is provided from the GPO Access Web site at http://www.access.gpo.gov/su_docs/index.html. This site also serves as a launching base for other GPO information resources, including the ''Code of Federal Regulations,'' the ''Federal Register,'' Congressional reports, hearings testimony, and legislative bills introduced into the U.S. Senate and House of Representatives.

The Science and Technology Division of the Library of Congress maintains an extensive inventory of technical report literature, primarily in microfiche formats. The Division's Technical Reports and Standards Collection is one of the largest in the world, with technical reports from 60 nations included in its holdings. Many of the major toxicology-related resources are identified in the ''LC Science Tracer Bullet'' series of pathfinders. New ''Tracer Bullets'' are announced in the Library of Congress Information Bulletin.

The agencies responsible for most of the government-sponsored report literature related to toxicology and environmental health are the Department of Agriculture, the Department of Energy, the Department of Health and Human Services, and the Environmental Protection Agency. Each of these agencies has a designated technical information unit or office that is responsible for the technical report literature it generates. In some cases, NTIS is also responsible for distribution of the same reports provided by these agency-specific technical information offices.

The Department of Energy (DOE) produces ''Energy Research Abstracts'' and its online equivalent, ''Energy Science and Technology'' (Office of Scientific and Technical Information, Oak Ridge, TN). All technical reports produced by DOE and its contractors and subcontractors (including the technical report literature of the National Laboratories) are covered in these DOE-sponsored indexing and abstracting services. DOE is one of the participating bodies in the international Energy Technology Data Exchange (ETDE), a consortium of government energy agencies. Reciprocal agreements within this consortium facilitate the inclusion the technical reports of ETDE member countries in the DOE databases. Coverage of toxicology is rather extensive in these resources and reflects DOE research in areas related to health effects associated with radioactive and

chemical wastes. OSTI provides access to the full text of DOE research and development results through the DOE Information Bridge Public Web site (http://www.doe.gov/bridge).

The ''EPA Publications Bibliography'' has been the primary vehicle for announcing EPA technical reports. Although the titles listed in this bibliography are the same as in the GRAI, the bibliographic records from the EPA service contain information not found in the NTIS inventory. Recently, the EPA has been making much more of its technical report literature available on their Web site (http://www.epa.gov); and it is planning to use this format in regularly disseminating report literature—such as ''The Handbook for Air Toxics Emission Inventory Development Volume I: Stationary Sources'' (EPA 454/B-98-002, 1998), which is now available from EPA'S CHIEF Web site (http://www.epa.gov/ttn/chief/ei_guide.html).

The National Library of Medicine (NLM) is the world's largest repository of medical research literature. It serves as an archive for technical report literature published by numerous agencies that document the public health interests of the nation and of individual states. NLM's computerized bibliographic retrieval systems, MEDLARS (MEDical Literature And Retrieval System), and its databases are a good resources for identifying toxicology-related technical report literature. Medical Subject Headings (MeSH) should be consulted to determine the precise indexing terms and structures of the NLM databases.

The U.S. Department of Agriculture supports the National Agricultural Library (NAL). Bibliographic access to the NAL repository of literature, which includes technical reports, is found in the ''Bibliography of Agriculture'' (Oryx Press) and the online database AGRICOLA. This technical report literature is related to pesticides and agricultural chemicals, including impacts of toxic chemicals on crops, forests, and animals. Various perspectives on food toxins and toxicity of natural poisons are found in the holdings of the NAL databases. The NAL also serves as the U.S. component of AGRIS (Agridex is the print equivalent), a database maintained by the United Nations Food and Agricultural Organization. AGRIS features a variety of sources of international report literature that may not be included in other bibliographic databases.

Additional sources of toxicology-related technical report literature include, but are not limited to, the following databases:

Biological Abstracts
Chemical Abstracts
Comprehensive Core Medical Library
Developmental and Reproductive Toxicology
DHSS-HEF
Environmental Mutagen Information Center Backfiles
Environmental Mutagen Information Center Data Base
NIOSHTIC
Smoking and Health

The Internet and World Wide Web hold promise as information tools to identify the sources of and access to toxicology research sponsored by industry. University libraries are developing a panoply of resources related to all aspects of collection development. The Science and Engineering Library (SEL) at State University of New York University at Buffalo is one example of a technical reports Web page (http://ublib.buffalo.edu/libraries/units/sel/collections/technic.html). SEL also maintains an inventory of technical reports for western New York at ublib.buffalo.edu/libraries/units/sel/tr/.

The General Accounting Office (www.gao.gov), the investigative arm of Congress, is charged with examining matters relating to the receipt and disbursement of public funds. GAO performs audits and evaluations of government programs and activities. Their toxicology-related reports are primarily in their sections devoted to Energy, Environment, Food and Agriculture, and Transportation. The following titles are representative of GAO reports and testimonies available.

Environmental Cleanup: DOD's Implementation of the Relative Risk Site Evaluation Process (GAO/NSAID-99-25, 1998)

Hazardous and Nonhazardous Waste: Demographics of People Living Near Waste Facilities (GAO/RCED-95-84, 1995)

Health and Safety: DOE's Epidemiological Data Base Has Limited Value for Research (GAO/RCED-95-126, 1995)

Medicaid: Elevated Blood Lead Levels in Children (GAO/HEHS-98-78)

Pesticides: EPA's Efforts to Collect and Take Action on Exposure Incident Data (GAO/RCED-95-163, 1995)

Superfund: Information on Current Health Risks (GAO/RCED-95-205, July 1995)

Superfund: Times to Complete Site Listing and Cleanup (GAO/T-RCEE-98-74)

Superfund Program Management (GAO/HR-97-14, 1997)

Toxic Substances: EPA Should Focus Its Chemical Use Inventory on Suspected Harmful Substances (GAO/RCED-95-165)

Reports are also issued by the Congressional Research Service (CRS) (lcweb.loc.gov/crsinfo), which is

the public policy research program of the Library of Congress. CRS's Environment and Natural Resources Policy Division (ENRPD) provides support in areas such as environmental protection, natural resources management, and energy policy. The CRS Science, Technology, and Medicine Division may also deal with environmental issues related to public and environmental health.

The Committee for the National Institute for the Environment has provided through its National Library for the Environment Web site a complete, full-text inventory of Congressional Research Service reports related to the environment (http://www.cnie.org/nle/crs_main.html). This compilation includes reports related to food safety, pesticides, air pollution, water quality, waste management, risk assessment, Superfund, and pollution. Examples of these CRS reports include ''Risk Analysis and Cost–Benefit Analysis of Environmental Regulations,'' ''Dioxin: Reassessing the Risk,'' ''Superfund Cleanup Standards Reconsidered,'' ''Treatment Technologies at Superfund Sites,'' and ''Lead-Based Paint Poisoning Prevention: Federal Mandates for Local Government.''

The CISTI Database (Canada Institute for Scientific and Technical Information), produced by the National Research Council of Canada is analogous to the U.S. NTIS and provides comprehensive access to the technical report literature of Canada. National and provincial documents related to toxicology, environmental health, and occupational health are provided through this bibliographic utility. CISTI began operations in the mid-1920s as the Library of the National Research Council of Canada. In 1957 it became the National Science Library, and it assumed its current name in 1974, reflecting the broader scope of services provided. Its Web site, http://www.nrc.ca/cisti, includes access to its online CISTI catalogue at http://cat.cisti.nrc.ca. It is available in French and English. CISTI's coverage of toxicology includes reports on the toxicity and metabolism, health threats, pharmacological effects of individual chemicals or chemical classes (e.g., explosives, industrial solvents) as well as series devoted to environmental health and occupational health.

The primary source of information on report literature in the United Kingdom is Her Majesty's Stationery Office (HMSO), which publishes legislation, parliamentary publications, and some government department and agency publications. The HMSO *Daily List* is a day-by-day inventory of publications issued by HMSO. This bibliographic utility includes the Department of Environment's series of ''Pollution Papers'' and ''Waste Management Papers.'' The *Daily List* is compiled into the ''Monthly Catalogue'' and the ''Annual Catalogue.'' A separate HMSO ''Agency Catalogue'' is also published and includes documents of foreign groups, including the European Union, for which the HMSO serves as the U.K. agent. The ''Catalogue of British Official Publications Not Published by the HMSO'' (Chadwyck-Healey, London) lists government department reports and other literature.

The Organization of Economic and Cooperative Development (OECD) (http://www.oecd.org/ehs) publishes country-specific environmental monographs under the generic title of Environmental Performance Reviews. These reports cover a myriad of issues related to environmental quality and natural resources, including topics related to toxicology and chemicals (most notable being releases and accidents) in the environment. From 1988 to 1996 OECD published an ''Environmental Monograph'' Series available from the OECD Environmental Health and Safety Programme page, http://www.oecd.org/ehs/accpub.htm. These reports cover the following topics (number of reports available): chemical accident prevention, preparation, and response (22); testing and assessment (32); good laboratory practices (12); pesticides (10); risk management (7); harmonization of regulatory oversight in biotechnology (14); and pollutant release and transfer registers (1). In 1998 OECD released their report Savings to Government and Industry Resulting from the Environmental Health and Safety Programme, ENV/EPOC/MIN(98)5.

The World Health Organization (WHO, http://www.who.org) publishes an ongoing series of toxicology reports by chemical name with the subtitles Health and Safety Guide. The WHO publication Guidelines for Poison Control examines the policies related to poison control as well as scientific and technical aspects of poisons.

STATE AND LOCAL GOVERNMENT TECHNICAL REPORTS

State depository libraries are usually mandated to receive state agency reports. However, not all states have mandatory depository provisions, and the depository status of state libraries varies. It is necessary to consult each state library to determine its depository status and holdings for toxicology-related reports. Several useful guides for locating state documents include the following.

''State Document Checklists: A Historical Bibliography, 1910–1988'' (1990). Hein, Buffalo, NY

''State Publications and Depository Libraries: A Reference Handbook'' (1981). Greenwood, Westport, CT

''The Documents on [State] Documents Collection'' American Library Association GODORT (Government Documents Round Table), Chicago, IL

''Monthly Checklist of State Publications,'' U.S. Government Printing Office, Washington, DC

It is extremely useful to consult individual state, county, and municipal public health and environmental quality agencies. Bibliographic control of state, county, and municipal agency reports is difficult at best and often requires considerable effort in searching the holdings of agency, public, and state libraries. It may be possible to request publication checklists from individual state and local agencies. Such inventories may be as elusive to identify as the agency's body of technical literature and are often produced at sublevels (divisions or departments) within the agency. Consulting the library holdings of larger land-grant universities and individual state libraries may be the best source for such state or local information. The American Library Association's ''Directory of Libraries'' is an excellent resource for identifying such libraries. The development of the World Wide Web as a means of disseminating report findings may result in better access to state and local agency reports. The List is a comprehensive Web site of library resources, including directories, associations, and organizations. The OCLC WorldCat database of U.S. and Canadian library holdings represents one of the few bibliographic databases that can identify state and local reports.

The California Office of Environmental Health Hazard Assessment (OEHHA) is an excellent example of a state agency that provides comprehensive coverage of toxicology and environmental health information to the public via the Internet. OEHHA's vast array of programs and publications can be easily located and obtained from the OEHHA Web site at http://www.calepa.cahwnet.gov/oehha. OEHHA's Scientific Documents can be found at http://www.calepa.cahwnet.gov/oehha/scidocs.htm.

INDUSTRY-SPONSORED TECHNICAL REPORT LITERATURE

Technical report literature produced by individual corporations, inter-industry consortia, and manufacturing and trade associations is most likely to be subject to commercial security and proprietary classification. Industry-sponsored research, though potentially beneficial to the community, is not typically made available outside of the sponsoring organization. Exceptions relate to regulatory compliance or enforcement (e.g., the Toxic Chemical Release Inventory or state/local emergency preparedness requirements). It may be worthwhile to contact corporate OPACs (online public access catalogs) available in company libraries or through public affairs or publications offices. E-mail discussion groups are also helpful in locating industrial technical reports.

Partial inventories of industries that may produce technical reports can be obtained by examining the corporate memberships of professional and trade associations, such as the Chemical Manufacturers Association, Chemical Specialties Manufacturing Association, Society of Toxicology, and the Society of Environmental Toxicology and Chemistry. As with government-sponsored research reports, the findings of industry-sponsored research can be found in the open journal and conference literature. An excellent resource for locating industries that conduct toxicology-related research is the papers presented at annual meetings of professional organizations, especially those of the Air and Waste Management Association, the American Chemical Society, the Society of Environmental Toxicology and Chemistry, and the Society of Toxicology. Consult Chapter 15, ''Organizations,'' for a more complete inventory of professional societies and associations.

Those indexing and abstracting services covering conference literature (e.g., Chemical Abstracts, Conference Papers Index, TOXLINE) are suggested as additional resources to identify potential locations of industry-sponsored research. Examples of industry technical reports series and resources include ''Cosmetic Ingredient Reviews'' and ''PRM [Perfume Raw Materials] Monographs,'' both published by the Research Institute for Fragrance Materials. International Toxicity Estimates for Risk (ITER), published by Toxicology Excellence for Risk Assessment (http://www.tera.org), includes compilations of human health risk values from a number of international health organizations and partnerships between environmental, industry, and government groups.

Individual industry Web sites are also good potential sources for technical report literature. Procter and Gamble, for example, provides reprints of toxicology-related articles and reports written by its staff at http://www.pg.com/docInfo/env_responsibility/esd/publications.html. Dow Chemical supports a product literature site at http://www.dow.com. Brochure-type information on specific chemicals or classes of chemicals is provided. Registration is required to access this site.

EXAMPLES OF TOXICOLOGY TECHNICAL REPORTS

The U.S. Agency for Toxic Substances and Disease Registry (ATSDR) (http://atsdr.cdc.gov) is responsible for issuing technical reports on chemicals found

at Superfund and other hazardous waste sites. The ''ATSDR Toxicological Profile'' series is one of the most comprehensive inventories of U.S. government-sponsored reports. In addition to the scores of reports in this series (available in full-text on CD-ROM by Lewis Publishing, Boca Raton, FL), ATSDR also publishes site-specific reports for individual Superfund and hazardous waste sites.

Public Health Statements, taken from ''ATSDR Toxicological Profiles,'' are brief summaries of information on specific toxic substances. Each summary focuses on the effects on human health of exposure to a toxic substance. These statements can be searched at http://atsdr1.atsdr.cdc.gov:8080/query-phs.htm1. ATDSR's *Public Health Assessments* are available as full-text documents at http://atsdr1.atsdr.cdc.gov:8080/HAC/PHA. In addition to these reports, ATSDR makes various other documents—such as the 1993 report *Priority Health Conditions: An Integrated Strategy to Evaluate the Relationship Between Illness and Exposure to Hazardous Substances*—available in full text electronically through their Web site. The NTIS database also inventories these ATSDR reports.

The National Toxicology Program (NTP) was established by the Secretary of Health and Human Services to coordinate toxicology research and testing activities within the department. NTP provides information about potentially toxic chemicals and strengthens the science base in toxicology. NTP is a world leader in designing, conducting, and interpreting animal assays for toxicity/carcinogenicity. The NTP consists of relevant toxicology activities of the National Institutes of Health's National Institute of Environmental Health Sciences (NIH/NIEHS), the Centers for Disease Control and Prevention's National Institute for Occupational Safety and Health (CDC/NIOSH), and the Food and Drug Administration's National Center for Toxicological Research (FDA/NCTR). NTP has issued hundreds of technical reports, many of which appear with titles such as *Final Report on the Short Term Reproductive and Developmental Toxicity of . . . ; Toxicology and Carcinogenesis Studies of . . . ;* or *NTP Technical Report on Comparative Toxicity Studies of . . . .* The National Institute for Occupational Safety and Health (NIOSH) (http://www.cdc.gov/niosh/homepage.html) produces series such as the *NIOSH Criteria Documents.* Formally known as the *Criteria for a Recommended Standard,* these reports provide the basis for comprehensive occupational safety and health standards. Other NIOSH reports are *Occupational Hazard Assessments and Special Hazard Reviews* and *Joint Occupational Health Documents*. NIOSH also publishes site-specific industrial health and hygiene reviews as part of the Health Hazard Evaluation Report (HETA) series from the NIOSH Hazardous Evaluation and Technical Assistance (HETA) Branch.

The EPA's Office of Research and Development (ORD) supports the National Center for Environmental Assessment (NCEA) (http://www.epa.gov/ncea/mission.htm), formerly the Environmental Criteria and Assessment Office (ECAO), which serves as the national resource center for the overall process of human health and ecological risk assessments—the integration of hazard, dose-response, and exposure data and models to produce risk characterizations. ECAO sponsored the production of a series of comprehensive, state-of-the-art reviews of chemicals, under the series title ''Health Effects Assessment.'' These lengthy overviews provide extensive coverage of toxicology-related information. ECAO was also responsible for ambient water quality criteria documents and drinking water quality documents for the protection of the nation's water resources. The ECAO technical report series are provided under the titles of ''Ambient Water Quality Criteria,'' ''Drinking Water Criteria,'' ''Ambient Aquatic Life Water Quality Criteria,'' and ''Water Quality Criteria Documents.''

A complete inventory of full-text online reports from NCEA is available on its Web site at http://www.epa.gov/ncea/biblio.htm. This inventory includes chemical-specific risk assessments, published under the generic title of ''Health Risk Assessment'' (e.g., dioxin, lead, PCBs, environmental tobacco smoke and passive smoking). The ''EPA Ecological Risk Assessment'' report series is also available on this site, as is the ''The Risk Guideline'' report series.

Environment Canada has drafted water-quality standards based on comprehensive toxicological reports that are made available through an NTIS reciprocal agreement. These Canadian reports are provided with the generic title of *Scientific Criteria Document for the Development of a Provincial Water Quality Guideline.*

The Netherlands National Institute for Public Health and Environmental Protection has made available for distribution in the U.S., Canada, and Mexico the series of toxicological reports produced from their Integrated Criteria Document process. These state-of-the-art assessment reports have been prepared with the technical report series title ''Integrated Criteria Document.''

The British Industrial Biological Research Association (BIBRA) (http://www.bibra.co.uk), in Carshalton, England, has made available for distribution through the NTIS Bibliographic Database one of the largest collections of toxicology report literature, under the generic title of ''BIBRA Toxicity Profile.'' The ''BIBRA Toxicity Profiles'' are concise critical reviews of the most pertinent toxicological data on commonly used chemicals. Each profile is prepared from primary sources (wherever possible) and is a comprehensive evaluative monograph. About 450 profiles have been

issued. A list of profiles available and some sample pages from two profiles may be viewed. An index of all toxicological profiles is available at http://www.bibra.co.uk/97index/97index.html. BIBRA's in-house databank comprises a unique collection of over 350,000 documents. These are key toxicological reports and critical legislation on

- Industrial, environmental and agricultural chemicals
- Cosmetic ingredients and pharmaceutical excipients
- Packaging materials
- Food additives, contaminants, and nutrients
- Food components conferring protective or beneficial effects

OTHER GOVERNMENT DOCUMENTS

In addition to the technical report literature, government agencies also produce other types of literature commonly referred to as government documents. It is here that a distinction is made between technical reports describing the results of ongoing research and development activities, and other agency and legislative documents written by or on account of federal support.

A second category of government documents or government publications include those items written for use by a much more general and broadly defined audience. These government publications include bulletins, pamphlets, guides, booklets, flyers, Congressional bills and hearings, and other nontechnical or nonresearch documents (see also Chapter 10, ''Audiovisual and Non-Print Media Resources''). Libraries, in particular, can make excellent use of these types of resources in vertical files or pamphlet files.

The Monthly Catalog of the Government Printing Office is the primary bibliographic utility for locating these other government documents. British Official Publications can be considered a UK equivalent for the GPO Monthly catalog.

It is perhaps fitting to introduce here a brief description of the vertical file as an information resource. Many of the organizations and agencies mentioned elsewhere in this book provide similar types of information resources and should be consulted for access to their pamphlets, brochures, guidebooks, etc.

Resources comprising vertical files represent the fugitive, gray, ephemeral, and nonconventional or nontraditional forms of literature. Vertical files are created to provide a readily accessible means of gaining access to these resources. The following citations from the open literature reveal the scant amount of information published on these special resources. More importantly, they reflect a change from the print to the online collection of this type of data (many of EPA's pamphlets, booklets, brochures, and flyers are made available electronically via the EPA Web site, http://www.epa.gov).

Allen, B. F. H. (1992). The information file in academic libraries: an unexploited resource. *Collection Management* **16**(3), 53–79.

Colburn, J. L. (1991). Horizontal wires replace the vertical files: World Wide Web at North Carolina Mountain Area Health Education Center Health Sciences Library. *Med. Reference Services Quart.* **16**(3), 19–25.

Conway, J. J. (1992). Communicating risk information medical-practice. *Radiographics* **12**(1), 207–214.

DeYoung, R, Dunkan, A., and Frank, J. (1993). Promoting source reduction behavior: the role of motivational information. *Environ. Behav.* **25**(1), 70–85.

Dixon, L. S. (1991/Summer). The vertical file: alive and well in an academic library. *Tennessee Librarian* **43,** 30–33.

Falk, H. (1996/August). Computer-based vertical files. *Electronic Library* **14,** 365–368.

Foss, B., Berkseth, K., and Qualley, B. (1987). Evaluation study of the booklet, preschoolers and poisons. *Vet. Hum. Toxicol.* **29**(5), 401–404. [Erratum in *Vet. Hum. Toxicol.* **30**(2), 107].

Gauther, I., and Malone, M. (1998). Drug–food interactions in hospital patients: methods of prevention. *Drug Safety* **18**(6), 383–393.

Grier, N. (1993). Spreading the word about pesticide hazards and alternatives. *J. Pesticide Reform.* **13**(2), 2–19.

Grieshop, J. I. (1990). Bridging gaps between them and us. *J. Extension* **28,** 12–15.

Harris, T. (1993). Low cost and no cost information: more on the vertical file. *School Librarians Workshop* **13**(1), 13.

Jacobs, D. S. (1993). The vertical file: an overview and guide. *Collection Building* **12**(1/2), 3–17.

Kronenfeld, M. R., and Howley, L. (1994). Theory and implementation of an automated vertical file. *RQ* (*Reference Quarterly*) **33**(2), 387–394.

Lee, T. R., and MacDonald, S. (1994). Public responses to indoor air pollution from radon. *Radiation Protection Dosimetry* **56**(1–4), 331–337.

Nester, R. M. (1996). Occupational Safety and Health Administration: building partnerships. *Am. Assoc. Occup. Health Nursing J.* **44**(10), 493–496.

Neuhaus, C. (1997). Developing a hypertext World Wide Web vertical file. *Collection Building* **16**(2), 66–72.

Sitter, C. L. (1992). *The Vertical File and Its Alternatives: A Handbook.* Libraries Unlimited, Englewood, CO.

Thomsen, E. (1997). The vertical file: Internet sites. *Collection Building* **16**(1), 30–35.

Woolf, A. D., Saperstein, A., and Forjuoh, S. (1992). Poisoning prevention knowledge and practices of parents after a childhood poisoning incident. *Pediatrics* **90**(6), 867–870.

Many federal agencies produce government documents that are considered to be elements of nontraditional literature (gray literature), consisting of brochures, booklets, pamphlets, etc. These resources clearly are produced for general audiences and are useful resources for teachers and their students, local officials, public and school libraries, and the interested or concerned citizen. Many of these resources are identified in the U.S. Government Printing Office's ''Monthly Catalog'' or individual agency Web sites. A representative list of several EPA documents in this category of literature include the following titles (with their respective report numbers and date of publication; they can be ordered directly from the EPA's Web site at http://www.epa.gov).

The Changing Nature of Environmental and Public Health Protection (1998). EPA100-R-98-003 (www.epa.gov/reinvent).

Citizens Guide to Pest Control and Pesticide Safety (1995). EPA 730-K-95-001.

The Effects of Great Lakes Contaminants on Human Health (1995). EPA 905-R-95-017.

EPA Guide to Environmental Issues (1996). EPA 520-B-94-001.

Expanding Community Right-to-Know: Recent Changes in the Toxics Release Inventory (1995). EPA 745-F-95-001.

Guidelines for Ecological Risk Assessment (1998). EPA-630-R-95-002F.

How to Obtain Information from EPA's Office of Pesticides Program (1996). EPA-735-F-96-004.

The Inside Story: A Guide to Indoor Air Quality (1995). EPA 402-K-93-007.

Lead Poisoning and Your Children (1995). EPA 800-B-92-0002.

Pest Control in the School Environment: Adopting Integrated Pest Management (1993). EPA 735-F-93-012.

Protect Your Family From Lead in Your Home (1995). EPA 747-K-94-001.

Recognition and Management of Pesticide Poisonings (1999). EPA-735-R-98-003.

RCRA: Reducing the Risk From Waste (1997). EPA 530-K-97-004.

This is Superfund: A Citizen's Guide to EPA's Superfund Program (1994). EPA 540-K-93-008.

Users Guide to Federal Accidental Release Databases (1995). EPA 550-B-95-001.

Representative resources from other federal agencies include the following materials.

Centers for Disease Control and Prevention

Preventing Lead Poisoning in Your Children: A Statement (1991).

Food and Drug Administration

Getting the Lead Out—of Just About Everything (1993). FDA 92-2249.

Mercury in Fish: Cause for Concern? (1995). FDA 95-2285.

An Unwanted Souvenir: Lead in Ceramic Ware (1991). FDA 90-1157.

Department of Housing and Urban Development

Lead-Based Paint: A Threat to Your Children—An Important Message for People Living in Housing Built Before 1978.

NIOSH

RTECS: Registry of Toxic Effects of Chemical Substances (1995).

OSHA

Access to Medical and Exposure Records (1993). OSHA 3110.

In addition to these resources, the reader is encouraged to contact Department of Agriculture-sponsored county cooperative extension offices, NOAA Sea Grant extension offices, and health and environmental agencies at the state and local levels (see Chapter 15, ''Organizations''.

This Page Intentionally Left Blank

CHAPTER

9

Publishers

LINDA MILLER POORE AND TAMARA L. B. WILSON

But once, when my father was soaring high in self-confident absentmindedness, and made tea by pouring hot coffee over tea leaves, she called him ''The Great Poisoner.'' He laughed, I remember, but looked abashed and sorrowful.

(Donald Hall, *Willow Temple*)

Publishers of toxicology literature are undergoing the same turbulence as the rest of the publishing industry in this Information Age. Publishing houses are being bought, sold, and consolidated constantly; this increased competition has resulted in publishers striving to add value to their products by offering online catalogs, secure (encrypted) Internet ordering, and current awareness services, as well as developing multiple platforms for delivery of their products. Toxicological information is now available in a wide array of guises that begin with the older information technologies of paper, microfilm, microfiche, film, video, and online databases, and expand into the evolving digital formats of diskette, CD-ROM, and Internet.

This chapter concentrates on major commercial and private, nonprofit publishers. We have included the publishers of the prestigious medical journals *JAMA, New England, Journal of Medicine,* and *The Lancet* here, for although they are not primarily toxicology journals, they are invaluable sources for poisoning-case studies. In addition, their large readerships and the press coverage they command mean that they act as important international forums for the discussion of public health policy issues.

Keep in mind that many government agencies and other organizations publish information of interest to the toxicological community; information on them is available in other chapters in this volume. The two major publishers of government information for many agencies are the Government Printing Office (GPO, http://www.gpo.gov), and the Department of Commerce's National Technical Information Service (NTIS, http://fedworld.gov/ntis/ntishome.html). Individual agencies also distribute some of their information products separately from GPO and NTIS; a few of interest to the toxicology community are the Environmental Protection Agency's National Service Center for Environmental Publications (NSCEP; 1-800-490-9198, http://www.epa.gov/ncepihom); the National Institute for Occupational Safety and Health, part of the Centers for Disease Control (NIOSH, http://www.cdc.gov/niosh/homepage.html); and the U.S. Department of Health and Human Services' Agency for Toxic Substances and Disease Registry (ATSDR, http://www.atsdr.cdc.gov/atsdrhome.html).

Finally, as noted above, it is now the norm for publishers to have constantly changing addresses and contact points; editorial offices may be far flung from customer service departments. Therefore, for the following list we have chosen customer service access points as the best starting place for obtaining further information, but have included additional addresses when appropriate.

Academic Press—A Harcourt Science and Technology Company
U.S. headquarters
525 B St., Suite 1900
San Diego, CA 92101-4495

619-231-6616.
Customer service
6277 Sea Harbor Drive
Orlando, FL 32887
Phone: 800-321-5068
Fax: 800-874-6418
E-mail: General inquiries: ap@acad.com (or) app@acad. com
Book: apbcs@harcourtbrace.com
Journal: apjcs@harcourtbrace.com
Web: http://www.apnet.com
Media: Books, CD-ROMs, journals

Web site offers the inScight current awareness service and full-text journals online through the IDEAL subscription service.

The American Chemical Society
Headquarters
Publication Support Services
1155 16th St., NW
Washington, DC 20036
Phone: 800-227-5558 (U.S. & Canada)
202-872-4554 (DC and outside the U.S.)
Fax: 202-872-6325
Email: pss@acs.org
Web: http://pubs.acs.org
Media: Microforms, article reprints, journals, books, CD-ROM, video, audio, posters/bumper stickers, career materials

Web site offers information on membership and its benefits; awards, grants and scholarships; meetings; and on ACS's public outreach and lobbying activities.

American Medical Association (AMA)
Headquarters
515 North State St.
Chicago, IL 60610
Phone: 312-464-5000
Subscriber Services Center
PO Box 10945
Chicago, IL 60610
800-AMA-2350
Fax: 312-464-5831
E-mail: ama-subs@ama-assn.org
Web: http://www.ama-assn.org
Media: Books, journals, pamphlets, medical kits

Publisher of the medical journal *JAMA* (formerly *Journal of the American Medical Association)*. The Web site has an unsecured online catalog service.

American Society for Testing Materials (ASTM)
100 Barr Harbor Drive
West Conshohocken, PA 19428-2959
Phone: 610-832-9585
Fax: 610-832-9555
E-mail: webmastr@astm.org
ASTM Customer Service: service@astm.org
Web: http://www.astm.org.
Media: Technical publications, journals, CD-ROM, WebFaxx (fax delivery of ASTM Standards), WebDoxx (PDF delivery of ASTM Standards), training courses, statistical quality assurance programs ''Annual Book of ASTM Standards''

The Web site offers links to each of the 132 technical committees' home pages, which give information plus a direct e-mail link; news and information; Technical & Professional Training Courses catalog; statistical quality assurance programs; ASTM Institute for Standards Research; staff directory listing phonenumbers and e-mail addresses; searching the Laboratory Directory; and searching the Consultants Directory.

Blackwell Science
Blackwell Science Inc.
Commerce Place, 350 Main St.
Malden, MA 02148-5018
Journals
Blackwell Science Ltd
Journal Subscriptions
PO Box 88
Oxford, OX2 ONE, UK
Phone: 781-388-8250 (U.S.)
Fax: 781-388-8255 (U.S.)
E-mail: Books Customer Service & Marketing: csbooks@blacksci.com
Journals Customer Service & Marketing: csjournals@blacksci.com
Web: http://www.blacksci.co.uk and http://www.blacksci.co.uk/usa/default.htm
Media: Books, textbooks, journals, CD-ROMs, electronic media

Agents for the American Society of Neurological Surgeons in Europe (except Spain and Portugal), the Middle East, and Africa. They are also agents for the American Society for Microbiology and Futura Publishing company worldwide, excluding the U.S., Canada and Japan. Contact: marketing@blacksci.co.uk.

CRC Press, LLC
Subsidiaries: Lewis Publishers, St. Lucie Press and Food Chemical News, Chapman & Hall
Attn: Customer Service
2000 NW Corporate Blvd.
Boca Raton, FL 33431
Phone: 1-800-272-7737
561-994-0555 (Florida & outside U.S.)
Fax: 1-800-374-3401
E-mail: orders@crcpress.com

Web: http://www.crcpress.com
Media: Books, software, journals, videos

The Web site has a secure online ordering service and announcements of upcoming exhibits.

Cambridge University Press
Headquarters
40 West 20th St.
New York, NY 10011-4211
Phone: 212-924-3900
Fax: 212-691-3239
Book orders
Customer Service Department (order #955)
Cambridge University Press
110 Midland Ave.
Port Chester, NY 10573-4930
Phone: 914-937-9600 or 1-800-872-7423
Fax: 914-937-4712
E-mail: Customer service: customer service@cup.org
Orders U.S.: orders@cup.org
All others: trade@cup.cam.ac.uk
Inquiries: information@cup.org
Journals: journalssubscriptions@cup.org
Web: http://www.cup.org
Media: Journals, books, CD-ROMs, examination papers, Bibles

Electronic order form available. Web site also has extensive listing of contacts arranged by account territories information for authors. New full-text journal service, Cambridge Journals Online, is available at http://www.journals.cup.org

Charles C. Thomas Publisher, LTD
2600 South First St.
Springfield, IL 62704
Phone: 800-258-8980
Fax: 217-789-9130
E-mail: books@ccthomas.com
Web: http://www.ccthomas.com
Media: Books, textbooks

The Web site offers online ordering. This publisher produces specialty titles and textbooks in medicine, dentistry, nursing, and veterinary medicine; and in the fields of biological sciences and the social sciences. Recent topics include behavioral sciences, education, special education and rehabilitation. Also one of the largest producers of books in all areas of criminal justice.

Elsevier Science—A member of Reed Elsevier plc group
Imprints: Elsevier, Pergamon, North-Holland, Excerpta Medica
Elsevier Science
Regional Sales Office
Customer Support Department
PO Box 945
New York, NY 10159-0945
Phone: 212-633-3730
888-4ES-INFO (437-4636) (toll-free for North America).
Fax: 212-633-3680
E-mail: usinfo-f@elsevier.com
Web: http://www.elsevier.com
Media: Books, journals, reference works, dictionaries, non-journal electronic publications, online databases, CD-ROMs, diskettes, tables of contents service

The Gordon and Breach Publishing Group
Imprints: Gordon and Breach Science, Harwood Academic, G+B Arts International
Ordering
International Publishers Distributor
PO Box 32160, Newark, NJ 07102
Amsterdam headquarters
Rijswijkstraat 175, 1062 EV Amsterdam, The Netherlands
Phone: Amsterdam: +31-20-408-98-10
Fax: Amsterdam: +31-20-408-98-11
E-mail: Customer Service: info@gbhap.com
Authors seeking advice: editlink@gbhap.com
Technical questions: webmaster@gbhap.com
Web: http://www.gbhap-us.com
Media: Books, magazines, reviews, monographs, videotapes, CDs

Extensive international contact information at its ''Web headquarters.''

Institute for Scientific Information, Inc.
3501 Market St.
Philadelphia, PA 19104
Phone: 800-336-4474
215-386-0100
Fax: 215-386-2911
E-mail: Customer service: custserv@isinet.com
Web: http://www.isinet.com
Media: Indexes, online databases, CD-ROMs, table of contents services

Publisher of unique *Citation Index* series; *Current Contents;* document delivery service.

Intox Press, Inc.
PO Box 24865
Little Rock, AR 72221
or 13924 Rivercrest Drive
Little Rock, AR 72221
Phone: 501-227-8622

Fax: 501-224-1947
Media: Journals, books, proceedings

Specializes in neurotoxicology.

Kluwer Academic Publishers—A member of the Wolters Kluwer Company
U.S. headquarters
101 Philip Drive, Assinippi Park
Norwell, MA 02061
Phone: 617-871-6600
Fax: 617-871-6528
U.S. customer service and ordering
Order Department
PO Box 358, Accord Station
Hingham, MA 02018-0358
Phone: 781-871-6600
Fax: 781-871-6528
E-mail: kluwer@wkap.com
Web: http://www.wkap.nl
Media: Books, journals, loose-leaf publications, electronic publications, printing-on-demand service for out-of-print journals

The Lancet Ltd.
Publisher
The Lancet Limited
42 Bedford Square
London WCIB 3SL
For delivery in U.S. or Canada
The Lancet
655 Avenue of the Americas
New York, NY 10010
Phone: 212-633-3800; 800-462-6198
Fax: 212-633-3850
E-mail: b.garcia@elsevier.com (subscriptions)
Web: http://www.thelancet.com
Media: Journals, microforms, online database

Web site has conferences list. Registration required.

Lippincott Williams & Wilkins—A subsidiary of Wolters Kluwer nv
Headquarters
227 East Washington Square
Philadelphia, PA 19106
Ordering
PO Box 1600
Hagerstown, MD 21741
Phone: 800-638-3030 (U.S. only)
301-714-2300
Fax: 301-824-7390
E-mail: services@lww.com
Web: http://www.lww.com
Media: Books, journals, looseleafs, newsletters, electronic media (including CD-ROM, software, video, and online formats)

Publishes in areas such as neurology, oncology, orthopedics, radiology, and nursing. Ordering online is available with secure encryption for all online transactions.

Marcel Dekker, Inc.
Headquarters
270 Madison Ave.
New York, NY 10016
Ordering
Cimarron Rd.
PO Box 5005
Monticello, NY 12701-5185
Phone: 800-228-1160
914-796-1919
Fax: 914-796-1772
E-mail: Established customers: bookorders@dekker.com
Customer and credit assistance: custserv@dekker.com
Web: http://www.dekker.com
Media: Books, journals, newsletters, reference books, textbooks, encyclopedias

Examination and desk copies available.

Mary Ann Liebert Publications
2 Madison Ave.
Larchmont, NY 10538
Phone: 914-834-3100
Fax: 914-834-3688
E-mail: General info: info@liebertpub.com
Sales: sales@liebertpub.com
Webmaster: aetkin@liebertpub.com
Web: http://www.liebertpub.com
Media: Journals, books, news publications

A Liebert company, Bioconferences International, presents international congresses and programs that complement their publishing program.

Massachusetts Medical Society (Owner and publisher of the New England Journal of Medicine)
1440 Main St.
Waltham, MA 02451-1600
Phone: 781-893-4610
800-THE-NEJM
Fax: 781-893-2105
E-mail: info@massmed.org
Web: http://www.massmed.org
Media: Journals

Web site has areas ''Especially for Patients'' and ''Especially for Physicians.''

Mosby—A Times Mirror Company
Mosby-Year Book, Inc.
Attention: Order Services (or) Journal Subscription Services (to order Journals/Periodicals)

11830 Westline Industrial Drive
St. Louis, MO 63146-9934
Phone: 800-325-4177
314-872-8370
Books: 800-426-4545
Journals: 800-453-4351;
Outside U.S.: 314-453-4351
Fax: 314-432-1380
Journals: 314-432-1158
E-mail: Use online form. Journals: periodical.service@mosby.com
Web: http://www.mosby.com
College catalog: http://www.mhhe.com
Media: Books, journals, serial publications, videos, software

Online ordering available. Co-sponsor with Lippincott-Raven and W.B. Saunders of MD Consult, a Web-based information service for practicing physicians. Web site also provides Ex-Libris, an online information source for librarians.

National Academy Press
2101 Constitution Ave, NW
Lock box 285
Washington, DC 20055
Phone: 888-624-8373
202-334-3313
Fax: 202-334-2451
E-mail: amerchan@nas.edu
Web: http://www.nap.edu
Media: Journals, books, electronic books and publications

Includes Joseph Henry Press. Publisher for the National Academy of Sciences, the National Academy of Engineering, the Institute of Medicine, and the National Research Council. Online order service. Full-text publications available for free on Web site.

Oxford University Press
Customer Service Department
2001 Evans Rd.
Cary, NC 27513
Phone: 800-445-9714
Journals: 919-677-0977 or 800-852-7323
Fax: 919-677-1303
Journals: 919-677-1714
E-mail: custserv@oup-usa.org
Journal: jnlorders@oup-usa.org
Web: http://www.oup-usa.org
Media: Journals, books

Secure online ordering service.

Plenum Publishing Corporation/Kluwer Academic
233 Spring St.
New York, NY 10013-1578
Phone: 800-221-9369
212-620-8000
Fax: 212-463-0742
E-mail: Books: kluwer@wkap.com
Journals: info@plenum.com
Web: http://www.plenum.com
Media: Journals, books, online databases, CD-ROM databases, electronic journals

Princeton Scientific Publishing Co., Inc.
PO Box 2155
Princeton, NJ 08543
Phone: 609-683-4750
Fax: 609-683-0838
E-mail: pspubinc@aol.com
Web: http://members.aol.com/pspubinc/
Media: Books, journals

PSP publishes on various subjects concerning toxicology and environmental health, including asbestos, silicone breast implants, pesticides, metals, and petroleum chemicals such as benzene and MTBE.

Society of Environmental Toxicology and Chemistry (SETAC)
1010 North 12th Ave.
Pensacola, FL 32501-3367
Phone: 850-469-1500
Fax: 850-469-9778
E-mail: setac@setac.org
Web: http://www.setac.org
Media: Journals, books

Nonprofit professional society. Also publishes its annual meeting abstracts. Downloadable PDF format order form for faxing.

Springer
Springer-Verlag New York, Inc.
175 Fifth Ave.
New York, NY 10010
Phone: 800-Springer
Fax: 201-348-4505
E-mail: orders@springer-ny.com
Web: http://www.springer-ny.com
Media: Books, journals

Web-site includes contact information for reprinting or reproducing Springer copyrighted material, plus a link to the article reprint service CISTI.

Taylor & Francis Group
Order Department
47 Runway Rd., Suite 6
Levittown, PA 19057-4700
Phone: 800-821-8312
Fax: 215-269-0400

E-mail: info@taylorandfrancis.com
Web: http://www.taylorandfrancis.com
Media: Books, journals

W B Saunders & Baillière Tindall
Orders
WB Saunders Company, Orlando
6277 Sea Harbor Drive
Orlando, FL 32887-4800
Other inquiries
WB Saunders Company
The Curtis Center
Independence Square West
Philadelphia, PA 19106-3399
Journals: 800-654-2452
Books: 800-545-2522
Other inquiries: 215-238-7800
Fax: Journals: 407-363-9661
Books: 407-352-3445
Other inquiries: 215-238-8483
E-mail: journals@wbs.hbuk.co.uk
Web: http://www.hbuk.co.uk/wbs
Media: Books, journals

Areas of interest: health science textbooks, reference works, and periodicals in all medical specialties, from undergraduate textbooks to major reference works; nursing; health-related professions; veterinary medicine and dentistry.

Walter de Gruyter, Inc., Scholarly and Scientific Publishers
200 Saw Mill River Rd.
Hawthorne, NY 10532
Phone: 914-747-0110
Fax: 914-747-1326
E-mail: wdg-info@deGruyter.de
Web: http://www.degruyter.de
Media: Books, journals

The Web site provides a catalog of the titles available. Publishes in the following fields: economics and social sciences, humanities, mathematics, medicine, natural sciences, law, and theology and religious studies.

Wiley-VCH—Part of John Wiley & Sons, Inc.
Imprints: Chemical Concepts, Verlag
Helvetica Chimica Acta
Orders
John Wiley & Sons, Inc.
Distribution Center
1 Wiley Drive
Somerset, NJ 08875-1272
Phone: 908-469-4400
Fax: 908-302-2300
E-Mail: custserv@jwiley.com
Web: http://www.wiley-vch.de
Media: Books, journals, electronic media

Formerly VCH.

CHAPTER

10

Audiovisuals and Non-Print Media Resources

FREDERICK W. STOSS AND KATHY DECK

The Goddess brought them inside, bade them sit down, and mixed for them a potion of ground barley, cheese, pale honey, and Pramneian wine, but added to the mixture the medicines of gloom, that make one utterly forget his true home. (Homer, *Odyssey*)

Recent years have seen the growth of presentation media for bringing to a broadly defined audience information concerning toxicology, environmental health, and related disciplines. While audiovisual resources have long held a popular place in classroom and laboratory instruction, the availability of such materials in videotape, video disc, and CD-ROM formats has made it easier to reach scientists, researchers, policy-makers, educators, students, and the general public at large.

One driving force behind the production of some of the audiovisual materials listed here is the need to train managers, administrators, and workers in environmental compliance. The areas of environmental and occupational health and safety provide extremely fertile grounds for the training of managers and staff at all levels and in many work settings. Hazardous materials training is required for many industrial and business applications in government agencies and in private commercial sectors.

The combination of sight, sound, and motion is an effective medley for understanding information. In some cases, the instructional video is replacing the traditional classroom presentation. The advantage of videos is that they can be used at the convenience and pace of the viewer. They may be accompanied by additional handout information to enhance instruction. Videos are also used in classrooms to further stimulate and enhance student learning.

A second factor driving the production of audiovisual materials is the general increase in consumer demand for toxicology and environmental health resources. Consumer need is a direct result of the increased awareness of and concerns about environmental issues. Titles addressing this need include resources for general education and for broadcast media (e.g., PBS), made-for-TV movies (e.g., Lois Gibbs and the Love Canal), and feature-length movies (e.g., A Civil Action and Silkwood). Recently, National Public Radio's Living on Earth program began providing print and audio access to its programs (beginning with 1998). Environmental health and chemicals in the environment are among major stories covered by Living on Earth (www.loe.org).

The 1998 release of the full-length, feature movie A Civil Action created in its own right a small information revolution and clearly demonstrates the significance of the Internet as a communications vehicle. The movie's title is taken from the nonfiction novel *A Civil Action,* authored by Jonathan Harr. The movie is based on real accounts of the poisoning of east Woburn's (Massachusetts) water supply and the subsequent marathon legal death match between citizens of Woburn and companies alleged to be the source of the chemicals, most notably W. R. Grace. The movie tells the story of a lawyer, Jan Richard Schlichtmann, attempting to establish responsibility for the contamination of

drinking water that was thought to have caused a cluster of childhood leukemia found in the town during the 1970s. Dozens of Web sites (Hotbot lists more than 2,800) sprang up months before the release of the movie (now available for video rental) representing various positions and aspects of the story behind the movie. A *partial* listing of sites is provided here as an example of the variety and flavor of resources and information transfer facilitated by a nonprint media dealing with a controversial toxicology-related issue in a public forum (and the nominees are . . .):

Beyond A Civil Action
http://www.civil-action.com/

The story told from the perspective of W. R. Grace, with many links to issues related to the issues raised by the Woburn incident.

A Civil Action Update: The Facts about Water Quality Today
http://www.civilaction.org/

A cite prepared by the Chemical Manufacturers Association and the Halogenated Solvents Industry Alliance to provide an industry perspective on the issues of the Woburn incident in the 1970s and today.

A Civil Action: From Woburn to Hollywood
http://www.loe.org/archives/981211.htm#feature6

Transcript of the radio broadcast with RealAudio audio version of an interview broadcast on National Public Radio's *Living on Earth* program aired December 11, 1998.

Death and Justice: Environmental Tragedy and the Limits of Science
http://www2.shore.net/~dkennedy/woburn_trial.html

Journalist Dan Kennedy's (award-winning staff reporter for the *Woburn Daily Times Chronicle,* for whom he covered the trial) perspective of the Woburn incident written at the time of the publication of Jonathan Harr's novel *A Civil Action.*

History of Environmental Contamination in Woburn, MA: Public Failures and Citizen Responses
http://www.jsi.com/99web/environmental/iseeisea.htm

Keynote address presented by Gretchen P. Latowsky, at the 1998 Joint Annual Conference of the International Society for Environmental Epidemiology and the International Society of Exposure Analysis (ISEA), 16 August 1998, Boston, MA.

Lessons from the Woburn Project
http://cyber.law.harvard.edu/acivilaction/

Resources *A Civil Action* and the legal case of Anne Anderson *et al.,* v. W. R. Grace & Co. *et al.* Links are to Web sites, many of which exclusively found on this site, including the record of our January 30th conference which brought together many of the case's major figures and a video of our conference sessions.

Science in the Courtroom
http://www.geology.ohio-state.edu/courtroom/

An Ohio State University undergraduate honors class examines the hydrologic, geologic, and chemical data from the Woburn Superfund site.

Wells G & H Superfund Site: Woburn, Massachusetts
http://www.cpa.gov/region01/remed/sfsites/wellsgh.html

The record of the U.S. Environmental Protection Agency's actions taken in Woburn and on behalf of the parties involved in the case.

Woburn Leukemia Cluster Study
http://www.magnet.state.ma.us/dph/beha/woburn.htm

A history of Massachusetts Department of Public Health's involvement in the Woburn studies.

Yahoo! Movies—Full coverage: A Civil Action
http://headlines.yahoo.com/Full_Coverage/Movies/A_Civil_Action/

This site provides many links to newspaper articles covering the release of the movie and the controversies rekindled. Reviews, commentaries, and lists of other links are provided.

Along with the audiovisual titles, we include the names of the producer(s) or distributor(s) (it is sometimes difficult to tell the two apart even after directly viewing the product) from which one may purchase or find out more about the product. It is best to contact the producer or distributor to determine if the title(s) you are seeking are available for sale or for rent. It is best to request a catalog of titles currently available for the most up-to-date inventory of a producer's or distributor's titles. You may also want to check your public library to determine what titles are held there or inquire whether audiovisual materials may be obtained through interlibrary loan agreements.

University libraries also have audiovisual materials in their collections. Such materials are generally located by using the library catalog. Most university and college libraries card catalogs have been replaced with online versions of their collections, and these online equivalents, online public access catalogs (OPACs), are another tool to use when searching for audiovisual

materials. Go directly to a local college's or university's OPAC and investigate their holdings. Government-agency libraries and information centers may also hold copies of audiovisual resources, as would extension service program offices (e.g., U.S. Department of Agriculture or Sea Grant) at the state and county levels.

A great many professional meetings provide selected papers from their annual or specialized meetings on audiotape or video, and in some cases, the entire proceedings are available on CD-ROM.

Sources to locate titles of audiovisual resources include any number of laboratory safety catalogs, trade publication advertisements, newsletters, and exhibits at conferences and workshops. Several reference sources for locating audiovisual resources include:

LOCATORplus
U.S. National Library of Medicine (NLM)
8600 Rockville Pike
Bethesda, MD 20894
Phone: 888-FIND-NLM
301-594-5983
Web: http://www.nlm.nih.gov.locatorplus

Contains full bibliographic descriptions of more than 32,000 audiovisual and other non-print teaching materials cataloged by U.S. National Library of Medicine.

National Infomation Center for Educational Media (NICEM)
PO Box 8640
Albuquerque, NM 87198-8640
Phone: 505-265-3591
800-926-8328
Fax: 505-256-1080
E-mail: nicem@nicem.com
Web: http://www.nicem.com

The NICEM database (International Directory of Educational Audiovisuals) of videos, audios, computer software, filmstrips, slides, laser discs, and assorted other educational media is available through a variety of means, including online, on CD-ROM, and in print.

WorldCat
Online Computer Library Center
6565 Frantz Rd.
Dublin, OH 43017-3395
Phone: 614-764-6000
E-mail: oclc@oclc.org
Web: http://www.oclc.org

Provides access to any type of materials cataloged by more than 15,000 libraries participating in the Online Computer Library Center (OCLC) network, including non-print media resources. A unique feature of WorldCat is a listing of libraries who have reported ownership to individual titles and their status as an interlibrary loan (ILL) lender.

Other online databases for retrieving information on audiovisual resources include, but are not limited to:

Agricola (U.S. Department of Agriculture)
AVMARC (Library of Congress)
LC MARC—Visual Materials (Library of Congress)

Various print resources are available for locating information related to audiovisual resources, including the following standard reference materials.

The National Wildlife Federation's annual **"Conservation Directory"** provides an inventory of about 30 sources of audiovisual materials or information on the availability of audiovisual resources related to conservation and environmental topics in a general perspective.

"The Gale Environmental Source Book" (Gale Research Company, Detroit, MI) features a chapter on videos. This 1992 title is a bit dated, but it serves as a rather comprehensive resource for audiovisual resources produced in the 1980s and into the early 1990s, and many of the resources are still available. Other print resources for locating information on audiovisual resources include:

Bowkers Complete Video Directory
RR Bowker, New Providence, NJ

Video Source Book
Gale Research, Detroit, MI

Instructional Materials for the Chemical and Petroleum Industries
OMG Booksource Co., Baltimore, MD

AV Market Place
[for lists of audiovisual services and suppliers in the U.S. and Canada]
RR Bowker, New Providence, NJ

Private production companies, such as Instant Replay (1349 East McMillan Street, Cincinnati, OH 45206; 513-569-8600), and commercial video rental and sale stores, such as Blockbuster Video or Media Play can assist in obtaining videos. You should check your local telephone book's yellow pages for appropriate listings of these services.

AUDIOVISUAL RESOURCES TITLES

A Question of Risk: Toxic Chemicals and Community Decisions (VHS)
Center for Environmental Information, Inc.

Advances in Toxicology (audiocassette)
Audio Digest Foundation

Ag Chemical Emergency Response: A Firefighters Guide (VHS)
Monsanto

Agent Orange—A Search for Answers (16 mm film, VHS)
U.S. National Audiovisual Center

Agent Orange—Putting the Pieces Together (VHS)
University of Wisconsin, University Extension

Agricultural Health Research at UC Davis (VHS)
Marshfield Video Network

Air Pollution—The Facts (16 mm film)
American Lung Association

Air Pollution and Human Health (two-part microscope slide set with script)
National Teaching Aids, Inc.

Air Pollution Impacts on Body Organs and Systems (Slide Program)
National Association of Physicians for the Environment

Air to Breathe (VHS)
The BIZ

Air, Water, and Industry (VHS)
Dow Chemical Co.

Always Suspicious, Always Prepared (VHS)
Pyramid Film and Video

American Agenda: Environmental Racism (VHS)
WABC-TV Channel 7-ABCNews

The American Way of Cancer (VHS)
AFL/CIO

. . . And Justice for All
Presbyterian Church U.S.A.

Applying Basic Chemistry (VHS)
Advanced Technology Environmental Education Center

Are Anesthetic Drugs Teratogenic (VHS)
University of Texas Medical School at Houston

Asbestos (VHS)
Department of Environmental Health and Safety

Asbestos (VHS)
U.S. National Audiovisual Center

Asbestos (20-minute and 10-minute version) (VHS)
Video Training Source

Asbestos—A Lethal Legacy (16 mm film, VHS)
Time-Life Films

Asbestos—The Way to a Dusty Death (16 mm film, BETA/VHS)
ABC Wide World of Learning
MTI Teleprograms

Asbestos: Understanding the Hazards (VHS)
The BIZ

Asbestos Abatement Training Materials
e.g., **Asbestos Abatement Contractors and Supervisors Model Curriculum for Training** (35 mm slides) and others
National Technical Information Service

Asbestos and Associated Pulmonary Diseases (2×2 slides)
Medcom, Inc.

Asbestos Awareness (VHS)
Bureau of National Affairs.

Asbestos Awareness (VHS)
Coastal Video Communications Corp.

Asbestos Awareness (CD-ROM)
Long Island Productions, Inc.

Asbestos Awareness in the Workplace (VHS)
Long Island Productions
Bureau of National Affairs

Asbestos Awareness Training for School Maintenance and Custodial Employees (VHS)
Office of Environmental Management, Health and Safety

Asbestos Health Hazards: A General Overview (VHS)
UBIX

Asbestos in Buildings (VHS)
The BIZ

Asbestos Safety in Schools (VHS)
AFL/CIO

The Asbestos Threat (VHS)
Long Island Productions

Asbestos Threat (VHS)
Safety Video

Assessing Environmental Exposures (VHS)
California Department of Health Services

Atomic Guinea Pigs (VHS)
Films for the Humanities and Sciences

Atrazine, Water Quality, and Best (VHS)
Management Practices

Audiovisual Training Aids on:
Air quality
Hazardous materials
Spill prevention
(various multimedia packages)
National Technical Information Service

Awareness for Initial Response to Hazardous Materials Incidents (VHS)
Advanced Technology Environmental Education Center

Bad Chemistry—Environmental Illness
Films for the Humanities & Sciences

Basic Chemistry and Toxicology (VHS)
Mosby (Lifeline)

Basic Concepts of Chemical Safety—Your Health Matters (VHS)
The BIZ

Basic Hazardous Material Toxicology for Field Responders (VHS)
Mosby

Basic Life Support and Hazardous Materials Support (VHS)
NTIS

Behind the Smoke Screen: Facts About Tobacco Use (VHS)
Films for the Humanities and Sciences

Benzene (VHS)
Video Training Source

Benzene, Toluene, Xylene (VHS)
Emergency Film Group

Benzene Safety Training (VHS)
Gulf Publishing Co.

Beyond Business as Usual (VHS)
Advanced Technology Environmental Education Center

Big Fears, Little Risks (VHS)
Film Counselors Associates

Biochemistry, Pharmacology, and Toxicology of the Alcohols (slides)
Milner-Fenwick

Blow the Whistle: How to Protect Yourself and Win (VHS)
The Video Project

Booklets—Health and Safety
e.g., ''Environmental Awareness''
''Hazardous Communication''
''Hazardous Communication—Construction''
''Hazardous Materials''
''Lab Safety''
''Lead Safety in Construction''
National Safety Council

Breath of Fresh Air (VHS)
Environmental and Occupational Health Sciences Institute.

Brownfields Redevelopment: Tools for Environmental Justice (VHS)

CAER Code (Community Awareness and Emergency Response Code) (VHS)
Chemical Manufacturers Association

CAER Program: Planning Emergency Exercises (VHS)
Advanced Technology Environmental Education Center

Can Mercury from Dental Amalgam Cause Your Health Problem? How to Remove Poison and Restore Your Health (VHS)
Queen & Company Health Communications, Inc.

Cancer and the Environment (VHS)
U.S. National Audiovisual Center

Cancer Risks (beta/VHS)
University of Texas–Anderson Hospital

Cancer's Impact on You—Radiation Hazards (VHS)
University of Arizona

Carbon Monoxide (VHS)
Long Island Productions

Carbon Monoxide: The Silent Killer (VHS)
Syndistar, Inc.

Carbon Monoxide Poisoning—Hypohemoglobinemic Hypoxia (16 mm film, silent)
Iowa State University

Carbon Monoxide Safety and Health (VHS)
Long Island Productions

Carcinogenic Chemicals (VHS)
Long Island Productions

Carcinogens, Mutagens, Teratogens (VHS)
Long Island Productions, Inc.

Caring for Life (VHS)
Society of Toxicology

Cases in Toxicology (audiocassette)
Audio Digest Foundations

Casmalia: Fighting a Deadly Neighbor (VHS)
Greenpeace

Cells Out of Control—The Causes of Cancer (35 mm slides)
Guidance Association/Center for Humanities

Chattanooga: A Community with a Vision (VHS)
Video Project

Chelation's Healing Powers
Malibu Video

Chemical Carcinogenesis—The Staging Theory (16 mm film or VHS)
McGraw-Hill Films

Chemical Hazard Identification and Training (VHS)
Long Island Productions

Chemical Hazards (16 mm film)
Kalmia Co.

Chemical Hazards (VHS)
Office of Environmental Management, Health and Safety

Chemical Hazards: Nurse Vera Explains It All (VHS)
Bureau of National Affairs

Chemical Hygiene Plan (VHS)
National Safety Council

Chemical Management Training—The Toxic Substances Control Act (TSCA) (VHS)
TSCA Video Lending Library

Chemical Safety—Health Hazards (VHS)
The BIZ

Chemical Safety in the Laboratory (VHS)
The BIZ

Chemical Safety Series (VHS)
The BIZ

Chemical Safety Training (VHS)
American Hospital Association

Chemical Storage Hazards (VHS)
Office of Environmental Management, Health and Safety

Chemical Toxicology (VHS)
American Chemical Society

Chemical Toxicology (online tutorial)
Risk Management Internet Services

Chemical Valley (VHS)
Appalshop Film & Video

Chemical Warfare
MPI Home Video

Chemical Waste—The Poisoning of America (filmstrip)
Society for Visual Education

Chemical Waste on Campus (VHS)
Office of Environmental Management, Health and Safety

Chemicals and Common Sense (VHS)
International Film Bureau, Inc.

Chemicals on Campus: Managing the Process for Design to Disposal (VHS)
Office of Environmental Management, Health and Safety

Chemicals & Pregnancy: Give Your Baby The Right Start (VHS)
The BIZ

ChemSafe Series, BNA (Bureau of National Affairs) (VHS)
Titles include ''Introduction to Chemical Safety''; ''Corrosives''; ''Solvents''; ''Oxidizers''; ''Poisons''; ''Gases''; ''Explosives''; and ''Carcinogens.''
Advanced Technology Environmental Education Center

Chemical Transportation Emergency Center (CHEMTREC) (VHS)
Chemical Manufacturers Association

Childhood Lead Poisoning in Arizona: A Physician Primer (VHS)
Arizona Department of Health Services

Chlorinated Hydrocarbons (filmstrip)
Random House, Inc.

Chlorine Crisis (VHS)
Greenpeace

Chlorine Does a World of Good (VHS)
Chemical Manufacturers Association

Cleaning Up Toxics: A 2-part How-to Series (VHS)
''Cleaning Up Toxics at Home''
''Cleaning Up Toxics in Business''
The Video Project

Cleaning Up Toxics (VHS)
National Environmental Health Association

Clinical Applications of Environmental Epidemiology and Toxicology for Primary Care Practitioners (VHS)
California Dept. of Health Services

Clinical Evaluation of Suspected Environmental and/or Occupational Illnesses (VHS)
California Department of Health Services

Clinical Issues in Environmental Epidemiology (VHS)
California Dept. of Health Services

Clinical Toxicology (audiocassette)
Audio Digest Foundation

CMA Outreach Series (VHS)
Building Blocks of Our World: Chlorine (VHS) (classroom materials, including teaching building)
Chemistry (VHS)
Educational Resource Guide
Chemicals We Use Every Day (poster, teachers guide, module kit)
Responding to the Media Following a Chemical Incident (VHS)
Risk: Taking Chances, Making Choices (teachers guide and student workbook)
What We Learned in the Valley (Charleston, West Virginia) (VHS)
Chemical Manufacturers Association

CO Response to Carbon Monoxide Incidents (VHS)
Emergency Film Group

CO Safety (Carbon Monoxide Safety)
LPV Productions

COSHH (Control of Substances Hazardous to Health) Regulations 1989 (VHS)
The BIZ

COSHH in Practice (VHS)
The BIZ

Communicating the Hazard of Ammonia (VHS)
Video Training Source

Communicating the Hazard of Chlorine (VHS)
Video Training Source

Communities in Crisis (VHS)
Greenpeace

Community Pharmacists' Role in Preventing and Treating Insect, Pesticide, and Sun-induced Medical Problems (VHS)
Medical University of South Carolina, College of Pharmacy and Health Communications Network

Controlling Lead Exposure for Stained Glass Professionals and Hobbyists (VHS)
Lead Industries Association

Dangers of the Animals Rights Movement (35 mm slides)
Society of Toxicology

Deadly Chemicals—Who's Minding the Store (35 mm slides)
Carolina Biological Supply Co.

Deadly Chemicals—Who's Minding the Store (filmstrip)
Current Affairs Films
Educational Images Ltd.

Deadly Deception
The Video Project

Deadly Formula (VHS)
Films for the Humanities and Science

Deadly Meat: When Hamburgers Can Kill (VHS)
Films for the Humanities and Sciences

Death in the West (VHS)
(Effects of smoking, viewed as a classic by C. Everett Koop, former U.S. Surgeon General)
Media Basics Video

Decontamination (VHS)
Video Training Source

A Degree of Risk—Risk Assessment in Practice (VHS)
The BIZ

Developing a Comprehensive Hazardous Materials Exercise Program (VHS)
Federal Emergency Management Agency

Dioxin—International Concern (VHS)
Journal Films, Inc.

Disease and Death (VHS)
Part 1: Disease and Health in Past Ages
Part 2: The Science of Health (includes cancer, toxic wastes)
Hawkhill Associates

Disposal of Household Hazardous Waste (slides)
Cornell Cooperative Extension

Do I Work in a Sick Building? (booklet)
American Industrial Health Association

Docket HM-181 Video Training Series (VHS)
Advanced Technology Environmental Education Center

Don't Blow It (VHS)
Environmental Protection Agency, Office of Pollution, Prevention, and Toxics

Down Wind/Down Stream (VHS)
Bullfrog Films

Drugs during Pregnancy—Are They Really Safe? (VHS)
University of Michigan Medical School

Drugs and Pregnancy (2×2 slides)
Ohio State University

Dying for a Smoke (VHS)
Media Basics Video

Earth At Risk Series (VHS)
Clean Air
Clean Water
Nuclear Energy/Nuclear Waste
Library Video Company

E. Coli: Case of the Mysterious Microbe (VHS)
Films for the Humanities and Sciences

Eco-Rap: Voices from the Hood (VHS)
The Video Project

Emergency Medicine Tapes 18 & 19—Toxicology (VHS)
CME Conference Video, Inc.

Emergency Planning (VHS, CD-ROM)
Long Island Productions, Inc.

Emergency Planning (VHS)
Emergency Evacuation Training: Preparing for the Future
Emergency Planning: Everybody's Business
Incident at Building 13 (Emergency Response)
Bureau of National Affairs

Emergency Planning/Emergency Response (VHS)
Flammable Liquids and Emergency Response: Proper Recognition and Safe Handling
Flammable Solids and Other Class Four Reactive Materials
Medical Responses to Chemical Emergencies
Oxidizers: Identification, Properties, and Safe Handling.
Poisons: Identification, Toxicity, and Safe Handling
Teamwork—Safe. Handling of a Hazardous Materials Incident
Chemical Manufacturers Association

Emergency Response: Incident Command System for Industrial Response (VHS)
National Safety Council

Employee's Right-to-Know Hazardous Materials Training Program (VHS)
American HazMat

Environmental Disasters in Property Transactions (audiocassettes)
Practicing Law Institute

Environmental Health (VHS)
RMI Media Productions

Environmental Health and Safety: Toxic Waste (VHS)
Office of Environmental Management, Health and Safety

Environmental Health for Physicians (VHS)
Medical University of South Carolina
Health Sciences Consortium

Environmental Illness: Bad Chemistry (VHS)
National Environmental Health Association
Films for the Humanities and Sciences

Environmental Justice (VHS)
Greenpeace

Environmental Safety (VHS)
RMI Media Productions

Environmental Toxicology: A Question of Balance (VHS, French or English)
Canadian Centre for Pollution Prevention

Environmental Vision (VHS)
Environmental Defense Fund

Environmental and Toxic Tort Claims: Insurance Coverage in 1989 and Beyond (audiocassettes)
Practicing Law Institute

EPA Poisons: My Sister's Story
The Video Project

Epidemics and the Environment (VHS)
Films for Humanities and Science

The Epidemiology of Pesticide Poisonings (16 mm film)
U.S. National Audiovisual Center

Ethylene Oxide (VHS)
The BIZ

The Etiology of Cancer (CD-i interactive multimedia)
SilverPlatter Education

Experimental Animals (VHS)
The Video Project

Farm Chemicals and Water Quality (VHS)
Agricultural Communications in Education

Fetal Alcohol Syndrome: Life Sentence (VHS)
Films for the Humanities and Sciences

Fetal Alcohol Syndrome and Other Drug Use During Pregnancy (VHS)
Films for the Humanities and Sciences

Fighting Fraudulent Testimony with World Class Experts (VHS)
Chemical Manufacturers Association

Fire Academy Training—Hazardous Materials: The Pesticide Challenge (instructor's package, student materials)
National Technical Information Service

First aid and Safety—Poisonings (16 mm film, VHS)
MTI Teleprograms
Churchill Films

First Aid Video Series (VHS)
Part 2. Poisons and Drug Overdose
Media Basics Video

Food Poisoning: The Choice is Yours! (VHS)
National Environmental Health Association

Food Safety (VHS)
Films for the Humanities and Sciences

Formaldehyde—A National Debate (VHS)
Modern Picture Service

From Sea to Shining Sea (VHS)
Bullfrog Films

The Four Corners: A National Sacrifice Area? (VHS)
Bullfrog Films

Get the Lead Out: A Community Discussion Package (multimedia package)
Lead Poisoning Prevention Education Training Program

Getting the Lead Out (VHS)
Lead Poisoning Prevention Program

Global Dumping Ground (VHS)
The Video Project
Media Basics Video

Growing Up Lead Safe (VHS, English or Spanish)
Manchester Health Department

The Great Experiment: Great Lakes Toxics (VHS)
Films for the Humanities and Sciences

Great Lakes Alive (VHS)
Canadian Centre for Pollution Prevention

Great Lakes Shore Line Protection and Clean Up: Spill Response and Environmental Impacts (VHS)
Canadian Centre for Pollution Prevention

Grower Pesticide Safety Course: Ontario Pesticide Education Program (VHS)
Canadian Centre for Pollution Prevention

Growing Like a Weed (VHS)
The Video Project

Growing Up Lead Safe (VHS)
National Environmental Health Association

Guide to AHERA Compliance (Asbestos) (VHS)
Long Island Productions

HACCP—Hazard Analysis and Critical Control Points: Food Hygiene and Safety (VHS)
The BIZ

HMT 240 (AV): Emergency Response II—Teaching and Learning Activities for the DECIDE Process (2×2 slides)
Hazardous Materials Training and Research Institute

Halogenated Solvents (VHS)
The BIZ

Handling Hazardous Chemicals (VHS)
CRM Films

Handling Safety Hazards (VHS)
The BIZ

Harrisburg (Three Mile Island) (VHS)
Bullfrog Films

Hazard Alert—Laboratory Spills (VHS)
The BIZ

Hazard Communication/Right-To-Know Series (VHS)
Bureau of National Affairs

Hazard Communication (software on disk)
National Safety Council

Hazard Communication (CD)
Safety Video

Hazard Communication (VHS)
Video Training Source
Department of Environmental Health and Safety
Long Island Productions

Hazard Communication—Health Care (VHS)
Long Island Productions

Hazard Communication: Road to Safety (VHS)
CRM Films

Hazard Communication: What's Wrong With This Picture? (VHS)
Bureau of National Affairs

Hazard Communication: Your Safety Net (VHS)
Coastal Video

Hazard Communication in the Health Care Setting (VHS)
Cinecraft Health & Safety Systems.

Hazard Communications: General Industries (VHS)
Safety Video

Hazard Communications: Hospitality Industry (VHS)
Safety Video

The Hazard Zone (VHS)
The BIZ

Hazardous Chemicals (VHS)
Film Communicators

Hazardous Chemicals—Handle with Care (35 mm slides)
Powell Labs/Carolina Biological Supply Co.

Hazardous Chemicals & Materials in Schools for Teachers (VHS)
Long Island Productions

Hazardous Inheritance (VHS)
Cambridge Documentary Films, Inc.

Hazardous Materials (video disc)
DAROX Interactive.

Hazardous Materials: A Citizen's Orientation (online tutorial)
Risk Management Internet Services

Hazardous Materials: Emergency Response (16 mm film)
Courter Films

Hazardous Materials and the EMS Response (VHS)
Emergency Training, Inc.

Hazardous Materials Contingency Planning Course for EPA, FEMA and DOY Requirements (VHS)
Advanced Technology Environment Education Center

Hazardous Materials Emergencies: A Special Report (DOT)
Livingston Train Derailment: Anatomy of a Crisis
CMAs Community Awareness and Emergency Response (CAER) Program: CAER #2 Reachout
Illegal Dumping in Cecil County, MD
Santa Clara County, CA: Chemical Hazard Assistance Program

Hazardous Materials Spill Cleanup (VHS)
Safety Video

Hazardous Spills and Flammables (VHS)
Safety Video

Hazardous Toxic Materials (VHS)
Film Communicators

Hazardous Waste (slides)
Cornell Cooperative Extension

Hazardous Waste—The Poison around Us (VHS)
Associated Press

Hazardous Waste—The Search for Answers (16 mm film)
AFL/CIO

Hazardous Waste Disposal (VHS)
Department of Environmental Health and Safety

Hazardous Waste Management (VHS)
Gulf Publishing

Hazardous Waste Options (16 mm film)
Stuart Finley, Inc.

Hazardous Wastes (filmstrip, two-part series)
Prentice Hall Media

Hazardous Wastes (VHS)
Decon (Decontamination)
The Disposal Facility
Drum Beat (Container Handling)
Handling Hazardous Waste
Hazardous Waste (Refresher)
Introduction to Hazardous Waste
Incident at Building 13 (Emergency Response)
Liquid Hazardous Waste
Packaging Hazardous Waste
Spills Happen: A Training Program for Small Spill Response
Tightrope
The Transporter's Checklist
Uniform Hazardous Waste Manifest
The Bureau of National Affairs

Hazardous Wastes and Superfund (VHS)
American Bar Association

HazChem Series, 11 Volumes (VHS)

HazCom—Your Right-to-Know (VHS)
Safety Video

HAZWOPER (VHS)
Long Island Productions

HAZWOPER—Series of 21 Applications (VHS)
Bureau of National Affairs

Health Hazards—Our Need to Know (16 mm film, VHS)
International Film Bureau, Inc.

Health Hazards of Working with Asbestos (2×2 slides)
Dow Chemical Co.

Health Hazards of Working with Pesticides (16 mm film)
U.S. National Audiovisual Center

Health and Safety (35 mm slides and VHS)
The BIZ

Health and Safety Double Pack (VHS)
The BIZ

Health and Safety for Educational Institutions (VHS)
Office of Environmental Management, Health and Safety

Health and Safety and Environmental Programs for Educational Institutions (VHS)
Office of Environmental Management, Health and Safety

Health and the Environment (VHS)
Films for the Humanities and Sciences

A Healthy Baby Girl (DES) (VHS)
Women Making Movies

Heptachlor in Hawaii (VHS, two-part series)
Bullfrog Films

Heroes of the Earth (VHS)
The Video Project

History of Toxic Waste in the Biosphere (filmstrip)
Random House

Hope (VHS)
Society of Toxicology

Hormone Copy Cats: The Emerging Issue of Endocrine Disruptors (VHS)
World Wildlife Fund Canada

How Green Is the Valley? Umgeni River (Natal, South Africa) (VHS)
Greenpeace

How to Analyze for Heavy Metals in Environmental Waters (2×2 slides)
Part 1. Absorption; Part 2. Atomic; Part 3. Anodic Communication Skills

How to Analyze for Chlorinated Hydrocarbon Pesticides in Water Using Gas Chromatography (2×2 slides)
Communication Skills

The Hudson River PCB Story: A Toxic Heritage (VHS)
Hudson River Sloop Clearwater

How to Save the Earth Series (VHS)
Bullfrog Films

Human Health Risk Assessment Process (slides & computer disk)
Center for Process Safety

Hydrogen Sulfide—Don't Let It Get You Down (VHS)
The BIZ

Hydrogen Sulfide—Matter of Minutes (VHS)
The BIZ

Implementing Risk Communication: Overcoming the Barriers (VHS)
American Industrial Health Association

In Our Own Backyard: The First Love Canal (VHS)
Bullfrog Films

In Our Own Backyards: Uranium Mining in the United States (VHS)
Bullfrog Films

In Partnership with Earth: Pollution Prevention for the 1990s (VHS)
Advanced Technology Environmental Education Center

Incident Under Control (VHS)
The BIZ

Inhalants: A Deadly High (VHS)
Meridian Education Corp

Initial Response to Hazardous Materials Incidents: Concept Implementation (multimedia)
NTIS

Introduction to Applied Toxicology (online tutorial)
Risk Management Internet Services

Introduction to Hazardous Materials (VHS)
Advanced Technology Environmental Education Center

Introduction to Health and Safety for Educational Institutions (VHS)
Office of Environmental Management, Health and Safety

Is There Poison in Your Mouth (VHS)
Ambrose Video Productions

Isocyanates (VHS)
The BIZ

It's Your Right to Be Safe (VHS)
Office of Environmental Management, Health and Safety

Jorge's New Job: The Importance of Cholinesterase Testing (VHS)
Agricultural Communications in Education

Journey of the Blob (VHS)
Bullfrog Films

Keep the Promise—Learn about Lead (VHS)
The Lead Program

Kids at Risk—Getting the Lead Out of Your Home (VHS)
Consumer Action

Kids at Risk: How to Cover Children's Environmental Health Stories (VHS)
Radio and Television News Directors Foundation

Kids and Lead Hazards—What Every Family Needs to Know (VHS)
Films Incorporated

Kids and Pesticides (VHS)
Films for the Humanities and Sciences

Lab Safety (VHS)
CRM Films

Laboratory Animals: Toxicology and the Public (VHS)
Production Plus

Laboratory Dogs (VHS)
Animal Welfare Institute

Laboratory Safety (VHS)
CLMA

LabL Material Safety Data Sheets (VHS)
Advanced Technology Environmental Education Center

The Last Epidemic (VHS)
The Video Project

Lead: The Silent Epidemic (35 mm slides, VHS)
Visual Media

Lead Based Paint (VHS)
Advanced Technology Environmental Education Center

Lead Buster (rap audiotape)
St. Louis Health Division

Lead Contamination: Health and Policy Implications (VHS)
Office of Environmental Management, Health and Safety

Lead Contamination: Taking Action—Identification, Control, and Abatement (VHS)
Office of Environmental Management, Health and Safety

Lead Exposure on the Job (VHS, Spanish version also available)
Long Island Productions

Lead in the Blood (VHS, Hmong language)
Minnesota Department of Health

Lead Paint Poisoning (16 mm film)
U.S. National Bureau of Standards

Lead Poisoning (VHS)
National Environmental Health Association

Lead Poisoning (2×2 slides)
National Medical Audiovisual Center
Fanfare Productions

Lead Poisoning (16 mm film)
West Glen Communications

Lead Poisoning—Getting Lead Out (VHS)
Films for the Humanities and Sciences

Lead Poisoning—It Affects Everyone (VHS)
Greater St. Louis Lead Poisoning Prevention

Lead Poisoning—The Hidden Epidemic (16 mm film)
Long Island Film Studios

Lead Poisoning—The Invisible Threat to Your Children (VHS)
Lead Elimination Action Drive

Lead Poisoning—It Doesn't Have to Happen (VHS)
Pennsylvania Chapter, American Academy of Pediatrics

Lead Poisoning Could Strike Your Child (16 mm film, VHS)
Mar/Chuck Film Industries

Lead Poisoning from Lead-Based Paint (VHS)
Advanced Technology Environmental Education Center

Lead Poisoning Prevention—A Video Guide for Parents (VHS)
Filmcraft Productions

Lead Poisoning—What Everyone Needs to Know (VHS)
Altschul Group

Lead Standard—OSHA Regulations (VHS, CD-ROM, Spanish Version also available)
Long Island productions

The Lindane Legacy
WLIW-21 (PBS)

Living Under the Cloud: Chernobyl Today (VHS)
Bullfrog Films

Living with Lead (VHS)
National Environmental Health Association

Living with Lead (VHS)
The Video Project

Living with TSCA Conference (VHS)
Chemical Manufacturers Association

Lois Gibbs and the Love Canal (VHS)
Trylon Video

Long-Term Health Effects of Pesticide Exposure (VHS)
Agricultural Communications in Education

Long-Term Pesticide Exposure (VHS)
Agricultural Communications in Education

Love, Flowers, Women (VHS)
Women Making Movies

MSDS: Read It Before You Need It (VHS)
Office of Environmental Management, Health and Safety

Making Your Home Lead Safe (VHS)
Iowa Department of Public Health

The Mighty River (VHS)
The Video Project

Managing Toxins, 2 Volumes (audiocassette)
Audio Digest Foundation

Managing the Hazardous Materials Incident (VHS)
Advanced Technology Environmental Education Center

Material Safety Data Sheets (VHS)
Long Island Productions

Material Safety Datasheets Terminology: Interpreting Chemical Properties (VHS)
Advanced Technology Environmental Education Center

Med-Challenger EM: Clinical Reference and Educational Software for Emergency Physicians (CD-ROM)
Module 3.2 Environmental Injuries
Module 3.3 Toxicology

Medical Aspects of Toxic Tort Cases (audiocassettes)
The Institute

Medical Operations at HazMat Incidents (VHS)
Emergency Film Group

Medical Programs (VHS)
Advanced Technology Environmental Education Center

Medical and Environmental Emergencies (2×2 slides)
Robert J. Brady Co.

(Of) Mercury, Sheep, and Man (VHS)
Productions West

Mercury Story (VHS)
Arkansas Educational Telecommunications Network

Mercury Toxicity from Dental Fillings (VHS)
Malibu Video

M.E.S.H.—Managing Employee Safety and Health: A Complete Course for Supervisors (leader's kit and VHS)
The BIZ

Metal Toxicology (VHS)
Gamut Productions

Methyl Ethyl Ketone (MEK) (VHS)
The BIZ

A Miracle at Risk (VHS)
Society of Toxicology

More Than We Can Bear: Reproductive Hazards in the Work Place (VHS)
The Labor Institute

Multiple Chemical Sensitivities: No Place to Hide (VHS)
Films for the Humanities and Sciences

NEHA Learning Modules (VHS)
Data Collection, Arrangement, and Interpretation
Hazardous Materials Incident Response
Improving Communication
Occupational Health
Radiation in the Human Environment
Radiological Health
Toxicology: Common Problems
National Environmental Health Association

NEHA's Fundamental Toxicology & Risk Assessment (VHS)
National Environmental Health Association

NEHA's OSHA 8-Hour Refresher Course (VHS)
National Environmental Health Association

Neurotoxicology (VHS)
California Dept. of Health Services

A New Look at Lead Toxicity—from the conference on Childhood Lead Toxicity (VHS)
McNiel Consumer Products Company

Nine Steps to Safe Pesticide Use: A Guide for Home Owners (VHS)
Agricultural Communications in Education

NO CO (carbon monoxide) (VHS)
Northern Illinois Gas

The NOVA Series (VHS)
Can Buildings Make You Sick?
Library Video Company
Media Basics Video

The Nuclear Threat at Home (VHS)
The Video Project

Office Hazard Communications (VHS)
Safety Video

OSHA's Chemical Standards (VHS)
American Society of Clinical Pathologists

OSHA Lab Standard (VHS)
Office of Environmental Management, Health and Safety

Occupational Health (BETA/VHS)
TV Ontario

Occupational Health Issues (VHS)
Long Island Productions

Occupational Health Training Course for Compliance Safety and Health Officers (2×2 slides)
U.S. National Audiovisual Center

Occupational Medical Surveillance (VHS)
The BIZ

Occupational Medicine (audiocassette)
Audio Digest Foundation

Occupational and Environmental Medicine (VHS)
CMEVideo

Organization for HazMat Emergencies, 3 Volumes (VHS)
Emergency Film Group

Organizing Household Hazardous Waste Collections (VHS)
Agricultural Communications in Education

Our Polluted Planet—The Price of Progress (35 mm slides)
Powell Labs

Our Polluted Planet—The Price of Progress (filmstrip)
Current Affairs Films

Overview of the Resource Conservation and Recovery Act
Chemical Manufacturers Association

Pediatric Aspects of Environmental Epidemiology (VHS)
California Department of Health Services

Pesticide Toxicology (VHS)
Medical University of South Carolina

Pediatric Lead Poisoning for the Practitioner
Lead Poisoning Prevention Education Training Program

Perspectives in Science: Toxic Wastes (CLV Videodisc Series)
Bullfrog Films

Perspective on Pesticides (16 mm film)
U.S. National Audiovisual Center

Pesticide Politics (VHS)
University Community Video

Pesticide Poisoning and Injuries—Where, When, How (2×2 slides)
University of Iowa
U.S. National Audiovisual Center

Pesticide Safety: Worker Protection (VHS)
Agricultural Communications in Education

Pesticide Safety in the Greenhouse (VHS)
AV Resource Center, Cornell University

Pesticide Safety in the Landscape (VHS)
AV Resource Center, Cornell University

The Pesticide Safety Service (VHS)
Visual Education Productions

Pesticide Safety: Worker Protection
AV Resource Center—Cornell University

Pesticide Toxicology (VHS)
The Program

Pesticide Toxicity (filmstrip)
Bergwall Productions
Career Aids, Inc.

Pesticides (filmstrip)
Q-ED Production

Pesticides, Food Safety, and Science (VHS)
University of California

Pesticides Laws and Regulations (2×2 slides)
U.S. National Audiovisual Center

Pesticides and Wildlife (2×2 slides)
Tennessee Game and Fish
U.S. National Audiovisual Center

Pesticides in Agriculture (VHS)
Visual Education Productions

Pesticides in Forestry: Behavior, Toxicology, and Risk Analysis (VHS)
Agricultural Communications in Education

Pesticides in the Environment (2×2 slides)
U.S. National Audiovisual Center

Pointless Pollution: Americas Water Crisis (VHS)
Bullfrog Films

Poison in Disguise: The Dangers of Lead-Based Paint (VHS)
Advanced Technology Environmental Education Center
Ryno Productions

The Poison Problem (16 mm film VHS)
Aims Media

Poisoned Winds of War (VHS)
Coronet

The Poisoning of Michigan (16 mm film, VHS)
Media Guild

Poisonous House and Garden Plants (VHS)
Educational Images Ltd.

Poisonous Wild Plants of North America (VHS)
Educational Images Ltd.

Poisons in the Rockies (VHS)
Bullfrog Films

Politics, People, and Pollution (VHS)
Films for the Humanities and Sciences

Politics of Poison (16 mm film, two-part series)
KRON-TV

Pollution (16 mm film)
University of California

Pollution of the Air (filmstrip)
Clear Vue, Inc.

Pollution of the Water (filmstrip)
Clear Vue, Inc.

Process Safety Management Series (VHS)
Video Training Source

Process Safety Management for Ammonia (VHS)
Video Training Source

Process Safety Management for Chlorine (VHS)
Video Training Source

Profits from Poisons (VHS)
Cinema Guild

Protectors and Polluters (VHS)
The Video Project

Profile of a Hazardous Waste Clean Up (VHS)
Advanced Technology Environmental Education Center

Public Health Context of Clinical Aspects of Environmental Exposure (VHS)
California Dept. of Health Services

Putting Aside Pesticides (VHS)
National Environmental Health Association
Films for the Humanities and Sciences

Quantitative Risk Communication: Explaining the Data: Peter Sandman Explains Risk (VHS)
American Industrial Health Association

Question of Safety (VHS)
Society of Toxicology

RCRA/UST, Superfund, and EPCRA Hotline Training Modules
National Technical Information Service

Rachel Carson Speaks about Silent Spring (audiocassette)
Rachel Carson Council

Rachel Carson's Silent Spring (VHS)
Peace River Films

Rachel's Daughters: Searching for the Causes of Breast Cancer (VHS)
Women Making Movies

Radioactive Waste Disposal: The 10,000 Year Test (VHS)
Films for the Humanities and Sciences

Radiation: Impact on Life (VHS)
Bullfrog Films

Radiation and Environment (VHS)
Media Basics Video

Radiation and Your Environment (VHS)
Educational Media Corporation

Raw Terror: E. Coli Bacteria (VHS)
Films for the Humanities and Sciences

Reducing the Hazards: A Look at the P2 Programs in Texas (VHS)
Canadian Centre for Pollution Prevention

Reducing the Risks of PCBs (VHS)
Environmental Protection Agency, Office of Pollution, Prevention, and Pesticides

Regulatory Compliance—Environmental Library (software on disk)
National Safety Council

Reporting the Risk—How TSCA Sections 8(c) and 8(e) Work (VHS)
TSCA Video Lending Library

Responsible Care
Brochures
Communication Kits
Every Hour Every Day (VHS)
A Look at Three Codes (VHS)
Posters
Understanding Responsible Care (VHS)
Chemical Manufacturers Association

Responsible Chemical Manufacturing (VHS)
The BIZ

Right-to-Know (VHS)
Long Island Productions

Right-to-Know Chemical Safety Video (VHS, Spanish version also available)
Long Island Productions

Right-to-Know Retraining for Health Care (VHS)
Long Island Productions

Risk = Hazard + Outrage: A Formula for Effective Risk Communication (VHS)
American Industrial Health Association

Risk Management Rule: Understanding Atmospheric Dispersion of Accidental Releases (VHS)
American Institute of Chemical Engineering

Safe Handling of Cytotoxic and Hazardous Drug (VHS)
American Society of Hospital Pharmacists

Safe Uses of Pesticides in Outdoor Nurseries: Working Safely Near Pesticides and Handling Pesticides Safely (VHS)
Agricultural Communications in Education

Safely Incinerating Hazardous Wastes (VHS)
Advanced Technology Environmental Education Center

Safety-Kleen Presents the Employees Right-to-Know Hazardous Materials Training Program (VHS)
American HazMat/Impact Through Video

Safety Orientation (VHS, three-part series)
(Environmental safety and health concerns for elementary and secondary schools)
Long Island Productions

SARA Title III: Emergency Training and Community Right-to-Know Training Materials (35 mm slides and binder)
Michigan State University

Second Thoughts: Silver Fillings in Your Head (VHS)
Televent

Seminar on Toxicology and the Chemical Engineer (slides and disk)
Center for Process Safety

Sensitivity, Allergy, and the Immune System (VHS)
California Dept. of Health Services

Silkwood (VHS)
Summa Video

Smokeless Tobacco: Breaking Free (VHS)
Films for the Humanities and Sciences

Society of Toxicology Slide Set (introduces the subject to the general public)
Society of Toxicology

Solid Solutions: Rural America Confronts the Waste Crisis (VHS)
The Video Project

Spills: The First Responder's Duty (VHS)
Bureau of National Affaris

Stop That Dose: Working Safely with Toxic Chemicals (VHS)
American Chemical Society

Sunlight and Skin Cancer (VHS)
Films for the Humanities and Sciences

Superfund (audiocassettes)
Pennsylvania Bar Institute

The Superfund Innovative Technology Evaluation Program (training fiche)
U.S. EPA

Surviving the Hazardous Materials Incident (VHS, Series 1, 9 Parts; Series 2, 11 Parts)
Advanced Technology Environmental Education Center

TSCA Phase II Production (VHS)
TSCA Video Lending Library

TSCA, Section 8(c) (VHS)
TSCA Video Lending Library

TSCA—The Wrong Formula (VHS)
TSCA Video Lending Library

Teratology (35 mm slides)
Teratology Society

Terrorism: Biological Weapons (VHS)
Emergency Film Group

Testing the Waters: Niagara's Legacy (VHS)
Bullfrog Films

Times Beach, Missouri (VHS)
The Video Project

Tina's Journal (VHS)
The Video Project

Tinka's Planet (VHS)
The Video Project

Toluene/Xylene (VHS)
The BIZ

Too Close for Comfort: Reducing Household Toxics (VHS)
Contra Costa County

Toxic Chemicals: Information is the Best Defense (VHS, two-part series)
Bullfrog Films

Toxic Earth—The Need to Unite (VHS)
AFL/CIO

The Toxic Goldrush (VHS)
WNET-TV
Films for the Humanities and Sciences

Toxic Hazard in Industry (16 mm film, VHS)
International Film Board

Toxic Links: Cancer and the Environment (audiocassette)
University of New Mexico

Toxic Perils (VHS)
Econews

Toxic Racism (VHS)
The Video Project
Films for the Humanities and Sciences

Toxic Release Inventory Training Video (VHS)
Dickinson College

Toxic Swat (VHS)
National Geographic

Toxic Tort Litigation (VHS)
Pennsylvania Bar Institute

Toxic Waste—Positive Solutions (VHS)
Econews

Toxic Waste Contamination: In Our Waters (VHS)
Econews

Toxic Waste in America (VHS)
Downtown Community Center TV

Toxic Wastes (VHS)
Part 1. A History of Toxic Wastes in the Biosphere
Part 2. Toxic Wastes Today
Hawkhill Associates

Toxic Wastes (VHS)
Media Basics Video

Toxic Wastes Discovered in Cecil County (VHS)
National Audiovisual Center

Toxic Wastes—Disposal or Dumping (filmstrip)
Random House

Toxic Wastes—The Fouling of America (filmstrip)
Knowledge Unlimited

Toxic Wastes—Today & Tomorrow (filmstrip)
Random House

Toxicological Emergencies (VHS)
American Safety Video Publishers

Toxicological Review (VHS)
U.S. National Audiovisual Center

Toxicology (VHS)
California Department of Health

Toxicology (VHS)
Core Media Training Solutions

Toxicology: A Problem Solving Approach (VHS)
California Department of Health Services

Toxicology Tutorials (online tutorials)
Risk Management Internet Services

Toxicology and Public Health: Understanding Chemical Exposure (5 1/4-inch diskette)
Cornell Cooperative Extension

Toxicology of Cholinesterase-Inhibiting Insecticides (2×2 slides)
U.S. National Audiovisual Center

Toxicology of Commonly Used Herbicides (2×2 slides)
U.S. National Audiovisual Center

Toxigenicity Test of C Diphtheria (16 mm film)
U.S. National Audiovisual Center

Toxins: Occupational and Environmental
Audio-Digest Foundation

Toxins & Poisons (VHS)
AIMS Media

Toxins and Poisons (VHS)
Gulf Publishing Co.

Toxins and Poisons (VHS)
Long Island Productions

Toxins in Our Lives (VHS)
Media Basics Video

Training on a Disc (CD-ROM)
Bureau of National Affairs

TRANSCAER (VHS)
Chemical Manufacturers Association

Turning the Toxic Tide (VHS)
Bullfrog Films

Under Surveillance—Detecting Environmental Hazards (VHS)
American Hospital Association

The Underlying Threat (to groundwater) (VHS)
Bullfrog Films

Uranium (VHS)
Bullfrog Films

Veterinary Toxicology (laser video disc)
American Academy of Veterinary and Comparative Toxicology

Waste Disposal: Household, Medical, Animal (VHS)
Films for the Humanities and Sciences

Wastes (VHS)
Bullfrog Films

Water Pollution (filmstrip)
Guidance Association

Water Pollution—Can We Keep Our Water Clean (16 mm film, VHS)
Journal Films

The Water in Our Backyard (VHS)
The Video Project

What Every Real Estate and Business Lawyer Needs To Know About Environmental Law (audiocassettes)
Pennsylvania Bar Institute

What in the World is an Industrial Hygienist? (VHS)
American Industrial Health Association

What is Poisoning Your Children (VHS)
New York State Department of Health

When the Spill Hit Homer (VHS)
The Video Project

Without a Trace (VHS)
Films for Humanities & Science

Witness to the Future: The Legacy of A Silent Spring and a Call for Environmental Action (VHS)
The Video Project

Worker Right-to-Know (VHS)
Office of Environmental Management, Health and Safety

AUDIOVISUAL MATERIALS—PRODUCERS AND DISTRIBUTORS

Many of the producers and distributors of these AV and non-print resources produce catalogs of their holdings and are most accomodating for sending their inventories in a timely manner.

ABC Wide World of Learning
1330 Avenue of the Americas
New York, NY 10019

Advanced Technology Environmental Education Center
Web: http://ateec.kirkwood.ca.us/videos.html

AFL/CIO
Education Department
815 16th St., NW
Washington, DC 20006

Agricultural Communications in Education
Web: http://www.acewest.orst.edu

Altschul Group Corporation
1560 Sherman Avenue, Suite 100
Evanston, IL 60201
Phone: 800-421-2363 or 708-328-6700
Fax: 708-328-6706

AIMS Media
9710 De Soto Avenue
Chatsworth, CA 91311-4409
Phone: 800-367-2467
818-773-4300

Ambrose Video Publishing
28 West 44th St., Suite 2100
New York, NY 10036
Phone: 800-526-4663
Web: http://www.ambrosevideo.com/

American Academy of Veterinary and Comparative Toxicology
College of Veterinary Medicine
Department of Large Animal Clinical Sciences
CVM Box 1071
University of Tennessee
Knoxville, TN 37901
Phone: 423-974-5701
423-974-8222

American Association of Poison Control Centers
3201 New Mexico Ave., NW, Ste. 310
Washington, DC 20016
Phone: 202-362-7217
E-mail: aapcc@aol.com

American Bar Association
Division of Professional Education
750 N. Shore Drive
Chicago, IL 60611
Phone: 312-988-6101

1800 M St., NW
Washington, DC 20036
Phone: 202-331-2200

American Chemical Society
1155 16th St., NW
Washington, DC 20036
Phone: 202-872-4600
800-227-5558
Fax: 202-872-4615
E-mail: meminfo@acs.org
Web: http://www.acs.org

American Hospital Association
Film Library
840 North Lake Shore Drive
Chicago, IL 60611
Phone: 312-280-6642

American Industrial Health Association (AIHA)
2700 Prosperity Ave., Suite 250
Fairfax, VA 22031
Phone: 703-849-8888
Fax: 703-207-3561
Web: http://www.aiha.org/

American Institute for Chemical Engineering
AChExpress Services Center
345 East 47th St.
New York, NY 10017-2395

American Lung Association
Public Relations Department
1740 Broadway
New York, NY 10019
Phone: 212-315-8700
212-265-5642

American Safety Video Publishers
Mosby-Year Book, Inc.
11830 Westline Industrial Drive
St. Louis, MO 63146
Phone: 314-872-8370

American Society of Clinical Pathologists
2100 W. Harrison St.
Chicago, IL 60612-3798
Phone: 312-738-1336
800-621-4142
Fax: 312-738-1619

American Society of Hospital Pharmacists
7272 Wisconsin Ave.
Bethesda, MD 20814
Phone: 301-657-3000
Fax: 301-652-8278

Animal Welfare Institute
PO Box 3650
Washington, DC 20007
Phone: 202-337-2332
Fax: 202-338-9478
E-mail: awi@animalwelfare.com
Web: http://www.animalwelfare.com

Appalshop Film & Video
306 Madison Street
Whitesburg, KY 41858
Phone: 800-545-7467

Arkansas Educational Telecommunications Network
R. Lee Reaves Center for Educational Telecommunications
Donaghey and Sesame Sts.
Conway, AR 72032
PO Box 1250
Conway, AR 72032
Phone: 800-662-2386
501-682-2386
501-450-1727
Web: http://www.aetn.org

Arizona Department of Health Services
Office of Environmental Health
3815 North Black Canyon
Phoenix, AZ 85015
Phone: 602-230-5808
Web: http://www.hs.state.az.us/edc/ehpage.html

Associated Press
50 Rockefeller Plaza
New York, NY 10020
Phone: 212-621-1500

Audio Digest
1577 East Chevy Chase Drive
Glendale, CA 91206
Phone: 818-240-7500
Web: http://www.audio-digest.org/prog2fr.htm

AV Resource Center
Cornell University
8 Business & Technology Park
Ithaca, NY 14850
Phone: 607-255-9946

AWWA Research Foundation
6666 W. Quincy Ave.
Denver, CO 80235
Phone: 303-794-7711
800-926-7337

Bergwall Productions
PO Box 238
Garden City, NJ 11530
Phone: 800-645-3565

The BIZ
Phone: 01926 854111
Fax: 01926 854222.
E-mail: thebiz@easynet.co.uk
Web: http://www.thebiz.co.uk/info.htm

Robert J. Brady Co.
Rtes 450 & 197
Bowie, MD 20715
Phone: 301-262-6300

Bullfrog Films
PO Box 149
Oley, PA 19547
Phone: 800-543-FROG (543-3764)
610-779-8226
E-mail: bullfrog@igc.apc.org
Web: http://www.bulfrog.com/

Bureau of National Affairs (BNA) Communications
9439 Key West Avenue
Rockville, MD 20850-3396
Phone: 800-21-SAFETY (217-2238)
301-948-0540
Web: http://www.bna.com/

California Dept. of Health Services
Environmental Epidemiology and Toxicology Section
714 P St., Room 550
PO Box 942732
Sacramento, CA 94234-7320
Phone: 916-654-0348
Fax: 916-654-5900
Web: http://www.dhs.cahwnet.gov/

Cambridge Documentary Films, Inc.
PO Box 385
Cambridge, MA 02139
Phone: 617-484-3993

Canadian Centre for Occupational Health and Safety (CCOHS)
250 Main St., East
Hamilton, ON L8N 1H6 Canda

Canadian Centre for Pollution Prevention (C2P2)
265 North Front St., Suite 112
Sarnia, ON N7T 7X1 Canada
Phone: 519-337-3423
800-667-9790
Fax: 519-337-3486

Career Aids, Inc.
20417 Nordhoff St., Dept. VC76
Chatsworth, CA 91311
Phone: 818-341-8200

Carolina Biological Supply Co.
2700 York Drive
Burlington, NC 27215
Phone: 800-334-5551

Center for Environmental Information, Inc.
50 West Main St.
Rochester, NY 14614
Phone: 716-262-2870
Fax: 716-262-4156
E-mail: cei@servtech.com
Web: http://www.awa.com/nature/cei

Center for Process Safety
American Institute of Chemical Engineers
3 Park Avenue
New York, NY 10016-5991
Phone: 212-591-7338
800-242-4363
Web: http://www.aiche.org

Challenger Corporation
5530 Summer Avenue
Memphis, TN 38134-7202
Phone: 901-385-1840
800-676-0822 (ext. 610)
Web: http://WWW.CHALL.COM or http://www.chall.com

Chemical Manufacturers Association
1300 Wilson Blvd.
Arlington, VA 22209
Phone: 713-741-5000
Web: http://www.cmahq.com/index.html

Churchill Films
662 No. Robertson Blvd.
Los Angeles, CA 90069
Phone: 800-339-7830

CIBA-Geigy Corporation
Agricultural Division
556 Morris Ave.
Summit, NJ 07901

Cinecraft Health & Safety Systems
2515 Franklin Blvd.
Cleveland, OH 44113
Phone: 800-959-CINE
216-781-2300
Fax: 216-781-1067
Web: http://www.cinecraft.com/

Cinema Guild
1697 Broadway, Suite 802
New York, NY 10019
Phone: 212-246-5522

Clear Vue Inc.
5711 N. Milwaukee Ave.
Chicago, IL 60646
Phone: 800-253-2788
312-775-0433

CME Conference Video, Inc. (CME Video)
2000 Crawford Place, Suite 100
Mt. Laurel, NJ 08054
Phone: 609-866-9100
Web: http://www.cmeinfo.com/

Coastal Video Communications Group
3083 Brickhouse Court
Virginia Beach, VA 23452
Phone 757-498-9014
Web: http://www.safetyonline.com/storefronts/coastal

Consumer Action
Lead Poisoning Prevention Project

116 New Montgomery St.
San Francisco, CA 94105
Phone: 202-429-9506

Continuing Education Services
3855 Pichett Rd.
PO Box 2666
Fairfax, VA 22031
Phone: 703-425-7500

Contra Costa County
Health Services Department
20 Allen St.
Martinez, CA 94553
Phone: 510-370-5003
Web: http://www.co.contra-costa.ca.us/depart/hsd

Core Media Training Solutions
1732 N.W. Quimby St.
Portland, OR 97209
Phone: 503-223-6794
Fax: 513-223-9654

Cornell Cooperative Extension
Cornell University
Ithaca, NY 13840
Web: http://freedom.cce.cornell.edu/

Coronet Instructional Films
Simon & Schuster Films and Videos
Deerfield, IL 60015

Courter Films and Associates
121 NW Crystal St.
Crystal River, FL 32629

CRM Films
2215 Faraday Ave.
Carlsbad, CA 92008
Phone: 800-421-0833
Web: http://www.crmfilms.com

Current Affairs Films
Key Productions
346 Ethan Allen Highway
Rte. 7, PO Box 426
Ridgefield, CT 06877
Phone: 203-431-0421

DAROX Interactive
7825 Fay Ave., Suite 200
La Jolla, CA 92037
Phone: 800-733-1010
619-456-3577
Fax: 619-456-2114

Department of Environmental Health and Safety
Training and Communication Office
Stanford University
Stanford, CA 94305
Phone: 650-723-0448
Web: http://www-leland.stanford.edu/dept/EHS/

Dickinson College
Department of Environmental Studies
PO Box 1773
Carlisle, PA 17013-2896
Phone: 717-243-5121
Web: http://alpha.dickinson.edu/

Dow Chemical Co.
2030 Dow Center
Midland, MI 48640
Phone: 517-636-1231

Downtown Community TV Center
87 Lafayette St.
New York, NY 10013
Phone: 212-966-4510

Econews
PO Box 351419
Los Angeles, CA 90035-9119
Phone: 310-559-9160

Educational Images, Ltd.
PO Box 3456, West Side Station
Elmira, NY 14905
Phone: 607-732-1090

Educational Media Corporation
2036 Lemoyne Ave.
Los Angeles, CA 90026

Emergency Film Group
225 Water St.
Plymouth, MA 02360
Phone: 800-842-0999
508-746-0466
Web: http://www.efilmgroup.com

Emergency Medicine Educational Enterprises
Cincinnati, OH

Emergency Training Division
Education Direction, Inc.
150 N. Miler Road, Bldg 200
Akron, OH 44333
Phone: 330-836-0600
Fax: 330-836-4227

Environmental Defense Fund
257 Park Avenue, South
New York, NY 10010
Phone: 212-505-2100

Environmental and Occupational Health Sciences Institute
681 Frelinghuysen Rd.
Piscataway, NJ 08855-1179

Phone: 908-445-0200
Web: http://www@www.eohsi.rutgers.edu
http://www.eohsi.rutgers.edu/

Environmental Protection Agency
Superfund Innovative Technology Evaluation Group
401 M St., SW
Washington, DC 20640
Web: http://www.epa.gov

Fanfare Productions
Boston, MA

Federal Emergency Management Agency (FEMA)
Federal Center Plaza
500 C. St., SW
Washington, DC 20472
Phone: 800-480-2520

Film Communicators
(MII Film and Video Rental)
108 Wilmot Rd.
Deerfield, IL 60015
Phone: 800-621-2131

Film Counselors Association
630 9th Ave. #1408
New York, NY 10036

Filmcraft Productions
111 University Rd.
Brookline, MA 02146
Phone: 617-738-3363

Films Incorporated
5547 N. Ravenswood Ave.
Chicago, IL 60640-1199
Phone: 800-343-4312

Films for the Humanities and Sciences
PO Box 2053
Princeton, NJ 08543-2053
Phone: 800-257-5126
609-275-1400
Web: http://www.k3.com/education/films/FHLO-GO.HTML

Greater St. Louis Lead Poisoning Prevention
PO Box 63263
St. Louis, MO 63103
Phone: 314-577-8527

Greenpeace Public Information
1436 U. St., NW
Washington, DC 20009
Phone: 202-319-2444

Guidance Association for Humanities
Communications Park
PO Box 3000
Mt. Kisco, NY 10549

Gulf Publishing Co.
PO Box 2608
Houston, TX 77252-2608
Phone: 800-321-6275

Hawkhill Video
125 E. Gilman St.
PO Box 1029
Madison, WI 53701-1029
Phone: 800-422-4295
Fax: 608-251-3924
Web: http://www.hawkhill.com/

Hazardous Materials Training and Research Institute (HMTRI)
Kirkwood Community College
6301 Kirkwood Blvd., SW
Cedar Rapids, IA 52406
Phone: 800-GO-HMTRI (464-6874)
E-mail: hmtri@kirkwood.cc.ia.us
Web: http://www.hmtri.org

Health Sciences Consortium
201 Silver Cedar Court
Chapel Hill, NC 27514
Phone: 919-942-8731

International Film Bureau
332 So. Michigan Ave.
Chicago, IL 60604-4382
Phone: 312-427-4545

International City/County Management Association
777 North Capitol St., NW, Suite 500
Washington, DC 20002-4201
Phone: 800-745-8780

Iowa Department of Public Health
Des Moines, IA

Iowa State University
Media Resources Center
Media Productions Unit
Exhibit Hall South
Ames, IA 50011
Phone: 515-294-2316

Journal Films, Inc.
930 Pitner
Evanston, IL 60202
Phone: 800-323-5448

Kalmia Co.
21 West Circle,
Concord, MA 01742

Knowledge Unlimited
PO Box 52
Madison, WI 53701-0052
Phone: 800-356-2303

KRON-TV
1001 Van Ess Ave.
San Fransisco, CA 94109

Lead Elimination Action Drive
2125 West North Ave.
Chicago, IL 60647-5495
Phone: 312-292-4990

Lead Industries Assocation
295 Madison Ave., Suite 808
New York, NY 10017
Phone: 212-578-4750

Lead Poisoning Prevention Education Training Program
University of Medicine and Dentistry—School of Medicine, Suite 1600
42 East Laurel Rd.
Stratford, NJ 08084
Phone: 609-566-6034

The Lead Program
Childern's Hospital at Yale, New Haven
333 Cedar St.
PO Box 208064
New Haven, CT 06520-8064
Phone: 203-737-2878

Library Video Company
PO Box 1110
Ball Cynwyd, PA 19004
Phone: 880-843-3620
Fax: 610-667-3425

Long Island Film
PO Box 49403
Atlanta, GA 30359

Long Island Productions, Inc.
106 Capitola Drive
Durham, NC 27713
Phone: 800-397-5215
Fax: 919-544-5800
E-mail: lipmail@mindspring.com

LPV Productions
37427 Hunters Ridge Rd.
Cleveland, OH
Phone 440-498-0711

McGraw-Hill Films
See: CRM Films

Malibu Video, Inc.
6955 Fernhill Drive, Suite 14
Malibu, CA 90265
Phone: 310-457-0833

Manchester Health Department
Manchester, NH 03103
Phone: 603-622-1710
Fax: 603-626-3722

Marshfield Video Network
Marshfield Medical Foundation
1000 N. Oak Ave.
Marshfield, WI 54449-5797

Massachusetts Institute of Technology
Video Courses CEC
77 Massachusetts Ave.
Cambridge, MA 02139
Phone: 617-253-7444

McNeil Consumer Products Company
750 Camp Hill Rd.
Fort Washington, PA 19034
Phone: 215-233-7000
800-962-5357

Medcom, Inc.
PO Box 116
Garden Grove, CA 92642
Phone: 714-898-2561

Media Basics Video
Lighthouse Square
PO Box 449
Guilford, CT 06437-0449
Phone: 800-542-2505
203-458-2505
Fax: 203-458-9816

Medical University of Sourth Carolina
College of Pharmacy and Health Communications Network
171 Ashley Ave.
Charleston, SC 29425
Phone: 803-792-3111
Web: http://www.musc.edu/pharmacy/

Meridian Education Corp.
236 East Front Street
Bloomington, IL 61701
Phone: 309-827-5455

Michigan State University
Pesticide Education Office
East Lansing, MI 48824-1115

Milner-Fenwick
2125 Greenspring Dr.
Timonium, MD 21093
Phone: 800-432-8433
410-560-1212
Web: http://www.milner-fenwick.com

Minnesota Department of Health, Lead Program
121 E. Seventh Place, Suite 200
PO Box 64975
St. Paul, MN 55164-0975
Phone: 612-215-0888

Monsanto Department of Agriculture
Helena, MT

Mosby
11830 Westline Industrial Dr.
St. Louis, MO 63146
Phone: 800-325-4177
Web: http://www.mosby.com

MPI Home Video
16101 108th Ave.
Orlando Park, IL 60462-5305
Phone: 800-323-0442

National Audiovisual Center
8700 Edgeworth Drive
Capitol Heights, MD 20743-3701
Phone: 301-763-1850

National Environmental Health Association
720 South Colorado Blvd.
South Tower, Suite 970
Denver, CO 80222-1925
Phone: 303-756-9090
Web: http://www.neha.org

National Geographic Education Video
1145 17th St., NW
Washington, DC 20036-4688
Phone: 800-368-2728
TDD: 800-822-8207
Fax: 515-362-3366

Ordering:
PO Box 10798
Des Moines, IA 50340-0798

National Medical Audiovisual Center
National Library of Medicine
8600 Rockville Pike
Bethesda, MD 20894
Phone: 301-496-1131
800-638-8480

National Safety Council
Central Regional Office
1121 Spring Lake Drive
Itsaca, IL 60143-3201

PO Box 558
Itsaca, IL 60143-0558
Phone: 800-621-7619
708-775-2056

National Teaching Aids, Inc.
1045 Highlands Ave.
Hyde Park, NY 11040

National Technical Information Service (NTIS)
U.S. Department of Commerce
Springfield, VA 22161
Phone: 703-487-4600
Web: http://www.ntis.gov/ordernow

Northern Illinois Gas
PO Box 190
Aurora, IL 60507-0190
Phone: 630-983-8676
Web: http://www.nicorinc.com/nigas/

NYC Department of Health
Lead Poisoning Prevention Education and Training Unit
311 Broadway, 2nd Floor Rear
Box 58A
New York, NY 10007
Phone: 212-BAN-LEAD

Office of Environmental Management, Health and Safety
California State University, Chico
400 W. First St.
Chico, CA 95929
Phone: 530-898-INFO
Web: http://www.csuchico.edu/ehs/index.html
http://www.csuchico.edu/ehs/videos.html#Hazmat

Ohio State University
Center for Continuing Medical Education
Columbus, OH
Phone: 614-293-3576
800-492-4445
Web: http://ccme.med.ohio-state.edu/

Peace River Films
Vestron Video
PO Box 4000
Stamford, CT 06907
Phone: 617-492-7990
617-492-7993

Pennsylvania Bar Institute
Pennsylvania Bar Institute
5080 Ritter Rd.
Mechanicsburg, PA 17055
Phone: 800-932-4637
717-796-0804
800-247-4724
E-mail: info@pbi.org
Web: http://www.pbi.org/

Pennsylvania Chapter, American Academy of Pediatrics
Dayton Building
610 Old Lancaster Rd., Suite 220
Bryn Mawr, PA 19010
Phone: 215-520-9125

Powell Labs
Carolina Biological Supply Co.
2700 York Drive
Burlington, NC 27215
Phone: 800-334-5551

Practising Law Institute
810 Seventh Ave.
New York, NY 10019-5818
Phone: 800-260-4PLI (260-4754)
212-824-5710
E-mail: info@pli.edu
Web: http://www.pli.edu/prog-home.html

Presbyterian Church (USA)
100 Witherspoon Street
Louisville, KY 40202-1396

Productions West
2110 Overlook Ave., Suite 120
Billings, MT 59102
Phone: 406-656-9417
Fax: 406-656-0124

Pyramid Film and Video
PO Box 1048
Santa Monica, CA 90406
Phone: 800-421-2304

Q-ED Production
Cathedral Films
PO Box 4029
2282 Towngate Rd.
West Lake Village, CA 91359

Queen & Company Health Communications, Inc.
PO Box 49308
Colorado Springs, CO 80949-9308
Phone: 719-598-4968
Web: http://www.queenhealth.com/

Rachel Carson Council (audiocassette)
8940 Jones Mill Rd.
Chevy Chase, MD 20815
Phone: 301-652-1877
E-mail: rccouncil@aol.com
Web: http://members.aol.com/wcouncil/ourpage/rcc_page.htm

Radio and Television News Directors Foundation
1000 Connecticut Ave. NW, Suite 615
Washington, DC 20036-5302
Phone: 202-659-6510
E-mail: rfndf@rtndf.org
Web: http://www.rtndf.org

The Radiological Society of North America
2021 Spring Rd., Suite 600
Oak Brook, IL 60523-1860
Phone: 630-571-7862
Web: http://www.rsna.org/

Random House, Inc.
400 Hahn Road
Westminster, MD 21157

225 Park Avenue South
New York, NY 10013
Phone: 212-254-1600

Risk Management Internet Services
Managerial Technologies Corporation
900 Ogen Ave., Ste. 158
Downers Grove, IL 60515
Phone: 630-221-9116
E-mail: info@rmis.com
Web: http://www.rmis.com

RMI Media Productions
1365 N. Winchester
Olath, KS 66061
Phone: 800-745-5480
913-262-3974

Ryno Production, Inc.
Stone Point Landing, Suite 100
500 Market St.
Bridgewater, PA 15009
Phone: 800-860-7966
412-775-9393

Safety Video
1429 West Collins Ave.
Orange, CA 92867
Phone: 714-744-4041
Web: http://safetyvideo.com

St. Louis Health Division
Office of Health Promotion
PO Box 14702
St. Louis, MO 63178
Phone: 314-658-1044

SilverPlatter Education
SilverPlatter International
246 Walnut St.
Newton, MA 02160-1639
Phone: 617-244-0284, ext. 29

Society of Toxicology
1767 Business Center Drive, Suite 302
Reston, VA 22090

Phone: 703-438-3115
Fax: 703-438-3113
Web: http://www.toxicology.org/

Society for Visual Education
1345 Diversey Parkway
Chicago, IL 60602

Stuart Finley, Inc.
3428 Mansfield Drive
Falls Church, VA 22041

Summa Video/Image Entertainment
Capital Cities/ABC Video Publishing, Inc.
1200 High Ridge Rd.
Stamford, CT 06905
Phone: 203-329-6413

Syndistar, Inc.
St. Rose, LA
Phone: 800-841-9532
E-mail: syndistar@aol.com
info@syndistar.com
Web: http://www.syndistar.com/order.htm

TSCA Video Lending Library
Synthetic Organic Chemicals Manufacturers Association
1850 M St., NW, Suite 700
Washington, DC 20036
Phone: 202-721-4100
Web: http://www.socma.com/urdlend.html

Televent
Box 3453
Cherry Hill, NJ 08034
Phone; 609-547-6706
Fax: 609-546-7658

Tennessee Game and Fish Commission
PO Box 40747
Nashville, TN 37330

Teratology Society
9650 Rockville Pike
Bethesda, MD 20814

Time Life Films
100 Eisenhower Drive
PO Box 644
Paramus, NJ 07652
Phone: 201-843-4545

Trylon Video
101 Park Ave.
New York, NY 10178-0001
Phone: 212-767-0500

TV Ontario Ario/USA
143 W. Franklin, Suite 206
Chapel Hill, NC 27514
Phone: 800-331-9566

UBIX Corporation
PO Box 2187
Charlottesville, VA 22902-2187
E-mail: info@ubix.com

Universal Health Associates, Inc.
PO Box 6546
Washington, DC 20035-5465
Phone: 202-429-9506

University Community Video
425 Ontario, SE
Minneapolis, MN 55414
Phone: 612-376-333

University of Arizona
Agricultural Sciences Communications
College of Agriculture
or
Film Library/Audiovisual Bldg.
Tucson, AZ 85721

University of California—Davis
DANR Communication Services
University of California
6701 San Pablo Ave.
Oakland, CA 94608-1239
Phone: 800-994-8849
510-642-2431
E-mail: danrcs@ucdavis.edu
Web: http://danr.commserv.ucdavis.edu/products/default.html#catalogs

University of Iowa
UI-ISU Audiovisual Center/Iowa Films
C-8 Seashore Hall
University of Iowa
Iowa City, IA 52242
Phone: 319-353-5885

University of New Mexico
Department of Public Affairs
1805 Roma NE
Albuquerque, NM 87131
Phone: 505-277-5813
E-mail: paaffair@unm.edu

University of Texas Medical School at Houston
Learning Resource Center
6431 Fannin, Suite G-101
Houston, TX 77030
Phone: 713-500-5145
Web: http://www.med.uth.tmc.edu/lrc/lrc.htm

U.S. Department of Interior
Bureau of Mines
Graphic Services Section
4800 Forbes Ave.
Pittsburgh, PA 15213

U.S. National Institute of Standards and Technology
(formerly the National Bureau of Standards)
Department of Congress
Connecticut Ave. and Van Ess
Washington, DC 20234

U.S. National Medical Audiovisual Center
8700 Edgeworth Drive
Capitol Heights, MD 20743-3701
Phone: 301-763-1896

The Video Project
Media for a Safe and Sustainable World
200 Estates Drive
Ben Lomond, CA 95005
Phone: 800-4-PLANET (800-475-2637)
408-336-0160
Fax: 408-336-2168
Web: http://www.videoproject.com/

Video Training Source, Inc.
Phone: 800-779-7210
303-665-7200
E-mail: sheffel@ix.netcom.com
Web: http://www.catalog.com/shop/video/

Visual Education Productions
California Polytechnic State University Foundation
Cal Poly State University
San Luis Obispo, CA 93407
Phone: 800-235-4146

Visual Media
University of California
Davis, CA 95616
Phone: 916-757-8980

WABC—TV Channel 7-WABC News
7 Lincoln Square
New York, NY 10023
Phone: 212-456-7777

WLIW-21
Channel 21 Drive
Plainview, NY 11803
Phone: 516-367-2100

WNET-TV
356 West 58th St.
New York, NY 10019

West Glenn Communications
1430 Broadway
New York, NY 10018
Phone: 212-921-0966
Fax: 212-944-9055

Women Making Movies
462 Broadway, Suite 500R
New York, NY 10012
Phone: 212-925-0606
Web: http://www.wmm.com

World Wildlife Fund Canada
90 Eglinton Ave. E, Suite 504
Toronto, ON M4P 2Z7 Canada
Phone: 416-489-3611

This Page Intentionally Left Blank

CHAPTER

11

Toxicology Data and Information Management

FREDERICK W. STOSS AND PHILIP WEXLER

Now that we may understand it, I will tell you why different creatures have different foods, and why what is bitter and acrid to one can nevertheless seem very sweet to another. In this matter there are such great differences and variations that what is food for one can be bitter poison for others. For example, there is a serpent that dies if touched by the saliva of a man, biting itself to death. Moreover, hellebore is a dire poison to us, but it fattens goats and quails.

(Lucretius, *De Rerum Natura (On Nature),* Book IV)

This chapter is a bibliography of information resources about toxicology. Since the publication of the second edition of this book, there has been an enormous growth in the literature of information and information resources pertaining to toxicology, environmental health, environmental medicine, and related topics. This growth is attributed to several factors. First and foremost is the growing need for all practitioners—research scientists, policy analysts, communication specialists, librarians, and journalists—to stay abreast of current information trends and resources in the rapidly evolving field of toxicology. Second is the wider dissemination of this information via newer electronic systems, such as the Internet and the World Wide Web. Relevant discussions of toxicology information are scattered throughout the book and journal literature of toxicology, on the one hand, and of library and information sciences, on the other.

A major driving force behind these stimuli for more effective, efficient, and equitable access to toxicology-related information are the mandated responses of industry, business, and other government and academic research institutions for compliance with various worker and community right-to-know laws, emergency planning and response programs, and other compliance-based environmental health and safety rules and regulations at federal, state, and local levels.

In recent years there has been a major recognition of the active role citizens (a.k.a. ''local stakeholders'') can and should play as partners with other professionals in government agencies, industries and businesses, and other community-based entities in making decisions about environmental matters impacting their communities. Part of this recognition involves how citizens and other parties receive information on which they will formulate environmental decisions. This recognition is part of a phenomenon that has seen a substantial evolution and maturation of audiences and stakeholders with regard to their access and understanding of environmental information resources and contents.

The Internet provides a new dimension in the process for making environmental decisions. This communication vehicle delivers a tremendous depth and breadth of information from the highly accurate to the highly fabricated. Resources describing the use of these new electronic and digital resources are published in a wide variety of periodicals, reports, and books, as reflected in the first two sections below.

It is in these contexts that authors from many disciplines and representing a full spectrum of issues, view-

points, and work settings have taken heed of the editor-in-chief of this work, who in earlier editions noted the paucity of resources in the open literature pertaining to the information and data issues of toxicology and allied disciplines. The change is evident when one looks at the growth in numbers and breadth of readership addressed by the articles covered in this significantly larger chapter.

PERIODICALS

Practical information about the development of new, or enhancements to, existing databases and information resources can be found in many periodicals. Some periodicals now provide dedicated coverage (much like their respective book review sections) to electronic and online data and information resources. The following is a partial list of trade magazines, scholarly journals, and newsletters that frequently provide updates on changes to and development of information and data management for toxicology and environmental health information.

CD-ROM (Online, Inc., Weston, CT)

Chemical Health and Safety (American Chemical Society, Washington, DC)

Chemical Heritage (Chemical Heritage Foundation, Philadelphia, PA)

Counterpoise (American Library Association, Chicago)

Database (Online, Inc., Weston, CT)

Electronic Green Journal (EGJ, University of Idaho)

Environment (Heldref Publishing, Washington, DC)

Environmental Health Perspectives (National Institute of Environmental Health Sciences, Research Triangle Park, NC)

Environmental Progress (American Institute of Chemical Engineers, New York)

ES&H News (Society for Technical Communication, Arlington, VA)

Environmental Science and Technology (American Chemical Society, Washington, DC)

ERMD News (Special Libraries Association, Washington, DC)

GreeNotes (American Library Association, Chicago, IL)

Information Services and Use (IOS Press, Amsterdam)

Information Today (Information Today, Inc., Medford, NJ)

***JAMA* (*Journal of the American Medical Association*)** (AMA, Chicago, IL)— especially the NetSight column

Journal of Chemical Information and Computer Sciences (American Chemical Society, Washington, DC)

Link-Up (Information Today, Inc., Medford, NJ)

Medical Reference Services Quarterly (Haworth Press, Binghamton, NY)

Occupational Hazards (Penton Publishing, Cleveland, OH)

Online (Online, Inc., Weston, CT)

Online & CD-ROM Review (Learned Information, Oxford, UK)

Pollution Engineering (Cahners Publishing, Highlands Ranch, CO)

Risk Analysis (Plenum Publishing, New York)

Searcher (Information Today, Medford, NJ)

Toxicology (Elsevier Science, Shannon, Ireland—especially the Toxicology Information and Resources section

DATABASES

Several print and online bibliographic databases are also quite useful for retrieving relevant resources on information and data management for toxicology and environmental health.

ABI/Inform

Chemical Abstracts

ERIC (Educational Resources Information Clearinghouse)

First Search

Information Science Abstracts

Library and Information Science Abstracts

Library Literature

MEDLINE

TOXLINE

BIBLIOGRAPHY

Over the past several years, considerable attention has been paid to the discussion of toxicology-related information by the broadly defined community of in-

formation providers, intermediaries, and consumers in both the public and private settings. Research scientists, policy analysts, business managers, educators, and environmental advocates are now much more aware of the information resources and tools at their disposal. Information-related literature increasingly focuses on the Internet and the World Wide Web. Instructional workshops and training opportunities related to the Internet and other computerized information access are common fare at meetings of information-related organizations, and are now filtering into meetings of professional toxicology societies, as well.

This bibliography covers a broad span of issues related to the management of toxicology data and information. These issues include strategies, activities, and services available for the identification, aquisition, organization, evaluation, dissemintion, and storage of information in its many manifestations. The bibliography is grouped into four main areas: Internet and World Wide Web sites and services; other electronic services, products, and systems; general data and information handling and management; and Material Safety Data Sheets.

Internet and World Wide Web Sites and Services

Abeytunga, P. K. (1995). An overview of the electronic health and safety services of the Canadian Centre for Occupational Health and Safety. *Toxicology* **96**(1), 71–75.

Alston, P. G. (1995). Finding your way in the maze: negotiating the information highways. In ''*International Congress on Hazardous Waste: Impact on Human Health and Ecological Health. Atlanta, GA, June 5–8, 1995*,'' Abstract 298.

Anonymous. (1999). Toxnet: All things toxic. *Environ. Health Perspect.* **107**(4), A189.

Anonymous. (1997). The environmental information explosion. *Environ. Manager* (*EM*) **9**(3), 1–5.

Anonymous. (1996). NRDC on the Web: a worldwide environment. *Amicus J.* **18**(3), 51–52.

Anonymous. (1996). Hazardous waste clean-up information on the Web. *J. Environ. Health* **59**(4), 25.

Anonymous. (1996). Enviro-data hits full tilt in cyberspace. *Environ. Today* **7**(3), 42.

Anonymous. (1995). EHPnet. *Environ. Health Perspect.* **103**(11), 991.

Anonymous. (1995). OcoLink. *Environ. Health Perspect.* **103**(10), 895.

Anonymous. (1995). Radon home page. *Environ. Health Perspect.* **103**(12), 1083.

Anonymous. (1994). Free rides on the EH&S information superhighway. *Environ. Manager* **5**(9), 12–13.

Auletta, A. E., Kier, L. D., and Mitchell, A. D. (1990). Current status of the GENE-TOX program. *Prog. Clin. Biol. Res.* **340**(D), 273–281.

Bolstridge, J. C. (1998). Strategic value and use of the Internet's environmental information. *ASLIB Proc.* **50**(3), 57–60.

Blotzer, M. J. (1995). ''*Internet Users Guide for Safety & Health Professionals*.'' Genium, Schenectady, NY.

Briggs-Erickson, C., and Murphy, T. (1997). ''*Environmental Guide to the Internet*.'' 3rd ed. Government Institutes, Rockville, MD.

Brown, L. J. (1994). Environmentalism goes online: its only natural. *Link-up* **11**(2), 12–13+.

Corbin, L. (1997). Data warehouses hit the Web. *Government Executive* **29**(2), 47–48.

Daniels, W. J., and James, K. P. (1996). NIOSH electronic information resources. *Appl. Occup. Environ. Hygiene* **11**(6), 528–530.

Darmoni, S. J., Massari, P., Droy, J. M., Mahe, N., Blanc, T., Mirot, E., and LeRoy, J. (1994). SETH: an expert system for the management of acute drug poisoning in adults. *Comput. Methods Programs Biomed.* **43**(34), 171–176.

(U.S.) Environmental Protection Agency. (1998). Harnessing the power of the Internet: EPA responds to the rising demand for environmental information EPA-100-R-98-04. USEPA, Washington, DC.

Fairly, P. (1997). Environmental information: EPA's Internet leaves industry feeling exposed. *Chem. Eng. Week* **159**(13), 42–43.

Feidt, W. B., and Roos, C. (1995). Environmental information resources on the Internet. *Bull. Am. Soc. Info. Sci.* **21**(4), 22–23.

Friede, A., O'Carroll, P. W. (1996). CDC and ATSDR electronic information resources for health officers. *Am. J. Infect. Control* **24**(6), 440–454.

Gardner, R. A. (1995). Toxicology Abstracts: an electronic journal on the internet. *Toxicology* **99**(3), 219–228.

Garrison, S. (1998). Evaluating health Internet sites: A white paper's criteria. *Med. Ref. Serv. Quart.* **17**(3):41–47.

Garvey, P. (1998). From world-wide web to satellite sensing: The potential impact of information technology on regulatory compliance—A government perspective. *Hum. Ecol. Risk Assess.* **4**(1), 11–16.

Glaze, W. H. (1996). Originality of research and the Internet. *Environ. Sci. Technol.* **30**(7), A273–A274.

Government Accounting Office. ''Internet and Electronic Dial-up Bulletin Boards: Information Reported by Federal Organizations'' (includes supplement, '' 4,300 World Wide Websites Reported by Federal Organizations'') [GAO/GGD-97-86S] Available only on the GAO Web site: http://www.gao.gov

Government Institutes. (1997). ''*CFR Chemical Lists on CD-ROM*.'' Government Institutes, Inc., Rockville, MD (CD-ROM).

Government Institutes. (1997). ''*IRIS-CD: EPA's Integrated Risk Information System on CD-ROM*.'' Government Institutes, Inc., Rockville, MD (CD-ROM).

Government Institutes. (1996). ''*RCRA Hazardous Waste SourceDisk—Laws, Regulations, and Contacts, USA!*'' Government Institutes, Inc., Rockville, MD (CD-ROM).

Government Institutes (1993). Eco-Data: Using your PC to obtain free environmental data. Government Institutes, Inc., Rockville, MD.

Grygar, W. W. (1997). Surf the net for environmental information. *Chem. Eng. Prog.* **93**(9), 64–69.

Guth, D. J., and Raymond, T. S. (1996). A database designed to support dose–response analysis and risk assessment. *Toxicology* **114,** 81–90.

Hargreaves, P. (1997). Mining the Net for health and safety regs. *Sci. Eng. Network News* **3**(7), 1, 10–11.

Hargreaves, P. (1997). Safety and health resources online. *Sci. Eng. Network News* **3**(5), 12–14.

Hatfield, T. H. (1997). The Internet: legitimate educational tool or giant electronic sandbox? *J. Environ. Health* **59**(8), 19ff.

Hatfield, T. H. (1995). Environmental health databases on the World Wide Web. *J. Environ. Health* **57**(10), 30–32.

Hsu, K. F., and Kousts, R. N. (1997). Surfer's guide to the EPA online. *Environ. Protection* **8**(6), 23–25.

Katz, M. (1996). ''*Environmental Management Tool on the Internet: Accessing the World of Environmental Information*.'' St. Lucie Press, Delray Beach, FL

Kiley, R. (1999). *Medical Information on the Internet: A Guide for Health Professionals*. Churchill Livingstone, Inc., New York.

Kollig, H. P., Kitchens, B. E., and Hamrick, K. J. (1993). FATE: the environmental fate constants information database. *J. Chem. Information Computer Sci.* **33**(1), 131–134.

Krasowska, F. (1996). Hot Net resources: hazardous materials. *Occup. Health Safety* **65**(8), 30–32.

Kruper, J. A., Lavenant, M. G., Maskay, M. H., and Jones, T. M. (1994). Building Internet accessible medical education software using the World Wide Web. *Proceedings of the Annual Symposium on Computer Applications in Medical Care* pp. 32–36.

Kumar, A., Chigullapalli, V., Tqnna, C. (1995). A review of three software programs for emission rate estimation. *Environ. Prog.* **14**(4), N9–N14.

Kumar, A., DSouza, F., and Vashisth, S. (1996). Environmental datasets on the information superhighway. *Environ. Prog.* **15**(2), F13–F18.

Kumar, A., and Manocha, A. (1995). A review of environmental sites on the World Wide Web. *Environ. Prog* **14**(3), A10–A16.

Kumar, A., and Pakala, P. (1998). Development of a world wide web site for indoor air quality. *Env. Prog.* **17**(4), W11–W15.

LaFollette, S. E. (1996). Internet in the environmental health and occupational safety curricula. *212th National Meeting of the American Chemical Society, Orlando, FL, August 25–29, 1996*, CHAS-009.

Lee, C. C., and Lee, E. (1999). *Chemical Guide to the Internet, 2nd Edition*. Government Institutes, Rockville, MD.

Liebl, D. S. (1997). electronic resources for hazardous waste management. In *Standard Handbook of Hazardous Waste Treatment and Disposal, 2nd Edition*. (Freeman, H. M., Ed.), pp. 15.3–15.8. McGraw-Hill, New York.

Littleton, D. (1998). A review of strategies for finding health information on the world wide web. *Med. Ref. Services Q.* **17**(2), 51–58.

Ludl, H., Schope, L. H., and Mangelsdorf, I. (1996). Searching for information on toxicological data of chemical substances in selected bibliographic databases: selection of essential databases for toxicological researchers. *Chemosphere* **32**(5), 867–880.

Lun, K. C. Tan, T. W., Gopalakrishnakone, P., and Loh, S. (1995). Delivering health information databases

on the World Wide Web at the National University of Singapore. *Medinfo* **8**(Pt 2), 1528.

Mangels, G. (1998). From world-wide web to satellite sensing: The potential impacts of information technology on regulatory compliance testing—An industry perspective. *Hum. Ecol. Risk Assess.* **4**(1), 17–20.

Marra, C. A., Lynd, L. D., McKerrow, R., and Carleton, B. C. (1996). Drug and poison information resources on the Internet, part 1: an introduction. *Pharmacotherapy* **16**(4), 537–546.

Marra, C. A., Carleton, B. C., Lynd, L. D., Marra, F., McDougal, A. R., Chow, D., and McKerrow, R. (1996). Drug and poison information resources on the Internet, part 2: identification and evaluation. *Pharmacotherapy* **16**(5), 806–818.

Maxwell, B. (1996). ''*How to Access the Government's Electronic Bulletin Boards*.'' Congressional Quarterly, Inc., Washington, DC.

McCarley, T. L., and Cook, R. L. (1997). Impact of the Internet on a small government EH&S service. *Abstracts of the 214th American Chemical Society National Meeting, Las Vegas, NV, September 7–11, 1997,* CHAS-024.

McGaughey, B. D., and Thompson, C. M. (1998). From world-wide web to satellite sensing: The potential impacts of information technology on regulatory compliance testing—Introduction. *Hum. Ecol. Risk Assess.* **4**(1), 7–10.

Micke, M. M. (1996). The case of hallucinogenic plants and the Internet. *J. Sch. Health* **66**(8), 277–280.

Mitchell, N. A. (1997). Latex allergy: accessing information on the Internet. *J. Emergency Nursing* **23**(1), 51–52.

Murphy, T., and Briggs-Erickson, C. (1998). *Environment Guide to the Internet, 4th Ed.* Government Institutes, Rockville, MD.

Nash, M. R., and Faranio, R. L. (1999). Internet resources in legal medicine and forensic science. *Med. Ref. Serv. Q.* **18**(1), 59–68.

Nashed, A., and Fink, G. ''*Emergency Medicine Bulletin Board System (EMBBS): Emergency Medicine and Primary Care*.'' http://www.njnet.com/~embbs.

Nestorov, I. A. (1998). A WWW resource for physiologically based modelling in pharmacokinetics, pharmacodynamics, toxicology, and risk assessment. *Med. Info.* **23**(3), 193–198.

Newland, L., and Morgan, K. (1997). The Internet: global environmental information. *Environ. Sci. Pollution Res.* **4**(1), 1.

O'Regan, B. (1997). Sources of environmental information on the Internet. *Appl. Cat. B Environ.* **12**(1), N2.

Parris, T. M. (1999). Envirofacts revisited. *Environment* **41**(4), 3.

Parris, T. M. (1998). Rx for medical information online. *Environment* **40**(10), 3.

Pearson, R. S. (1998). From world-wide web to satellite sensing: The potential of information technology on regulatory compliance testing—An academic perspective. *Hum. Ecol. Risk Assess.* **4**(1), 21–24.

Perry, B. (1996). Finding environmental, health and safety resources on the Internet. *Plant Eng.* **50**(8), 60–62.

Perry, L. M. (1995). Internet and the World Wide Web. *International Congress on Hazardous Waste: Impact on Human Health and Ecological Health, Atlanta, GA, June 5–8, 1995,* Abstract No. 234.

Peters, R. W. (1994). Information superhighway or technical sewer: what will it be? *Federal Commun. Law J.* **47**(2), 333–339.

Pinson, T. J. (1995). Environmental information through the Internet. *Waste Manage.* **15**(7), 521–530.

Prorak, D. (1991). Toxic chemical release inventory: EPA data available online, on CD-ROM, on microfiche, and in paper format. *Idaho Librarian* **43,** 63.

Raeder, A. (1997). Environmental information sources on the Net. *Searcher* **5**(2), 20–26.

Risin, J. A. (1998). Breaking down information barriers: A guide to research of medical resources on the world wide web. *Med. Ref. Serv. Q.* **17**(4), 39–46.

Ronald, K., and Nicholls, P. (1992). Environmental information sources: online and ondisc. *Can. Library J.* **49**(4), 277–284.

Scanlan, L. (1996). Internet resources. *Environ. Sci. Technol.* **30**(5), A184.

Schwarzwalder, R. (1996). Government technical information—online, on disc, and on the Internet. *Database* **19**(3), 82–85.

Skinder, R. F., and Gresehover, R. S. (1995). An Internet navigation tool for the technical and scientific researcher. *Online* **19,** 38.

Stuart, R. B., III. (1998). *Safety and Health on the Internet, 2nd Ed.* Government Institutes, Rockville, MD.

Stutz, J. B. (1997). Navigation of pesticide related databases on the Internet. 213th National Meeting of the American Chemical Society, San Francisco, California, USA, April 13–17, 1997. *Abstr. Papers Am. Chem. Soc.* **213**(1–3), Agro134.

Suter, G. W., and Sample, B. E. (1996). Internet resources. *Environ. Sci. Technol.* **30**(5), A184.

Takala, J. (1993). CD-ROMs and databases as vehicles for chemical safety information. *Am. Ind. Hygiene Assoc. J.* **54**(11), 683–696.

Takala, J., Pesonen, J., Kulikov, L., and Jappinen, H. (1991). Machine translation for chemical safety information. *J. Hazardous Materials* **27**(2), 213–230.

Talley, E. A. (1997). Development of the DCHAS Web Pages. *Abstracts of the 214th American Chemical Society National Meeting, Las Vegas, NV, September 7–11, 1997,* CHAS-016.

Taylor, K. C. (1995). More Environmental resources on the Internet. *Environ. Protection* **6**(6), 58.

Thompson, P. A., Jenkins, J. J., and Buhler, D. R. (1995). Teaching online data systems to graduate students of toxicology. *J. Chem. Education* **72**(4), 324–326.

Toll, M. A. (1991). Online access to government information: a foundation's view. *Bull. Am. Soc. Information Sci.* **17**(6), 11–12.

Toxicon Multimedia Project. ''Toxicology Internet URLs. '' University of Illinois at Chicago, Toxicon Multimedia Project. http://tigger.uic.edu/~crockett/toxlinks.html.

Urquhart, Q. F., Jr. (1997). A primer on utilizing the Internet in litigation practice. *Defense Counsel J.* **64**(2), 311–315.

Vasta, B. M., and Lantz, R. E. (1994). TOXNET's windows of opportunity open through M Technology. *Health Management Today* **15** M4–M6.

Vieira, K. N. (1999). *Information Management for Environmental Health and Safety: A Practical Guide.* Lewis Publishers, Boca Raton, FL.

Wahl, G. H., Jr. (1995). Getting to the Federal Register: EPA's new electronic mailing lists make obtaining relevant Federal Register information easier. *Chem. Health Safety* **2**(1), 35, 44.

Wax, P. M., Rodewald, L., and Lawrence, R. (1994). The arrival of the ED-based POISINDEX: perceived impact on poison control center use. *Am. J. Emergency Med.* **12**(5), 537–510.

Weaver, M. (1996). Introduction to the Environmental Protection Agency's Website. *Abstracts of Papers of the 212th American Chemical Society National Meeting, Orlando, Florida, August 25–29, 1996,* ENVR-080.

Wise, D. L. (1997). The state of the Web for development toxicologists. *Reprod. Toxicol.* **11**(5), 751+.

Other Electronic Services, Products, and Systems

Agency for Toxic Substances and Disease Registry. (1996). ''*ATSDR's Toxicological Profiles on CD-ROM: Agency for Toxic Substances & Disease Registry*.'' Lewis Publishers, Boca Raton, FL.

Abeytunga, P. K. (1995). An overview of the electronic health and safety services of the Canadian Centre for Occupational Health and Safety. *Toxicology* **96**(1), 71–75.

Alexeef, G., Lewis, D., and Lipsett, M. (1992). Use of toxicity information in risk assessment for accidental releases of toxic gases. *J. Haz. Materials* **29**(3), 387–403.

Allen, D., and Jain, R. (Eds.) (1992). ''National Hazardous Waste Databases: Generation and Fate of Hazardous Materials in the U.S.A.'' Special Issue, *Hazardous Waste Hazardous Materials* **9**(1).

Anonymous (1998). Directory of hazardous waste information resources. *Hazardous Waste Consultant* **16**(3), D1–D28.

Anonymous (1998). Toxics information hard to come by, group says. *Chem. Eng. News* **76**(5), 18.

Anonymous (1997). Sector facility indexing project will enhance access to environmental information but proves controversial. **15**(7), B18–B19.

Anonymous (1997). New system links regulatory data to environmental information. *J. Environ. Qual.* **26**(5), 1195.

Anonymous (1997). RTECS database now includes Beilstein Numbers. *Online* **18**(6/7), 14.

Anonymous. (1997). Toxicology and environmental health databases assessed. *Public Health Rep.* **112**(3), 179–180.

Anonymous. (1996). Data elements for occupational exposure databases: guidelines and recommendations for airborne hazards and noise. *Appl. Occup. Environ. Hygiene* **11**(11), 1294–1311.

Anonymous. (1995). National Center for Human Genome Research. *Environ. Health Perspect.* **104**(5), 471.

Anonymous. (1995). Environmental databases and other computerized information tools. *Government*

Reports Announcements and Index, No. 22, NTIS/N95-31810/1.

Auletta, A. E., Brown, M., Wassom, J. S., and Cimino, M. C. (1991). Current status of the Gene-Tox Program. *Environ. Health Perspect.* **96,** 33–36.

Bacher, S. M. (1996). Internet tools for the chemist. *Abstracts of Papers of the 212 American Chemical Society National Meeting, Orlando, Florida, August 25–29, 1996,* ENVR-079.

Banks-Anderson, Y., Coulberson, S. L., and Phelps, J. (1993). Overview of the EPA/NIEHS/ATSDR Workshop: ''Equity in Environmental Health: Research Issues and Needs.'' *Toxicol. Ind. Health* **9**(5), 679.

Barker, P. E., Bretlerick, L., and Kay, F. A. A. (1993). Problems and solutions in the development of hard and soft versions of a chemical-reaction hazards database. *J. Chem. Infor. Comp. Sci.* **33**(2), 184–192.

Beard, J. M., Rosenthal, D., Howald R., Long, G. R., Pacheo, M. D., and Snyder, C. H. (1996). An online course in environmental and industrial chemistry. *Abstracts of Papers of the 212 American Chemical Society National Meeting, Orlando, Florida, August 25–29, 1996,* ENVR-083.

Behrens, G. P., Orr, D. A., Wetherold, R. G., and O'Neil, B. T. (1996). Use of the PICES database: power plant aqueous stream compositions. *Water Air Soil Pollut.,* **90**(1–2), 113–122.

Benigni, R. (1991). Mathematical models for exploring different aspects of genotoxicity and carcinogenicity databases. *Environ. Health Perspect.* **96,** 81–84.

Bennet, J. P., and Buchen, M. J. (1995). BIOLEFF: Three databases on air pollution effects on vegetation. *Environ. Pollut.* **88**(3), 261–265.

Benz, J., Voigt, K., and Mucke, W. (1989). Strategy for computer-aided searches for information about chemicals. *Online Rev.* **13,** 383.

Blotzer, M. (1993). Professional communications by computer. *Occup. Hazards* **55**(8), 37–40.

Borman, S. (1991). National Library of Medicine expanding its chemical databases. *Chem. Eng. News* **68**(47), 15–16.

Branchick, S. E., and Duane, C. A. (1997). Using data from the National Pesticide Information Retrieval System (NPIRS) to assist in pesticide research. *Abstracts of Papers of the 213th American Chemical Society National Meeting, San Francisco, California, April 13–17, 1997,* CINF-049.

Briggs, D. J., and Elliott, P. (1995). The use of geographical information systems in studies on environment and health. *World Health Statistics Q.* **48**(2), 85–94.

Bronson, R. J. (1992). GENE-TOX: an EPA toxic chemical database. *Med. Reference Services Q.* **11**(Spring), 47–54.

Bronson, R. J. (1992). TRIFACTS: Toxic Chemical Release Inventory Facts Databank: companion databank on NLM's TOXNET. *Med. Reference Services Q.* **12**(Fall), 59–68.

Bronson, R. J. (1991). Toxic chemical release inventory information: NLM's TOXNET databanks. *Med. Reference Services Q.* **10**(Spring), 17–34.

Brooks, J. H., Renz, K. K., Kattoua, S., White, S. E., Richardson, S. L., and Delgigante, J. (1993). Linking environmental and health care databases: assessing the health effects of environmental pollutants. *Int. J. Bio-Med. Comput.* **32**(3–4), 279–288.

Brueggemann, R., and Voigt, K. (1995). An evaluation of online databases by methods of lattice theory. *Chemosphere* **31**(7), 3585–3594.

Buckley, D. S., Tonnet, I. L., and Ison, C. R. (1997). Pesticide information resource initiatives by CAB International: meeting a global need. *Abstracts of Papers of the 213th American Chemical Society National Meeting, San Francisco, California, April 13–17, 1997,* AGRO-136.

Caroli, S., Menditto, A., and Chiodo, F. (1996). International Registry of Potentially Toxic Chemicals: challenges of data collection in the field of toxicology. *Environ. Sci. Pollut. Res.* **3**(2), 104–107.

Cassens, V. J., Luke, E. M., and Hoover, P. J. (1997). The National Pesticide Information Retrieval System. *Abstracts of Papers of the 213th American Chemical Society National Meeting, San Francisco, California,* April 13–17, 1997, CINF-048.

Castriotta, M., and Dracos, A. (1994). Online information sources on chemical substances. *Ann. Istituto Superiore di Sanita* **30**(4), 411–416.

Cimino, M. C., and Auletta, A. E. (1993). Availability of the GENE-TOX database on the National Library of Medicine TOXNET System. *Mutat. Res.* **297**(1), 97–99.

Cimino, M. C., and Auletta, A. E. (1994). The Gene-Tox Program: Data evaluation of chemically induced mutagenicity. *Environ. Epidemiol.* **241**(1), 89–104.

Cimino, M. C., and Auletta, A. E. (1993). Availability of the Gene-Tox database on the National Library

of Medicine TOXNET Sytem. *Environ. Molec. Mutagenesis* **21**(3), 306–307.

Cimino, M. C., and Auletta, A. E. (1993). Availability of the Gene-Tox database on the National Library of Medicine TOXNET System. *Mutagenesis* **8**(2), 163–164.

Clark, Y. R. (1996). Geographical information accessible on the Internet and available to the environmental chemist for the purpose of fate and transport modeling. *Abstracts of Papers of the 212th American Chemical Society National Meeting, Orlando, Florida, August 25–29, 1996,* ENVR-085.

Cochrane, C. E., Donahue, H. V., Hoffamn, T. M., Pariandi, N., and Stobart, N. N. (1997). CAS database: a source rich in pesticide information. *Abstracts of Papers of the 213th, American Chemical Society National Meeting, San Francisco, California, April 13-17, 1997,* AGRO-145.

Cornell, J., et al. (1995). Poisonous plant identification: a comparison of databases designed for veterinary use. *Vet. Hum. Toxicol.* **37**(5), 482–485.

de Bliek, R., Friedman, C. P., Wildemuth, B. M., Martz, J. M., File, D., Twarog, R. G., Reich, G. M., and Hoekstra, L. (1993). Database access and problem solving in the basic sciences. *Proceedings of the Annual Symposium on Computer Applications in Medical Care,* 678–682.

Dutcher, G. A., and Arnesen, S. J. (1995). Developing a subject-specific gopher at the National Library of Medicine: AIDS gopher toxicology and environmental health information program gopher. *Bull. Med. Library Assoc.* **83**(2), 228–233.

European Foundation for the Improvement of Living and Working Conditions. (1996). ''*Occupational Exposure Databases: A Proposal for Core Information for Workplace Exposure Measurements on Chemical Agents*.'' Office for Official Publications of the European Communities, Luxembourg.

Fang, J. C., Friedman, A. E., MacDonald, W. E., Lewis, R. J., Sr., and Tatken, R. L. (1980). Improvements in the NIOSH Registry of Toxic Effects of Chemical Substances. *Drug Chem. Toxicol.* **3**(1), 35–45.

Fay, M. (1997). Frequency of top binary-pair mixtures in major media, based on HAZDAT data from all National Priorities List sites. *J. Clean Technol. Environ. Toxicol. Occupat. Med.* **6**(1), 77–90.

Fedra, K., Greppin, H., Haurie, A., Hussy, C., Dao, H., and Kanala, R. (1996). GENIE: an integrated environmental information and decision support system for Geneva, part 1: air quality. *Arch. Sci.* **49**(3), 247–263.

Fiedler, L., and Quander, J. (1996, October). Over 300 innovative treatment technologies selected at Superfund sites: new database provides search capability. *EM,* 21–25.

Fisher, L. (1992). The Chemical Manufacturers Association hazardous waste database. *Hazardous Waste Hazardous Materials* **9**(1), 85–90.

Fishman, D. L. (1992). Computerized Clinical Information System: CCIS from MicroMedex. *Database* **15**(2), 58–62.

Fonger, G. C. (1996). Toxicology and environmental health information from the National Library of Medicine. *Toxicol. Ind. Health,* **12**(5), 639–649.

Fonger, G. C. (1995). Hazardous Substances Data Bank (HSDB) as a source of environmental fate information on chemicals. *Toxicology* **103**(2), 137–145.

Foster, R. S. (1996). Navigating your way through the National Library of Medicine's TEHIP files via the Internet. *Abstracts of Papers of the 212th American Chemical Society National Meeting, Orlando, Florida, August* 25–29, 1996, American Chemical Society, Washington, DC.

Friede, A., and O'Carroll, P. W. (1996). CDC and ATSDR electronic information resources for health officials. *J. Environ. Health.* **59**(4), 13–22 (reprinted in *J. Public Health Management Practice* **2,** 10–24, 1996).

Goldman, L. R., Gomez, M., Greenfield, S., Hall, L., Hulka, B. S., Kaye W. E., Lybarger, J. A., McKenzie, D. H., Murphy, R. S., Wellington, D. G., *et al.* (1992). Use of exposure databases for status and trends analysis. *Arch. Environ. Health* **47**(6), 430–438.

Goodomon, L. J. (1994). A rational approach to risk assessment requires the use of biological information: an analysis of the National Toxicology Program (NTP): final report of the advisory review by the NTP Board of Scientific Counselors. *Regul. Toxicol. Pharmacol.* **19**(1), 51+.

Gotchfield, M. (1993). Electronic media: EPA's IRIS chemical information database. *Choice* **31**(3), 442.

Grygar, W. W., II. (1997, September). Surf the Net for environmental information. *Chem. Eng. Prog.* **93**(9): 64–69.

Guth, D. J., and Raymond, T. S. (1996). A database designed to support dose-response analysis and risk assessment. *Toxicology* **114**(1), 81+.

Haas, S., and Clark, M. (1992). Research journals and databases covering the field of agrochemicals and water pollution. *Sci. Technol. Libraries* **13**(2), 57–63.

Haines, J. A. (1992). INTOX: a computerized trilingual poisons information package. *Journal of Toxicology—Clinical Toxicology*, **30**(2), 239–243.

Hakkinen, P. J. (1997). Computer software programs, databases, and the use of the Internet, World Wide Web, and other online systems. In *Fundamentals of Risk Analysis and Risk Management* (V. Molak, Ed.), pp. 203–230. CRC Lewis Publishers, Boca Raton, FL.

Hallett, S. H., et al. (1995). SEISMIC: A desktop information system for assessing the fate and behaviour of pesticides in the environment. *Computers Electronics Agric.* **13**(3), 227–242.

Halton, D. M. (1986). Computerized information resources in toxicology and industrial health: a review. *Toxicol. Ind. Health* **2,** 113.

Hamel, D. R. (1990). Assessing Human Health Risk in the USDA Forest Service. In *Proceedings of the Symposium on the Access and Use of Information Resources in Assessing Health Risks from Chemical Exposure*, (Lu, P.-Y., Wassom, J. S., Fraland, W. H., and DeRosa, C., Eds.), pp. 133–134. U.S. Environmental Protection Agency and Oak Ridge National Laboratory, Oak Ridge, TN (ORNL Conf-9006324).

Hane, P. (1992). *Environment Online: The Greening of the Databases—The Complete Environmental Series from Database Magazine*. Eight Bit Books, Online, Inc., Wilton, CT.

Hayashi, M., Nakadate, M., Osada, T., Ishibe, T., Tanaka, S., Maekawa, A., Sofuni, T., Nakata, Y., Kanoh, N., Hashiba, S., *et al.* (1991). A fact database for toxicological data at the National Institute of Hygienic Sciences, Japan. *Environ. Health Perspect.* **96,** 57–60.

Hazard, G. F., Jr. (1997). Online pesticide resources at the Toxicology and Environmental Health Information Program. *Abstracts of Papers of the 213th American Chemical Society National Meeting, San Francisco, California, April 13–17, 1997,* CINF-029.

Hung, O., and Nelson, L. S. (1997). TOXNET: A guide to clinical toxicology resources available on the Internet. *J. Toxicol. Clin. Toxicol.* **35**(6), 677+.

Inoue, J. (1991). [A survey of the best bibliographic searching system in occupational medicine and discussion of its implementation] [Japanese]. *Sangyo Ika Daigaku Zasshi* **13**(4), 285–294.

Jacobs, M., Edwards, A., Graves, R. S., and Johnson, E. D. (1998). Criteria for evaluating MEDCINE Search Engines. *Med. Reference Services Q.* **17**(3), 1–13.

Jaraczewska, W., Czerczak, S., and Kotwica, M. (1996). The National Poison Information Center of Poland. *J. Toxicol. Clin. Toxicol.* **34**(6), 669+.

Johnson, B. L. (1995). ATSDR's information databases to support human health risk assessment of hazardous substances: Agency for Toxic Substances and Disease Registry: a review. *Toxicol. Lett.* **79**(1–3), 11–16.

Jones, T. D., Walsh, P. J., and Zeighami, E. A. (1985). Permissible concentrations of chemicals in air and water derived from RTECS entries: a rash chemical scoring system. *Toxicol. Ind. Health* **1**(4), 213–234.

Kaczmarek, M., and Rzepecki, J. (1991). Database on individual cases of acute poisonings. *Polish J. Occup. Med.* **4**(2), 175–181.

Kamrin, M. A., Craigmill, A., Miller, T., and Jenkins, J. (1997). EXTOXNET: an Internet pesticide information resource for non-specialists. *Abstracts of Papers of the 213th American Chemical Society National Meeting, San Francisco, California, April 13–17, 1997,* CINF-045.

Krenzelok, E. P., and McElwee, N. E. (1995). International Poison Information Center data collection capabilities. *Vet. Hum. Toxicol.* **37**(3), 246+.

Krieger, J. (1989). Hazardous waste management database starts to take shape. *Chem. Eng. News* **676,** 19–21.

Kumar, A., Kode, S., and Patel, V. (1993). A review of two risk assessment computer programs. *Environ. Prog.* **12**(1), F12–F16.

Kumar, A., Madasu, R., and Mahurkar, A. (1995). A review of AIRSCAPE program for the ISC2 model. *Environ. Prog.* **14**(2), M13–M16.

Kumar, A., Madasu, R., and Manocha, A. (1994). An evaluation of SmartRISK and ACE 2588 health risk assessment software. *Environ. Prog.* **13**(4), N14–N17.

Kumar, A., and Manocha, A. (1995). A survey of environmental bulletin boards. *Environ. Prog.* **14**(1), F14–F17.

Kumar, A., and Manocha, A. (1994). Environmental resources on the Internet. *Environ. Prog.* **13**(2), M12–M18.

Kumar, A., and Mohan, S. (1991). Use of bulletin board system for air quality modeling. *Environ. Prog.* **10**(1), F8–F12.

Kumar, A., and Patel, V. (1992). A review of three toxic release screening models. *Environ. Prog.* **11**(1), F12–F16.

Kumar A., and Rao, H. G. (1991). Use of electronic bulletin boards for environmental management. *Environ. Prog.* **10**(3), A12–A16.

Kumar, A., and Rao, H. G. (1990). Software for regulatory compliance of chemical hazards. *Environ. Prog.* **9**(4), N7–N13.

Kumar, A., and Riswadkar, R. (1992). Environmental databases. *Environ. Prog.* **11**(2), M14–M20.

Kumar, A., and Sahore, S. (1994). Public domain software for exposure assessment modeling. *Environ. Prog.* **13**(1), F14–F18.

Kumar, A., Sahore, S., and Bellam N. K. (1993). Environmental software from flyers. *Environ. Prog.* **12**(3), A8–A12.

Kumar, A., and Srinivas, K. (1992). Sources of environmental software. *Environ. Prog.* **11**(3), A10–A14.

Kumar, A., and Vashisth, S., and D'Souza, F. (1996). Introduction to WWW.Environmental_Health_&_Safety.Com. *Environ. Prog.* **15**(4), W13–W18.

LaFollette, S. E., and Martz, W. W. (1996). Incorporating Internet resources into a multimedia approach to environmental health curriculum. *Proceedings of the 1996 Annual Meeting of the Society for Toxicology,* Abstract Paper no. 52.

Langer, P., and Wilson, A. J. C. (1994). Online user needs in chemical information. *J. Chem. Infor. Comp. Sci.* **34**(4), 707–713.

Langerman, N. (1997). MSDS management: options and limitations. *Chem. Health Safety* **4**(4), 8–11.

Lapointe, G., Larue, M., and Baril, M. (1990). Computerized product information system: the toxicological index. *Hum. Exp. Toxicol.* **9**(4), 207–210.

Liverman, C. T., Ingalls, C. E., Fulco, C. E., and Kipen, H. M. (1997). *Toxicology and Environmental Health Information Resources: The Role of the National Library of Medicine*. National Academy Press, Washington, DC.

Ludl, H., Schope, L. H., and Mangelsdorf, I. (1995). Searching for information on chemical substances in selected biomedical bibliographic databases. *Chemosphere* **31**(2), 2611–2628.

Ludl, H., Schope, L. H., and Mangelsdorf, I. (1996). Searching for information on toxicological data of chemical substances in selected bibliographic databases: selection of essential databases for toxicological researches. *Chemosphere* **32**(5), 867–880.

Macko, L., and Steffy, J. M. (1995). A new pathway to health and safety information: SciFinder, the new research tool from CAS can help. *Chem. Health Safety* **2**(5), 14–17.

Magee, L. A. (1994). The use of teratogen information services for research: assessment of reliability of data entry. *Reprod. Toxicol.* **8**(5), 419+.

Mahoney, M. A., and Kubota, C. (1996). Electronic resources for toxicology and environmental health. In *Toxicology and Risk Assessment: Principles, Methods, and Applications* (Fan, A. M., and Chang, L. W., Eds.), pp. 741–774. Dekker, New York.

Marnicio, R. J., Hakkinen, P. J., Lutkenhoff, S. D., Hertzberg, R. C., and Moskowitz, P. D. (1991). Risk analysis software and databases: reviewe of Riskware Proceedings of the 90 Conference and Exhibition. *Risk Anal.* **11,** 545.

Maroni, M., Fait, A., Azimonti, G., Bersani, M., Colombo, M. G., Ferioli, A., La Ferla, F., and Mainini, F. (1995). Programmes and activities of the International Centre for Pesticide Safety. *Central Eur. J. Public Health* **3**(2), 103–106.

Mateu, J., and Argemi, J. (1992). [Informtoxic: a multimedia toxicological database] [Spanish]. *Anales Espanoles Pediatr.* **36**(Suppl 48), 322–323.

McNamara, E. J. (1993). INFOTERRA: gateway to international environmental information. *Green Library J.* **2**(1), 12–16.

Meier, P. E. (1995). Online metadata prototype: search and access of key data for ATSDR health assessments. *International Congress on Hazardous Waste: Impact on Human Health and Ecological Health. Atlanta, GA, June 5–8, 1995,* Abstract No. 306.

Miido, H., and Rice, J. M. (1997). Pesticide information at IARC. *Abstracts of Papers of the 213th American Chemical Society National Meeting, San Francisco, California, April 13–17, 1997,* AGRO-137.

Miller, T. L., Jenkins, J. J., and Wagner, S. L. (1997). National Pesticide Telecommunications Network (NPTN). *Abstracts of Papers of the 213th American Chemical Society National Meeting, San Francisco, California, April 13–17, 1997,* CINF-030.

Morrell, J. (1996). Mining information from databases for drug discovery. *Abstracts of Papers of the 21th American Chemical Society National Meeting, New Orleans, Louisiana, March 24–28, 1996,* CINF-052.

Nakadate, M., Hayashi, M., Sofuni, T., Kamata, E., Aida, Y., Osada, T., Ishibe, T., Sakamura, Y., and Ishidate, M., Jr. (1991). The expert system for toxicity prediction of chemicals based on structure-activity relationship. *Environ. Health Perspect.* **96,** 77–97.

Neuhann, H. F., Prator, K., Szemkus, M., Wiesmuller, G. A., and Schlipkoter, H. W. (1992). [PATIS: a questionnaire-based, PC-assisted patient information system in the field of environmental medicine]. [German]. *Zentralblatt Hygiene Umweltmedizin* **193**(4), 350–363.

Nitsche, C. I., and Buntrock, R. E. (1996). SciFinder 2.0: preserving the partnership between chemist and information professional. *Database* **19**(6), 51–58.

Norager, O. (1996). High production volume chemicals in the IUCLID database: the result of 3 years of data collection for the EU. *Abstracts of Papers of the 211th American Chemical Society National Meeting, New Orleans, Louisiana, March 24–28, 1996.* CINF-079.

Orloff, K. G., Noegel, R. A., and Nelson, W. (1993). The role of ATSDR public health advisories in protecting public health from environmental contamination: the Forest Glen experience. *J. Environ. Health,* **55**(4), 24+.

Oxyman, M. A., Kissam, H. M., Burnsides, J. M., Edge, J. R., Haberman, C. B., and Wykes, A. A. (1976). The Toxicology Data Bank. *J. Chem. Information Computer Sci.* **16,** 19–21.

Park, R. A., Clough, J. S., Wellman, M. C., and Mauriello, D. A. (1997). Estimating fate and effects with the aquatic ecosystems model, AQUATOX. *Abstracts of Papers of the 213th American Chemical Society National Meeting, San Francisco, California, April 13–17, 1997,* CINF-033.

Parodi, S., Malacarne, D., and Taningher, M. (1991). Examples of uses of databases for quantitative and qualitative correlation studies between genotoxicity and carcinogenicity. *Environ. Health Perspect.* **96,** 61–66.

Parris, T. M. (1996). Rummaging around in the EPA's data warehouse. *Environment* **38**(5), 44–47.

Patton, D. E. (1990). EPA's program for risk assessment guidelines: an overview. In *Proceedings of the Symposium on the Access and Use of Information Resources in Assessing Health Risks from Chemical Exposure* (Lu, P.-Y., Wassom, J. S., Fraland, W. H., and DeRosa, C., Eds.), pp. 95–96. U.S. Environmental Protection Agency and Oak Ridge National Laboratory, Oak Ridge, TN (ORNL Conf-9006324).

Paulu, C. A., Ozonoff, D. M., Coogan, P., and Wartenberg, D. (1995). Making environmental data accessible for public health aims: the Massachusetts Environmental Database Project. *Public Health Rep.* **110**(6), 776–783.

Perlin, S. A., Setzer, R. W., and Sexton, K. (1995). Distribution of industrial air emissions by income and race in the United States: an approach using the Toxic Release Inventory. *Environ. Sci. Technol.* **29**(1), 69+.

Pexieder, T., and Dolivo, A. (1992). Comparison of three drug teratogenicity databases. *Teratology* **45**(5), 488.

Prusek, M. A. (1998). BIOSIS previews: The power of codes. *Med. Reference Services Q.* **17**(2), 43–51.

Quane-Keita, F. (1994). Information for chemical management: the approach of the International Register of Potentially Toxic Chemicals. *Ann. Istituto Superiore di Sanita* **30**(4), 419–423.

Quinn, J. (1997). POWERAG (TM): The Agricultural Information Network. *Abstracts of Papers of the 213th American Chemical Society National Meeting, San Francisco, California, April 13–17, 1997,* AGRO-148.

Ratza, C. A. (1996). The Great Lakes Information Network: the region's Internet information service. *Toxicol. Ind. Health* **12**(3/4), 557+.

Ray, R. M., and Mumtaz, M. M. (1996). Development of a priority list of chemical mixtures at 1188 hazardous waste sites, using the HazDat database. *Food Chem. Toxicol.* **34**(11–12), 1163–1165.

Rieder, M. J., and Morrison, C. (1994). A survey of information provided by the North American Teratogen Information Services. *Reprod. Toxicol.* **8**(5), 425+.

Rieger, O. Y. (1994). *Public's Right-to-Know: Toxic Release Inventory*. Government CD-ROMs (Mecklermedia Corp., Westport, CT).

Ribble, J. (1994). CD-ROM in brief: environmental chemistry, health, and safety. *CD-ROM Professional* **7**(4), 139–140.

Riley, G. I., Warren, J. L., and Goidel, E.-S. (1994). Assessment of changes reported TRI releases and transfers between 1989 and 1990. *J. Air Waste Management Assoc.* **44**(6), 769+.

Rittner, D. (1992). *Eco-Linking: Everyone's Guide to Online Environmental Information.* Peachpit Press, Berkeley, CA.

Robertson, W. Davenport. (1988). The CLSI LIBS 100 automation system at the National Institute of Envi-

ronmental Health Sciences. *Sci. Technol. Libraries* **9:**21–33.

Running, W. E. (1996). A comparison of Micromedex and CCOHS CCINFODISC sources of chemical safety information. *Med. Reference Services Q.* **15**(2), 33–51.

Scheer, S., and Maserck, M. (1993). A knowledge-based approach for a decision–support system on factors affecting river quality. *Toxicol. Environ. Chem.* **39**(1–2), 113–131.

Selkirk, J. K. (1990). National Toxicology Program chemical nomination and selection process. In *Proceedings of the Symposium on the Access and Use of Information Resources in Assessing Health Risks form Chemical Exposure* (Lu, P.-Y., Wassom, J. S., Fraland, W. H., and DeRosa, C., Eds.), pp. 129–132. U.S. Environmental Protection Agency and Oak Ridge National Laboratory, Oak Ridge, TN (ORNL Conf-9006324).

Shidhu, K. S. (1993). Computerized data base for carcinogenicity and risk assessment. *Environ. Toxicol. Chem.* **8,** 1217.

Siegel, H., and Scurr, E. (1985). The CIS database: occupational health and safety information online. *Online Rev.* **9,** 51–59.

Silberger, K. K. (1991). TOXNET database system. *RQ* **30**(4), 551.

Snow, B. (1991). TOXLINE search tips. *Database* **14**(6), 100–105.

Snyder, D. (1991). Tracking environmental, health and safety issues. *Link-Up* **8**(4), 18–20,22.

Stockwell, J. R., Sorensen, J. W., Eckert, J. W., Jr., and Carreras, E. M. (1993). The U.S. EPA Geographic Information System for mapping environmental releases of Toxic Chemical Release Inventory (TRI) chemicals. *Risk Analy.* **13**(2), 155–164.

Stoss, F. (1997). The Toxic Release Inventory. In *The Environmentalist's Guide to the Public Library* (A. Koebrick, and S. Feldstein, Eds.), pp. 26–27. Libraries for the Future, New York.

Sweet, D. (1994). RTECS alleges misrepresentation of data. *Database* **17**(2), 7.

Swuste, P., and Hale, A. (1994). Databases on measures to prevent occupational exposure to toxic substances. *Appl. Occup. Environ. Hygiene* **9**(1), 57–61.

Takala, J. (1993). CD-ROMs and databases as vehicles for chemical safety information. *Am. Ind. Hygiene Assoc. J.* **54**(11), 683–696.

Tennant, R. W. (1991). The genetic toxicity database of the National Toxicology Program: evaluation of the relationships between genetic toxicity and carcinogenicity. *Environ. Health Perspect.* **96,** 47–51.

Thomas, D., and Miller, G. (1992). Using existing hazardous waste databases: limitations and future needs. *Hazardous Waste Hazardous Materials* **9**(1), 97–111.

Travis, C. C., Wang, L. A., and Morris, J. M. (1992). Comparison of the Gene–Tox and RTECS data-bases as predictors of carcinogenic potency. *Mutations Res.* **279**(4), 261–268.

Van Camp, A. J. (1989). The TOXNET gateway. *Online* **13**(4), 70–74.

Vasta, M., and Wexler, P. (1993). Computer database helps douse toxic flames. *Fire Chief* **37**(7), 42–51.

Vasta, B. M., and Casey, S. M. (1991). Down-sizing: a case study of the National Library of Medicine's TOXNET system. *Management Technol. Q.* **21,** 11–15.

Voigt, K., and Bruggemann, R. (1995). Toxicology databases in the metadatabank of online database. *Toxicology* **100**(1–3), 225–240.

Wagner, B. (1994). International Registry of Potentially Toxic Chemicals Data Bank: an information system for managing chemicals. *Ann. Istituto Superiore di Sanita* **30,** 417–418.

Wahl, G. H. (1995). All about the CCOHS World Wide Web server. *Chem. Health Safety* **2**(2), 35–36.

Walker, J. D. (1990). The TSCA Interagency Testing Committee's approaches to screening and scoring chemicals and chemical groups: 1977–1983. In *Proceedings of the Symposium on the Access and Use of Information Resources in Assessing Health Risks from Chemical Exposure* (P.-Y. Lu, J. S. Wassom, W. H. Fraland, and C. DeRosa, Eds.), pp. 71–93. U.S. Environmental Protection Agency and Oak Ridge National Laboratory, Oak Ridge TN (ORNL Conf-9006324).

Wang, S. and Milne, G. W. (1993). Applications of computers to toxicological research [a review]. *Chem. Res. Toxicol.* **6**(6), 748–753.

Wassom, J. S., and Lu, P.-Y. (1990). Evolution of toxicology information systems. *In Proceedings of the Symposium on the Access and Use of Information Resources in Assessing Health Risks from Chemical Exposure,* (P.-Y. Lu, J. S. Wassom, W. H. Fraland, and C. DeRosa, Eds.), pp. 35–42. U.S. Environmental Protection Agency and Oak Ridge National Laboratory, Oak Ridge, TN (ORNL Conf-9006324).

Waters, M. D. (1994). Development and impact of the Gene-Tox program, genetic activity profiles, and their computerized databases. *Environ. Mol. Mutag.* **23** (Suppl. 24), 67–72.

Waters, M. D., Stack, H. F., Garrett, N. E., and Jackson, M. A. (1991). The Genetic Activity Profile Database. *Environ. Health Perspect.* **96,** 41–54.

Watson, J. D. (1991). CD-ROMs is Missouri: census, toxic chemical, and trade data. *Show-Me Libraries* **42,** 26–28.

Wauchope, R. D., Buttler, T. M., Hornsby, A. G., and Augustijn-Beckers, P. W. (1992). The SCS/ARS/CES Pesticide Properties Database for environmental decision-making. *Rev. Environ. Contam. Toxicol.* **123,** 1–155.

Weaver, M. (1996). The Environmental Protection Agency and new technology. *Abstracts of Papers of the 212th American Chemical Society National Meeting, Orlando, Florida, August 25–29, 1996,* ENVR-087.

Weaver, M. (1996). The Environmental Protection Agency and some chemical and regulatory holdings. *Abstracts of Papers of the 212th American Chemical Society National Meeting, Orlando, Florida, August 25–29, 1996,* ENVR-081.

Weiskel, T. C. (1991). Environmental information resources and electronic research systems (ERSs): Eco-Link as an example of future tools. *Library Hi Tech.* **9**(2), 7–19.

West, C. R. (1990). Access and use of information resources by Massachusetts. In *Proceedings of the Symposium on the Access and Use of Information Resources in Assessing Health Risks from Chemical Exposure,* (P-Y. Lu, J. S. Wassom, W. H. Fraland, and C. DeRosa, Eds.), pp. 155–158. U.S. Environmental Protection Agency and Oak Ridge National Laboratory, Oak Ridge, TN (ORNL Conf-9006324).

Wexler, P. (1995). TOXNET: The National Library of Medicine's toxicology database. *Am. Family Phys.* **52**(6), 1677–1678.

Whitbeck, M. (1992). Bretlerick Reactive Chemicals Database—Version 1.00. *J. Chem. Infor. Comp. Sci.* **32**(4), 395–397.

Whyman, C. (1995). Workplace Hazardous Materials Information System (WHMIS). *Can. J. Infection Control* **10**(2), 63.

Wiggins, G. (1997). The Clearinghouse for Chemical Information Instructional Materials (CCIIM). *Abstracts of Papers of the 213th American Chemical Society National Meeting, San Francisco, California, April 13–17, 1997,* CINF-034.

Williams–Johnson, M. M., Henriques, W., and Fay, R. M. (1996). Investigating ratios of health effect levels using ATSDR's HazDat database: Extrapolation methodologies in quantitative risk assessment. *J. Clean Technol. Environ. Toxicol. Occup. Med.* **5**(4), 347–360.

Wrench, C. (1993). Software review: Emergency Information System/Chemical Emergencies (EIS/C). *Am. Ind. Hygiene Assoc. J.* **54**(6), 335–339.

Yin, L. B. (1994). Classification results of mass-spectra of toxic compounds by class modeling. *J. Chem. Info. Comp. Sci.* **34**(6), 1232–1234.

Zhu, Q. W., and Stillman, M. J. (1995). Design of an expert system for emergency response to a chemical spill: ER Expert Module design and development. *J. Chem. Info. Comp. Sci.* **35**(6), 956–968.

General Data and Information Handling and Management

Albertini, S. (1991). Reevaluation of the 9 compounds reported conclusive positive in yeast Saccharomyces cerevisiae aneuploidy test systems by the GENE-TOX program using strain D61.M of Saccharomyces cerevisiae. *Mutat. Res.* **260**(2), 165–180.

Alston, P. G. (1996). Environment online: update 95. *Database* **19**(1), 32–34, 36–38.

Alston, P. G. (1994). Environment online: update 94. *Database* **17**(6), 25–26, 28–29.

Alston, P. G. (1993). Environment online: update 93. *Database* **16**(6), 42–46.

Alston, P. G. (1992). Pesticide information sources in the United States. *Green Library J.* **1**(2), 45–50.

Alston, P. G. (1991). Environment online: the greening of database, part 2: scientific and technical databases. *Database* **14**(5), 34–52.

Alston, P. G., and Stoss, F. W. (1992). Environment online: the greening of databases, part 3: business and regulatory information. *Database* **15**(4), 17–20 22–28, 30–35.

American Health Research Institute Staff. (1993). *Anti-Oxidants and Toxicity Research Studies: Index of New Information with Authors, Subjects, and Bibliography*. ABBE Publishers, Washington, DC.

Anderson, D. C, and Larson, J. A. (1994). The landscape of information resources for alternatives to animals

in research, education, and testing: World Congress on Alternatives and Animal Use in the Life Sciences, Baltimore, Maryland, USA, November 14–19, 1993. *In Vitro Toxicol.* **7**(2), 160.

Anger, W. K. (1993). Database programs as a literature research tool for the 1990s scientist: surveillance of neurotoxicology data. *Environ. Res.* **62**(1), 71–75.

Anonymous. (1995). Updates on chemical hazards: timely tips. *Chemi. Health Safety* **2**(2), 37.

Anonymous. (1994). Framework for provision of teratology information services. *Reprod. Toxicol.* **8**(5), 439.

Anonymous. (1993). Empowering ES&H teams. *Environ. Manager* **5**(3), 12–13.

Anonymous. (1993). Proposed ANSI standard for electronic transfer of MSDS. *Environ. Today* **4**(9), 23.

Anonymous. (1992). ES&T books: IRIS chemical information database. *Environ. Sci. Technolo.* **26**(12), 2347.

Anonymous. (1991). The changing universe of ES&H information management. *Environ. Manager* **3**(5), 5–6.

Anonymous. (1991). Important aspects of right-to-know legislation and not being used by communities. *Am. J. Public Health* **81**(10), 1306.

Anonymous. (1992). *Chemical Exposure: Toxicology, Safety, and Risk Assessment* (Library of Congress Tracer Bullet Series). Library of Congress, Washington, DC.

Anonymous. (1991). Databases of genotoxicity and carcinogenicity and their usefulness for hazard evaluation. *Environ. Health Perspect.* **96** 3–126.

Anonymous. (1995). Directory of information resources on radioactive waste management, decontamination and decommissioning, and environmental restoration: data as of June 1995. *Government Reports Announcements and Index,* Issue 1, NTIS/DE96629659.

Anonymous. (1995). Using information strategically to protect human health and the environment: recommendations for comprehensive information resources management. Environmental Protection Agency, Washington, DC. Office of the Administrator. *Government Reports Announcements and Index,* Issue 11, NTIS/PB95-182572.

Anonymous. (1994). Access and use of information resources in assessing health risks from chemical exposure: proceedings. Department of Energy, Washington, DC. *Government Reports and Announcements and Index,* Issue 3, NTIS/DE93013818.

Antunano, M. J. (1993). Bibliographic guide to publications in aerospace medicine and related topics. *Aviation Space Environ. Med.* **64**(4), 327–336.

Applegate, J. S. (1991). The perils of unreasonable risk: information, regulatory policy, and toxic substances control. *Columbia Law Rev* **91**(2), 261–333.

Armstrong, C. J., and Fenton, R. R. (1996). *World Databases in Biosciences and Pharmacology.* Bowker-Saur, East Grinstead, Germany.

Auletta, A. E. (1990). Structure activity relationships to assess new chemicals under TSCA. In *Proceedings of the Symposium on the Access and Use of Information Resources in Assessing Health Risks from Chemical Exposure* (P.-Y. Lu, J. S. Wassom, W. H. Fraland, and C. DeRosa, Eds.), pp. 53–60. U.S. Environmental Protection Agency and Oak Ridge National Laboratory, Oak Ridge, TN (ORNL Conf-9006324).

Auster, E. C., and Chun, W. (1991). Environmental scanning: a conceptual framework for studying the information seeking behavior of executives. *Proc. ASIS Annu. Meeting* **28,** 3–8.

Bajaj, A. N., *et al.* (1994). Computer-aided drug interaction retrieval programme. *J. Assoc. Phys. India* **42**(9), 706–708.

Balachandran, S. (Ed) (1993). *Encyclopedia of Environmental Information Sources, No. 1.*, Gale Research, Detroit, MI.

Baldari, J. R. (1996). The information needs of regulatory departments with chemical research. *Abstracts of Papers of the 211th American Chemical Society National Meeting, New Orleans, Louisiana, March 24–28, 1996,* CINF-028.

Bandemer, J., and Tannery, N. H. (1998). A comparison of four current-awareness services. *Med. Reference Q.* **17**(2), 29–36.

Barillot, M. J., *et al.* (1997). Evaluation of drug interaction document citation in nine online bibliographic databases. *Ann. Pharmacother.* **31**(1), 45–49.

Bartone, J. C. (1997). *Breast Cancer, Fat, and Adipose Tissue with Toxic and Non-Toxic Chemicals and Residues: Index of New Information.* ABBE Publishers, Washington, DC.

Bartone, J. C. (1997). *Pesticide Residues in Food and Human Bodies: Index of New Information.* ABBE Publishers, Washington, DC.

Bartone, J. C. (1997). *Pesticides and Human Cancer Involvement: Index of New Information.* ABBE Publishers, Washington, DC.

Bashor, B. S. (1990). Use of information resources by the State of Tennessee in risk assessment applications. In *Proceedings of the Symposium on the Access and Use of Information Resources in Assessing Health Risks from Chemical Exposure* (P.-Y. Lu, J. S. Wassom, W. H. Fraland, and C. DeRosa, Eds.), pp. 169–172. U.S. Environmental Protection Agency and Oak Ridge National Laboratory, Oak Ridge, TN (ORNL Conf-9006324)

Bastian, C. L. (Ed.) (1995). *Toxics Watch, 1995.* INFORM, New York.

Bawden, D. (1988, March). Chemical toxicology databanks. *ASLIB Proc.* **40,** 79–85.

Baxter, R. H. (1990). Some public attitudes about health and the environment. *Environ. Health Perspect.* **86**(6), 261–269.

Benfenati, E., and Gini, G. (1997). Computational predictive programs (expert systems) in toxicology. *Toxicology* **119,** 213–225.

Berks, A. H. (1996). Patents as a source of data on biologically active compounds. *Abstracts of Papers of the 21 1th American Chemical Society National Meeting, New Orleans, Louisiana, March 24–28, 1996,* CINF-027.

Beauchamp, R. O., Jr. (1990). Chemical substructure analysis in toxicology. In *Proceedings of the Symposium on the Access and Use of Information Resources in Assessing Health Risks from Chemical Exposure* (P.-Y. Lu, J. S. Wassom, W. H. Fraland, and C. DeRosa, Eds.), pp. 211–218. U.S. Environmental Protection Agency and Oak Ridge National Laboratory, Oak Ridge, TN (ORNL Conf-9006324).

Bennet, D. A. (1990). Information needs for risk management communication. In *Proceedings of the Symposium on the Access and Use of Information Resources in Assessing Health Risks from Chemical Exposure* (P.-Y. Lu, J. S. Wassom, W. H. Fraland, and C. DeRosa, Eds.), pp. 31–34. U.S. Environmental Protection Agency and Oak Ridge National Laboratory, Oak Ridge, TN (ORNL Conf-9006324).

Benz, R. D., and Irausquin, H. (1991). Priority-based assessment of food additives database of the U.S. Food and Drug Administration Center for Food Safety and Applied Nutrition. *Environ. Health Perspect.* **96,** 85–89.

Berks, A. H. (1997). Competitive intelligence value of patents vs. other literature sources for drug compounds. *Abstracts of Papers of the 213th American Chemical Society National Meeting, San Francisco, California, April 13–17, 1997,* CINF-028.

Biarez, O., Sarrut, B., Doreau, C. G., and Etienne, J. (1991). Comparison and evaluation of nine bibliographic databases concerning adverse drug reactions. *DICP* **25**(10), 1062–1065.

Brody, J. G. (1996). Maooing out a search for environmental causes of cancer. *Public Health Rep.* **111**(6), 494–507.

Brennan, J. J. (1996). Critical success factors in the cost effective implementation of an environmental information management system. *Abstracts of Papers of the 21 1th American Chemical Society National Meeting, New Orleans, Louisiana, March 24–28, 1996,* CINF-077.

Bretthauer, E. W. (Ed.) (1991). *Dioxin Perspectives: A Pilot Study on the International Information Exchange on Dioxins and Related Compounds.* Plenum, New York.

Buntrock, R. E. (1996). Playing the chemical numbers game: CAS Registry Numbers (CASRN) revealed. *Database* **19**(4), 72–77.

Burgess, J. L., Keiffer, M. C., Barnhart, S., Richardson, M., and Robertson, W. O. (1997). Hazardous materials exposure information service: development, analysis, and medical implications. *Ann. Emergency Med.* **29**(2), 248–254.

Burke, T., *et al.* (1992). Role of exposure databases in risk management. *Arch. Environ. Health* **47**(6), 421–429.

Bylars, T., Patton, J., King, W., and Nichols, M. (1994). Utilization of the Poison Control Center (PCC) by emergency departments with PoisIndex (PI): North American Congress of Clinical Toxicology Salt Lake City, Utah, September 22–26, 1994. *Toxicology* **36**(4), 353.

Callahan, M. A. (1990). EPA's program for risk assessment guidelines: exposure issues. In *Proceedings of the Symposium on the Access and Use of Information Resources in Assessing Health Risks from Chemical Exposure* (P-Y. Lu, J. S. Wassom, W. H. Fraland, and C. DeRosa, Eds.), pp. 107–108. U.S. Environmental Protection Agency and Oak Ridge National Laboratory, Oak Ridge, TN (ORNL Conf-9006324).

Calmbacher, C. (1992). What will more RTK require? *Environ. Protection* **3**(8), 65–68.

Caravati, E. M., and McElwee, N. E. (1991). Use of clinical toxicology resources by emergency physicians and its impact on poison control centers. *Ann. Emergency Med.* **20**(20), 147–150.

Chyka, P. A., and Butler, A. Y. (1995). Utilization of expert consultants by poison centers in the United States. *Vet. Hum. Toxicol.* **37**(4), 369–370.

Committee on Risk Assessment of Hazardous Air Pollutants (National Research Council). (1996). Models, methods and data. In *Science and Judgement in Risk Assessment, Student Edition.* pp. 106–143. Taylor & Francis, Washington, DC.

Committee on Risk Assessment of Hazardous Air Pollutants (National Research Council). (1996). Data needs. In *Science and Judgement in Risk Assessment, Student Edition.* pp. 144–159. Taylor & Francis, Washington, DC.

Cosmides, G. J. (1990). Toxicological information series, I. toxicological information. *Fundam. Appl. Toxicol.* **14**(3), 439–443.

Cosmides, G. J. (1995). Electronic surveillance of the pharmacology-toxicology literature: the need for controlled vocabularies and registry systems. *Regul. Toxicol. Pharmacol.* **21**(2), 208–210.

Cranor, C. F. (1993). *Regulating Toxic Substances: A Philosophy of Science and the Law.* Oxford Univ. Press, New York.

Croner, C. M., Sperling, J., and Broome, F. R. (1996). Geographic Information Systems (GIS): new perspectives in understanding human health and environmental relationships. *Statistics Med.* **15**(17/18), 1961–1977.

Crowe, A. S., and Mutch, J. P. (1994). An expert systems approach for assessing the potential for pesticide contamination of ground water. *Ground Water* **32**(3), 487–498.

Dahl, R. (1997). Now that you know: Toxic Release Inventory. *Environ. Health Perspect.* **105**(1), 38–42.

Dean, B. S., and Krenzelok, E. P. (1994). The cost of employee turnover to a regional poison information center. *Vet. Hum. Toxicol.* **36**(1), 60–61.

Dean, B. S., and Krenzelok, E. P. (1992). A ten-step quality assurance program for regional poison control centers. *Vet. Hum. Toxicol.* **34**(5), 445–447.

Dearfield, K. L., Stack, H. F., Quest, J. A., Whiting, R. J., and Waters, M. D. (1993). A survey of EPA/OPP and open literature data on selected pesticide chemicals tested for mutagenicity. I. Introduction and first ten chemicals. *Mutat. Res.* **297**(3), 197–233.

Dearfield, K. L., Quest, J. A., Whiting, R. J., Stack, H. F., and Waters, M. D. (1991). Characteristics of the U.S. EPA's Office of Pesticide Programs toxicity information databases. *Environ. Health Perspect.* **96,** 53–56.

DeBlock, L. A., Treiger, B., Van der Auwer, L., and Van Griekan, R. E. (1998). Extraction of environmental information from large aerosol data sets through combined application of cluster and factor analysis. *Mikroahimia Acta* **128**(3–4), 191–200.

Decker, W. J. (1990). Toxicological information series, IV. Information resources for chemical emergency response. *Fundam. Appl. Toxicol.* **15**(2), 213–220.

de Groat, G. (Nov. 1997). Library of Congress subject headings for environmental sources. *Electronic Green J.* **7.** http://www.lib.uidaho.edu:70/docs/egj07/groat.htm.

De Lepper, M. J. (Ed.) (1995). *The Added Value of Geographical Information Systems in Public and Environmental Health.* Kluwer Academic, New York.

DeRosa, C. T., and Johnson, B. L. (1996). Strategic elements of ATSDR's Great Lakes Human Helath Effects Research Program. *Toxicol. Ind. Health* **12**(3/4), 315–325.

DeRosa, C. T., Johnson, B. L., Fay, M., Hansen, H., and Mumtaz, M. M. (1996). Public health implications of hazardous waste sites: findings, assessment, and research. *Food Chem. Toxicol.* **34**(11/12), 1131–1138.

DeRosa, C. T., Choudhury, H., and Schoeny, R. S. (1990). Information needs for risk assessment. In *Proceedings of the Symposium on the Access and Use of Information Resources in Assessing Health Risks from Chemical Exposure* (P.-Y. Lu, J. S. Wassom, W. H. Fraland, and C. DeRosa, Eds.), pp. 21–30. U.S. Environmental Protection Agency and Oak Ridge National Laboratory, Oak Ridge, TN, (ORNL Conf-9006324).

DeRosa, C. T., Stevens, Y. W., and Johnson, B. L. (1993). Cancer policy framework for: public health assessment of carcinogens in the environment. *Toxicol. Ind. Health* **9**(4), 559–575.

DeRosa, C. T., Stevens, Y. W., Wilson, J. D., Ademoyero, A. A., Buchanan, S. D., Cibulas, W., Jr., Duerksen-Hughes, P. J., Mumtaz, M. M., Neft, R. E., Pohl, H. R., *et al.* (1993). The Agency for Toxic Substances and Disease Registry's role in development and application of biomarkers in public health practice. *Toxicol. Ind. Health* **9**(6), 979–994.

Deschamps, J., and Morgan, D. (1993). Information resources for toxicology. In *General and Applied Toxicology, Vol. 1* (Ballantyne, B., Marrs, T., and Turner, P., Eds.), pp. 217–228. Stockton Press, New York.

DiZio, S. M. (1990). Information resources in state regulatory agencies: a California perspective. In *Proceedings of the Symposium on the Access and Use of Information Resources in Assessing Health Risks from Chemical*

Exposure (P.-Y. Lu, J. S. Wassom, W. H. Fraland, and C. DeRosa, Eds.), pp. 145–150. U.S. Environmental Protection Agency and Oak Ridge National Laboratory, Oak Ridge, TN, (ORNL Conf-9006324).

Dodge, C. (1992). Green zines: a list of alternative environmental periodicals. *Green Library J.* **1**(3), 20–32.

Dourson, M. L. (1990). EPA's program for risk assessment guidelines: quantitative issues. In *Proceedings of the Symposium on the Access and Use of Information Resources in Assessing Health Risks from Chemical Exposure* (P.-Y. Lu, J. S. Wassom, W. H. Fraland, and C. DeRosa, Eds.), pp. 103–106. U.S. Environmental Protection Agency and Oak Ridge National Laboratory, Oak Ridge, TN, (ORNL Conf-9006324).

Dowdeswell, E. (1993). Toxic chemicals: the right-to-know. *World Health* **46**(5), 3.

Dupuis, L. L. (1990). Teratology information sources. In *Maternal–Fetal Toxicol. Clinicians Guide,* pp. 340–353. Dekker, New York.

Eagle, S. (Ed.) (1996). *Information Resources in Environmental Protection.* Bowker-Saur, New Providence, NJ.

el Alami, J., Deroulede, A., Dutheuil, C., Levy, D., Miquel, J. F., Gilbert J., and Dore, J. C. (1990). Multiparametric bibliometric analysis of 15 years of international research in chemical toxicology. 1. General presentation and descriptive analysis [French]. *J. Toxicol. Clin. Exp.* **10**(2), 115–129.

Elias, A. W. (Ed.) (1990). Environmental health data in Europe: current approaches. *Information Services Use* **10**(1/2), 1–131.

Elmer, C. (1998). Toxicology information. *Chem. Eng. News* **76**(10), 2.

(U.S.) Environmental Protection Agency. (1999). Environmental and occupational history: Information resources. In *U.S. EPA Recognition and Management of Pesticide Poisonings,* EPA-735-R-98-003, pp. 27–32. Office of Prevention, Pesticides, and Toxic Substances, Washington, DC.

(U.S.) Environmental Protection Agency. (1997). *Access EPA: A Comprehensive Directory of Environmental Protection Agency's Major Information Resources and Services.* Gordon Press, New York.

(U.S.) Environmental Protection Agency. (1996). *How to Obtain Information from the EPA's Office of Pesticide Programs* (EPA 735-F-96-004). Office of Prevention. Pesticides and Toxic Substances (7506C). Environmental Protection Agency, Washington, DC.

(U.S.) Environmental Protection Agency. (1996). *The Hazardous Waste Program Information Strategy Plan* (EAP530-R-96-050), and Appendices (EPA530-R-96-050A) Office of Solid Waste and Emergency Response (5305W). Environmental Protection Agency, Washington, DC.

(U.S.) Environmental Protection Agency. (1992). *Environmental Information Management: A State Resource Guide* (EPA 220-R-92-001) Office of Information Resources Management (PM-211D). Environmental Protection Agency, Washington, DC.

(U.S.) Environmental Protection Agency. (1992). *Compendium of Superfund Program Publications* (EPA/540/8-91/014) Environmental Protection Agency, Washington, DC.

Ercegovac, Z. (1992). Environmental research: communication studies and information sources. *Annu. Rev. Information Sci. Technol.* **27,** 173–225.

Evalgelista, M., Bolognesi, C., Rabboni, R., and Ugolini, D. (1994). Chemical hazard evaluation: the use of factual health and safety databanks. *Sci. Total Environ.* **153**(3), 211–217.

Farland, W. H. (1990). Concluding remarks: where do we go from here? In *Proceedings of the Symposium on the Access and Use of Information Resources in Assessing Health Risks from Chemical Exposure* (P.-Y. Lu, J. S. Wassom, W. H. Farland, and C. DeRosa, Eds.), pp. 231–238. U.S. Environmental Protection Agency and Oak Ridge National Laboratory, Oak Ridge, TN (ORNL Conf-9006324).

Farquharson, M. (1993). Is is safe to breathe? Lack of hard data stymies pollution research. *Business Mexico* **3,** 32+.

Fehr, R., Kobusch, A. B., and Kohn-Schulze, E. (1994). A noxious agents information system with state-wide participation of the public health service. *Methods Inf. Med.* **33**(2), 237–242.

Felberg, L., Litovitz, T. L., and Morgan, J. (1990). State of the nation's poison centers: 1995 American Association of Poison Control Centers survey of U.S. poison centers. *Vet. Hum. Toxicol.* **38**(6), 445–453.

Felsot, A. S. (1997). Who do you trust? Environmental information from non-governmental organizations on the Internet. 213th National Meeting of the American Chemical Society, San Francisco, California, USA, April 13–17, 1997. *Abstr. Papers Am. Chem. Soc.* **213**(1–3), AGRO 149.

Feng, P., and Easley, M. (1999). Managing environmental data. *Environ. Protection* **10**(4), 19–23.

Fenner-Crisp, P. (1990). How information resources are used by federal agencies in risk assessment applica-

tions. In *Proceedings of the Symposium on the Access and Use of Information Resources in Assessing Health Risks from Chemical Exposure* (P.-Y. Lu, J. S. Wassom, W. H. Fraland, and C. DeRosa, Eds.), pp. 141–144. U.S. Environmental Protection Agency and Oak Ridge National Laboratory, Oak Ridge, TN (ORNL Conf-9006324).

Fenner-Crisp, P (1990). Information resources for accessing health effects from chemical exposure: Office of Pesticide Programs. In *Proceedings of the Symposium on the Access and Use of Information Resources in Assessing Health Risks from chemical Exposure* (P.-Y. Lu, J. S. Wassom, W. H. Fraland, and C. DeRosa, Eds.), pp. 203–204. U.S. Environmental Protection Agency and Oak Ridge National Laboratory, Oak Ridge, TN (ORNL Conf-9006324).

Fernando, R. (1995). Pesticide poisoning in the Asia-Pacific region and the role of a regional information network. *J. Toxicol. Clin. Toxicol.* **33**(6), 677+.

Fiorino, D. J. (1990). Citizen Participation and environmental risk: A Survey of institutional mechanisms. *Sci. Technol. Human Values* **15**(2), 226–243.

Friess, S. L. (1995). The use of toxicological research information: how and by whom. *Fundam. Appl. Toxicol.* **26**(2), 151+.

Gaba, J. M. (1990). Environmental laws regulating chemicals: uses of information in decision making under environmental statutes. In *Proceedings of the Symposium on the Access and Use of Information Resources in Assessing Health Risks from Chemical Exposure.* (P.-Y. Lu, J. S. Wassom, W. H. Fraland, and C. DeRosa, Eds.) pp. 13–20. U.S. Environmental Protection Agency and Oak Ridge National Laboratory, Oak Ridge, TN (ORNL Conf-9006324).

Gehanno, J. F., Paris, C., Thirion, B., and Caillard, J. F. (1998). Assessment of bibliographic databases performance in information retrieval for occupational and environmental toxicology. *Occ. Environ. Med.* **55**(8), 562–566.

(U.S.) General Accounting Office. (1998). *Environmental Information: Agencywide Policies and Procedures Are Needed for EPA's Information Dissemination* (GAO/RCED-98-245). General Accounting Office, Washington, DC: http://www.gao.gov/reports.

(U.S.) General Accounting Office. (1997). *Internet and Electronic Dial-Up Bulletin Boards: Information Reported by Federal Organizations* (GAO/GGD-97-86). General Accounting Office, Washington, DC. http://www.gao.gov/reports/.

(U.S.) General Accounting Office. (1997). *Toxic Substances: Few States Have Considered Reporting Requirements for Chemical Use Data* (GAO/RCED-97-154). General Accounting Office, Washington, DC. http://www.gao.gov/reports/.

(U.S.) General Accounting Office. (1997). *World Wide Web Sites Reported by Federal Organizations* (GAO/GGD-97-86S). http://www.gao.gov/reports/. Available only on the Internet.

(U.S.) General Accounting Office. (1995). *Hazardous Waste: Demographics of People Living Near Waste Facilities.* (GAO/RCED-95-84). General Accounting Office, Washington, DC. http://www.gao.gov/reports/.

Goldberg, L. (1982). A code of ethics for scientists reporting and reviewing information on chemicals. *Fundam. Appl. Toxicol.* **2**(6), 289–292.

Goldman, B. A. (1991). The environment and community right to know: information for participation. *Computers Hum. Services* **8**(1), 19–40.

Gong, S. D., Millares, M., and Van Riper, K. B. (1992). Drug information pharmacists at health-care facilities, universities, and pharmaceutical companies. *Am. J. Hospital Pharmacists* **49**(5), 1121–1130.

Goulding, R. (1991). Poisons information services: a look ahead. *Hum. Exp. Toxicol.* **10**(6), 401+.

Government Accounting Office. (1997). *Toxic Substances: Few States Have Considered Reporting Requirements for Chemical Use Data.* Government Accounting Office, Washington, DC. (GAO/RCED-97-154). Also available on the GAO Web site: http://www.gao.gov.

Government Institutes (staff). (1995). *Directory of Environmental Information Sources,* 5th ed. Government Institutes, Inc., Rockville, MD.

Grasmick, C. (1993). A fierce fire in a railroad yard on a bitter cold night shows the need for TOXNET information. *Vet. Hum. Toxicol* **35**(1), 56+.

Grassman, J. A. (1996). Obtaining information about susceptibility from the epidemiology literature. *Toxicology* **111**(1–3), 253+.

Grier, N. (1993). Spreading the word about pesticide hazards and alternatives. *J. Pesticide Reform* **13**(4), 2–19.

Griffin, R. J., and Dunwoody, S. (1995). Impacts of information subsidies and community structure on local press coverage of environmental contamination. *J. Mass Commun. Q.* **72**(2), 271–284.

Grouse, K. (1993). Round-table on environmental information and documentation. **20**(2), 174.

Gunther, J. A. (1994). Digital toxic avengers. *Popular Sci.* **245**(2), 16.

Gunther, O. (1997). *Environmental Information Systems.* Springer Verlag, New York.

Haastrup, P., and Romer, H. (1995). H. An analysis of the database coverage of industrial accidents involving hazardous materials in Europe. *J. Loss Prevention Process Industries* **8**(2), 79–86.

Hadden, W. J., Jr. (1990). A citizen's helper for chemical information. In *Expert Systems for Environmental Applications.* Hushon, J. M., Ed., pp. 109–119. Division of Chemical Information. Symposium at the 198th National Meeting, American Chemical Society, Washington, DC.

Hadden, S. G. (1989). Right-to-know: what it can mean for citizens. *EPA J.* **15**(3), 13–16.

Hall, F. R. (1997). Team building on the Web: an overview of coupling cost-benefit and environmental risk assessment models. *Abstracts of Papers of the 213th American Chemical Society National Meeting, San Francisco, California, April 13–17, 1997,* CINF-046.

Hanzlick, R. (1993). BLURBs: a coding scheme for toxicologic data. *Am. J. Forensic Med. Pathol.* **14**(1), 31–33.

Haselbauer, K. J. (1987). *A Research Guide to the Health Sciences: Medical, Nutritional, and Environmental. Reference Sources for the Social Sciences and Humanities—A Series*. Greenwood, Westpost, CT.

Heath, R. L., and Nathan, K. (1990–1991). Public relations role in risk communication: information, rhetoric and power. *Public Relations Q.* **35**(4), 15–22.

Henderson, H. (Ed). *Science Tracer Bullets: A Reference Guide to Scientific, Technological, Health, and Environmental Information Sources*. Omnigraphics. Library of Congress Tracer Bullets Series. Library of Congress, Washington, DC.

Hertz-Picciotto, I. (1996). Comment: toward a coordinated system for the surveillance of environmental health hazards. *Am. J. Public Health* **86**(5), 638–641.

Hiatt, P. H., and Olson, K. R. (1995). Hazardous materials emergency medical response. In *Environmental Medicine* (S. M. Brooks, J. Gochfeld, J. Herzstein, R. J. Jackson, and M. B. Schenker, Eds.), pp. 705–721. Mosby/Year Book, St. Louis, MO.

Holman, T. D. (1997). A case history: how pesticide data has been misrepresented to disparage roundup herbicide. *Abstracts of Papers of the 213th American Chemical Society National Meeting, San Francisco, California, April 13–17, 1997,* AGRO-147.

Huff, J., and Haseman, J. (1991). Long-term chemical carcinogenesis experiments for identifying potential human cancer hazards: collective database of the National Cancer Institute and National Toxicology Program (1976–1991). *Environ. Health Perspect.* **96,** 23–31.

Hungerford, L. L. Trammel, H. L., and Clark, J. M. (1995). The potential utility of animal poison data to identify human exposure to environmental toxins. *Vet. Hum. Toxicol.* **37**(2), 158–162.

Hungren, G. (1991). Survey of toxicology information. *Fundam. Appl. Toxicol.* **14**(4), 649–657.

Hutchins, J. (1996). Resources for biosciences: environmental activism. *Sci. Eng. Network News* **6**(9), 6–7.

Igarashi, T. (1993). A review of the Japanese Pharmaceutical Manufacturers Association database currently established to examine retrospectively the value of long-term animal toxicity studies. [A Review]. *Adverse Drug Reactions Toxicol. Rev.* **12**(1), 35–52.

Innes, J., and Mahoney, M. A. (1991). List of environmental and other useful listservs. *ERMD News* **2**(2), 14–21.

Innes. J., and Mahoney, M. A. (1991). E-newsletters and E-journals. *ERMD News.* **2**(2), 21.

Johnson-Cartee, K. S., Grahm, B. A., and Foster, D. (1992). Siting a hazardous waste incinerator: newspaper risk communication and public opinion analysis. *Newspaper Res. J.* **14**(4–1), 60–72.

Johnson, V. B. (1997). USDA pesticide use information. *Abstracts of Papers of the 213th. American Chemical Society National Meeting, San Francisco, California, April 13–17, 1997,* CINF-031.

Johnson, W. A. (1990). Access and use of information resources in accessing health risks from chemicals in food. In *Proceedings of the Symposium on the Access and Use of Information Resources in Assessing Health Risks from Chemical Exposure* (P.-Y. Lu, J. S. Wassom, W. H. Fraland, and C. DeRosa, Eds.), pp. 135–140. U.S Environmental Protection Agency and Oak Ridge National Laboratory, Oak Ridge, TN (ORNL Conf-9006324).

Jones, T. D., Walsh, P. J., Watson, A. P., Owen, B. A., Barnthouse, L. W., and Sanders, D. A. (1988). Chemical scoring by a rapid screening of hazard (RASH) method. *Risk Anal.* **8**(1), 99–118.

Joseph, T. W. (1990). Tactical approach to maneuvering within the chemical contamination labyrinth. In *Proceedings of the Symposium on the Access and Use of Information Resources in Assessing Health Risks from Chemical Exposure* P.-Y. Lu, J. S. Wassom, W. H. Fraland, and C. DeRosa, Eds.), pp. 115–180. U.S. Environmental Protection Agency and Oak Ridge National Laboratory, Oak Ridge, TN (ORNL Conf-9006324).

Judson, P. N., *et al.* (1996). Using new reasoning technology in chemical information systems. *J. Chem. Information Computer Sci.* **36**(4), 621–624.

Kaminstein, D. S. (1996). Persuasion in a toxic community: rhetorical aspects of public meetings. *Hum. Org.* **55**(4), 458–464.

Kamrin, M. A. (1990). Data base selection in toxicological risk assessment and management. *Regul. Toxicol. Pharmacol.* **11**(3), 308–313.

Karcher, W., and Karabunarliev, S. (1996). The use of computer-based structure–activity relationships in the assessment of industrial chemicals. *J. Chem. Info. Comp. Sci.* **36**(4), 672–677.

Kasilo, O. L., and Nhachi, C. F. B. (1991). Recommendations for establishing a drug and toxicology information center in a developing country. *DICP Annals Pharmacother.* **25**(12), 1379+.

Kaufman, A. S. (1998). *Pollutant Materials in the American Environment: Index of New Information*. ABBE Publishers, Washington, DC.

Kennedy, G. L., Jr. and Krivanek, N. D. (1996). Some thoughts about the use and communication of toxicology information: a review. *Drug Metab. Rev.* **28**(1/2), 235–243.

Kerr, M., *et al.* (1993). Teratogen information service update: computerized database of call management. *Reprod. Toxicol.* **7**(6), 636.

Khanna, M., Quimio, U. R. H., and Bojilova, D. (1998). Toxic release information: A policy tool for environmental protection. *J. Environ. Econ. Management* **36**(3), 243–266.

Kimbell, J., and Fireman, J. (1996). Computer simulation helps researchers gauge toxic effects on the human respiratory system. *Chem. Health Safety* **4**(5), 32–35.

Kingsley, W., and Segal, E. (1991). The hazards of household chemicals: getting the chemical kicks out of the kitchen. *201st National Meeting of the American Chemical Society, Atlanta, GA, April 14–19, 1991,* CHAS-028.

Kirsch, R. A. (1996). Environmental, health, and safety data integration. *Abstracts of Papers of the 211th American Chemical Society National Meeting, New Orleans, Louisiana, March 24–28, 1996,* CINF-032.

Kissman, H. M. and Wexler, P. (1985). Toxicology information systems: a historical perspective [A Review]. *J. Chem. Information Computer Sci.* **25**(3), 212–217.

Klopman, G., and Rosenkranz, H. (1991). Structure-activity relations: maximizing the usefulness of mutagenicity and carcinogenicity databases. *Environ. Health Perspect.* **96,** 67–75.

Koebrick, A., and Feldstein, S. (1997). *The Environmentalist's Guide to the Public Library*. Libraries for the Future, New York.

Koebrick, A. (1995). Environmental Information Access Project in the United States: information to help environmentalists become more active users of public libraries. *Electronic Green J.* **2**(1). http://www.lib.uidaho.edu:70/docs/egj03/egj-toc.html.

Konar, S., and Cohen, M. A. (1997). Information regulation: the effect of community right-to-know laws on toxic emissions. *J. Environ. Econ. Management* **32**(1), 109–124.

Krenzolok, E. P. (1995). The use of poison prevention and education strategies to enhance the awareness of the poison information center and to prevent accidental pediatric poisoning. *J. Toxicol. Clin. Toxicol.* **33**(6), 663+.

Krenzelok, E. P., and McElwee, N. E. (1995). International poison information center data collection capabilities. *Vet. Hum. Toxicol.* **37**(3), 246–248.

Krenzelok, E. P., and Provost, E. J. (1995). The ten most common plant exposures reported to poison information centers in the United States. *J. Nat. Toxins* **4**(2), 195–202.

Krupin, P. J. (1997). *Krupins Toll-Free Environmental Directory*. Direct Contact Publishing, Kennewick, WA. (53 sections, including: Asbestos; Hazardous Materials & Hazardous Wastes; Laboratories—Analytical, Environmental, Hazardous, Radiological, and Testing; Occupational Safety & Health Consultants; Pesticides, Herbicides, and Insecticides—Information; Poison Control Centers; Radon; Risk Management; Training and Education—Hazardous Materials, Regulatory & Safety).

Kunreuther, H. (1989). Learning about risk: consumer and worker responses to hazard information. *J. Econ. Literature* **27**(1), 137–138.

LaBar, G. (1992). Chemical safety data: global needs & national interests. *Occup. Hazards* **54**(6), 45–49.

Larson, J. A. (1993). A brief summary of Environmental/Biotechnology information resources. *Toxicol. Environ. Chem.* **4**(1–4), 155–165.

LaRue, J., *et al.* (1991). Libraries and the environment. *Wilson Library Bull.* **65**(6), 26–43.

Laskowski, D. M., Fergus, L., and Cordasco, E. M., Sr. (1995). Information resources in environmental lung disease. In *Environmental Respiratory Diseases* (E. M. Cardasco, *et al.,* Eds.), pp. 525–567. Van Nostrand–Reinhold, New York.

Layman, P. (1996). Center coordinates toxics data in Europe. *Chem. Eng. News* **74**(28), 21.

Lees, N. (1997). *Environmental Information: A Guide to Sources,* 2nd ed. Erlbaum, Mahwah, NJ.

Legg, W. E. (1990). How information resources are used by federal agencies in risk assessment applications. In *Proceedings of the Symposium on the Access and Use of Information Resources in Assessing Health Risks from Chemical Exposure* (P.-Y. Lu, J. S. Wassom, W. H. Fraland, and C. DeRosa, Eds.), pp. 113–114. U. S. Environmental Protection Agency and Oak Ridge National Laboratory, Oak Ridge, TN (ORNL Conf-9006324).

Lescher, J. (1996). Dialog on the Net: KR ScienceBase. *Online* **20**(3), 38–50.

Link, T. (1993). Environmental racism/environmental equity: a bibliography. *Green Library J.* **2**(1), 17–22.

Link, T. (1994, 1995). Environmental resources: news in brief of environmentally-related publications, online databases, and other resources. *Electronic Green J.* **2**(1), http://www.lib.uidaho.edu:70/docs/egj03/egj-toc.html; **1**(2), http://www.lib.uidaho.edu:70/docs/egj02/egj-toc.html; **1**(1), http://www.lib.uidaho.edu:70/docs/egj01/egj-toc.html.

Litvinov N. N., Ostapenko, Y. N., and Kazachkov, V. I. (1996). Information technologies for clinical toxicology in Russia. *J. Toxicol. Clin. Toxicol.* **34**(6), 665+.

Litovitz, T. L., Felberg, L., White, S., and Klein-Schwartz, W. (1996). 1995 Annual report of the American Association of Poison Control Centers Toxic Exposure Surveillance System. *Am. J. Emergency Med.* **14**(5), 487–537.

Litovitz, T. L., Oderda, G., White, J. D., and Shreidan, M. J. (1993). Occupational and environmental exposures reported to poison centers. *Am. J. Public Health* **83**(5), 739–743.

Lu, P.-Y., and Wassom, J. S. (1994). Information resources for chemical toxicology and regulation. *J. Hazardous Materials* **39**(2), 225–243.

Lu, P. -Y., and Wassom, J. S. (1990). Risk assessment and toxicology databases for health effects assessment. In *Proceedings of the Symposium on the Access and Use of Information Resources in Assessing Health Risks from Chemical Exposure* (P.-Y. Lu, J. S. Wassom, W. H. Fraland, and C. DeRosa, Eds.), pp. 79–194. U. S. Environmental Protection Agency and Oak Ridge National Laboratory, Oak Ridge, TN, (ORNL Conf-9006324).

Lu, P.-Y., and Wassom, J. S. (1996). Resources for toxicology risk assessment. In *Toxicology and Risk Assessment: Principles, Methods, and Applications* (A. M. Fan and L. W. Chang, Eds.), pp. 727–740. Dekker, New York.

Lu, P.-Y., and Wassom, J. S. (1993). Risk assessment and toxicology databases for health effects assessment. In *Proceedings of the Symposium on the Access and Use of Information Resources in Assessing Health Risks from Chemical Exposure,* pp. 179–194. U. S. Environmental Protection Agency and Oak Ridge National Laboratory, Oak Ridge, TN (ORNL Conf-9006324).

Lu, P.-Y., Wassom, J. S., Fraland, W. H., and DeRosa, C. (Eds.) (1990). *Proceedings of the Symposium on the Access and Use of Information Resources in Assessing Health Risks from Chemical Exposure*. U.S. Environmental Protection Agency and Oak Ridge National Laboratory, Oak Ridge, TN (ORNL Conf-9006324)

Lyndon, M. L. (1989). Information economics and chemical toxicity: designing laws to produce and use data. *Michigan Law Rev.* **87**(7), 1795–1861.

Maciaschapula, C. A., and Rodeacastro, I. P. (1997). Subject content of the Mexican production on health and the environment (1982–1993). *Scientometrics* **38**(2), 295–308.

MacLean, A. (1996). The right stuff: information in the public interest. *New Solutions* **6**(1), 58–68.

Makuch, J. (Jan. 1990–Nov. 1994). *Nonpoint-Source Pollution Issues*. QB 95-01 (National Agricultural Library), Quick Bibliography Series. National Library of Medicine, Beltsville, MD.

Makuch, J. (Jan. 1993–Jan. 1995). *Regulating Water Quality: Policy, Standards, and Laws.* QB 95-02 (National Agricultural Library), Quick Bibliography Series. National Library of Medicine, Beltsville, MD.

Makulowich, J. S. (1996, April/May). Government and health sites. *Database,* 92–94.

Maling, H. V. and Wassom, J. S. (1990). Information resources and the Correlation of response patterns between biological end points. In *Proceedings of the Symposium on the Access and Use of Information Resources in Assessing Health Risks from Chemical Exposure* (P.-Y. Lu, J. S. Wassom, W. H. Fraland, and C. DeRosa, Eds.), pp. 219–226. U. S. Environmental Protection Agency and Oak Ridge National Laboratory, Oak Ridge, TN (ORNL Conf-9006324).

Maxwell, C. (1996). Integrating process control technology, neural networks, and environmental database management systems for cost-effective continuous emissions monitoring. *Abstracts of Papers of the 211th American Chemical Society National Meeting, New Orleans, Louisiana, March 24–28, 1996.* CINF-076

Mayya, Y. S., *et al.* (1994). Database requirements for epidemiological estimates of radiation risks in continuously exposed populations. *Risk Anal.* **14**(5), 829–831.

McCallum, D. B., *et al.* (1991). Communicating about environmental risks: how the public uses and perceives information sources. *Health Education Q.* **18**(3), 349–361.

McCunney, R. J., Boswell, R., and Harzbecker, J. (1992). Environmental health in the journals. *Environ. Res.* **59**(1), 114–124.

McLellan, J. W. (1989). Hazardous substances and the right-to-know in Canada. *Int. Labor Rev.* **128**(5), 639–650.

Merrigan, S. D., and Baker, P. B. (1997). Flow of information in and out of a university pesticide information center. *Abstracts of Papers of the 213th American Chemical Society National Meeting, San Francisco, California, April 13–17, 1997,* CINF-047.

Metcalf, R. L. (1990). The problem of living in a world contaminated with chemicals. In *Proceedings of the Symposium on the Access and Use of Information Resources in Assessing Health Risks from Chemical Exposure* (P.-Y. Lu, J. S. Wassom, W. H. Fraland, and C. DeRosa, Eds.), pp. 1–12. U. S. Environmental Protection Agency and Oak Ridge National Laboratory, Oak Ridge, TN (ORNL Conf-9006324).

Milczarska, A., Chojnowska, A., Maciaszek, Z., and Przyluska, J. (1992). [Bibliographic and documentary activities in the fields of occupational medicine and toxicology] [Polish]. *Medycyna Pracy* **43**(2), 141–145.

Mills, A., and Foureman, G. L. (1998). U.S. EPA's IRIS pilot program: Establishing IRIS as a centralized, peer-reviewed data base with agency consensus. *Toxicology* **127,** 85–95.

Mondschein, L. G. (1994). The role of spatial information systems in environmental emergency management. *J. Am. Soc. Information Sci.* **45**(9), 678–685.

Monroe, M. C. and DeYoung, R. (1994). The role of interest in environmental information: a new agenda. *Children's Environ. Q.* **11**(3), 243–250.

Moulder, E. R. (1993). *Local Emergency Response Plans.* International City/County Management Association, Washington, DC.

Mount, E. (Ed.) (1990). *The Relationship of Sci-Tech Information to Environmental Studies.* Haworth Press, Binghamton, NY. [Special issue of *Science & Technology Libraries,* **10**(2)].

Moy, G. G. (1997). Pesticide information resources of the World Health Organization. *Abstracts of Papers of the 213th National Meeting of the American Chemical Society, San Francisco, California, USA, April 13–17, 1997,* AGRO–138.

Mrvos, R., Dean, B. S., and Krenzelok, E. P. (1994). A demographic profile of the specialist in poison information. *Vet. Hum. Toxicol.* **36**(4), 330–331.

Mullan, R. J., and Murthy, L. I. (1991). Occupational sentinel health events: an up-dated list for physician recognition and public health surveillance. *Am. J. Ind. Med.* **19**(6), 775–799.

National Association of Science Writers. (1993). *Communicating Science News: A Guide for Public Information Officers, Scientists, and Physicians.* National Association of Science Writers, Greenlawn, NY.

National Institute for Occupational Safety and Health (NIOSH). (1996). *Criteria for a Recommended Standard: NIOSH Criteria Documents, Occupational Hazard Assessments, Special Hazard Reviews, and Joint Occupational Health Documents.* National Institute for Occupational Safety and Health, U.S. Department of Health and Human Services, Washington, D.C. (Listed individually by chemical name. Print copies available from the National Technical Information Service; all Criteria Documents available on CD-ROM (NIOSH Publication No. 96-130, NTIS PB97-500375); entire report series available at http://www.cdc.gov/niosh/critdoc2.html.)

National Institute for Occupational Safety and Health (NIOSH). Fact Sheets. National Institute for Occupational Safety and Health, Washington, D.C. ''Preventing Silicosis'' (Doc. No. 705026, April 1996); ''NIOSH Research Agenda'' (Doc. No. 705011, April 1996); ''NIOSH'' (Doc. No. 705010, April 1997); ''Indoor Environmental Quality'' (Doc. No. 705002, June

1997); ''NIOSH Databases and Electronic Products'' (Doc. No. 705100). (Complete list of hypertext, linked fact sheets available at http://www.cdc.gov/niosh/factlist.html.)

Needham, R. D. (Ed.) (1992). Breaking the barriers to environmental information. *Environ. Monitoring Assessment* **20**(2/3). Special issue. Kluwer, Dordrecht, Netherlands.

Nelkin, D. (1991). *Risk Communication and the Mass Media.* School of Journalism, The Univerisity of Tennessee, Knoxville, TN.

Nohynek, G. J. (1996). *Presenting Toxicology Results: How to Evaluate Data and Write Reports.* Taylor and Francis, London.

O'Hara, F. W., Jr. (1994). EPA testimony at TSCA hearings. *ES&H News* (Society for Technical Communication, Environmental, Safety and Health Communication Professional Interest Committee) **1**(1), 9–10.

Olson, C. S. (1990). How information resources are used by state agencies in risk assessment applications—Illinois. In *Proceedings of the Symposium on the Access and Use of Information Resources in Assessing Health Risks from Chemical Exposure* (P.-Y. Lu, J. S. Wassom, W. H. Fraland, and C. DeRosa, Eds.), pp. 151–154. U.S. Environmental Protection Agency and Oak Ridge National Laboratory, Oak Ridge, TN (ORNL Conf-9006324).

Olson, D. K., Sax, L., Gunderson, P., and Sioris, L. (1991). Pesticide poisoning surveillance through regional poison control centers. *Am. J. Public Health* **81**(6), 750–753.

Paparis, S. Y. (1997) *Food Analysis—Contents and Toxicology: Index of New Information.* ABBE Publishers, Washington, D.C.

Parris, T. M. (1997). Spinning the Web of environmental justice. *Environment* **39**(4), 44–45.

Persson, B., *et al.* (1994). Comparison of information sources for case-referent data. *Scand. J. Work Environ. Health* **20**(5), 371–375.

Peters, H. P. (1982). In search for opportunities to raise environmental risk literacy. *Toxicol. Environ. Chem.* **40**(1–4), 289–300.

Peterson, K. L., *et al.* (1994). Information resources for US Department of Energy pollution prevention programs. Department of Energy, Washington, D.C. *Government Reports Announcements and Index,* Issue 15 (NTIS/DE94006677).

Philips, L. J. (1992). A comparison of human toxic exposure and environmental contamination by census division (NHATS and STORET). *Arch. Environ. Contam. Toxicol.* **22**(1), 1–5.

Piegorsch, W. W. (1994). Combining environmental information. *Environ. Health Perspect.* **102**(2), 222–225.

Piegorsch, W. W., and Cox, L. H. (1996). Combining environmental information II. *Environ. Epidemiol. Toxicol. EnviroMetrics* **7**(3), 309+.

Pierce, J. C., Steger, M. A. E., Steel, B. S., and Lovrich, N. P. (1992). *Citizens, Political Communication, and Interest Groups: Environmental Organizations in Canada and the United States.* Praeger, Westport, CT.

Pollastro, M. The Ecocruiser: electronic resources on environmental topics. *Electronic Green J.* **7,** November, 1997, http://www.lib.uidaho.edu:70/docs/egj07/pollastro.htm; **6,** December 1996, http://www.lib.uidaho.edu:70/docs/egj06/index.htm; **5,** June 1996, http://www.lib.uidaho.edu:70/docs/egj05/egj-toc.html; **4** December 1995, http://www.lib.uidaho.edu:70/docs/egj04/egj-toc.html; **3,** April 1995, http://www.lib.uidaho.edu:70/docs/egj03/egj-toc.html.

Polunin, N. V. C. (1996). Environmental information and children: The big and the small. *Environ. Conservation* **23**(2), 103–104.

Post, G. B., Baratta, M., Wolfson, S., and McGeorge, L. (1990). Information resources used in health risk assessment by the New Jersey Department of Environmental Protection. In *Proceedings of the Symposium on the Access and Use of Information Resources in Assessing Health Risks from Chemical Exposure* (P.-Y. Lu, J. S. Wassom, W. H. Fraland, and C. DeRosa, Eds.), pp. 163–168. U.S. Environmental Protection Agency and Oak Ridge National Laboratory, Oak Ridge, TN (ORNL Conf-9006324).

Postol, L. P. (1990). Chemical hazard information: injury logs get close inspection. *Natl. Law J.* **13**(8), 29.

Powers, M. B. (1994). New rule on hazardous leaks will spur information technology. *ENR* **233**(7), 54–56.

Porter, N. L., and Hullinger, C. (1987). Asbestos information sources. *Sci. Technol. Libraries* **9**(Summer), 107–122.

Prorak, D., and Von Braun, M. (1993). Teaching students to use electronic information sources to research chemical toxicity. *Res. Strategies* **11**(Spring), 106–110.

Pup, J. D., Kmiecik, J., and Reitman, F. (1996). Improvement in human health risk assessment utilizing site- and chemical specific information: A case study. *Toxicology* **113**(1–3), 346+.

Raber, L. (1996). Information can be quite uninformative. *Chem. Eng. News* **74**(47), 23.

Reisman, D. J. (1990). Information and technology: a coexistence without limits, a beginning with no apparent ending. In *Proceedings of the Symposium on the Access and Use of Information Resources in Assessing Health Risks from Chemical Exposure* (P.-Y. Lu, J. S. Wassom, W. H. Fraland, and C. DeRosa, Eds.), pp. 43–48. U.S. Environmental Protection Agency and Oak Ridge National Laboratory, Oak Ridge, TN (ORNL Conf-9006324).

Renner, R. (1997). Analyzing chemical toxicity in 3-D on the Web. *Environ. Sci. Technol.* **31**(1), 32A–33A.

Renner, R. (1996). Pilot program will update IRIS health risk database for 11 chemicals. *Environ. Sci. Technol.* **30**(6), A240–A241.

Repetto, M. R. (1996). Pediatric poisonings due to cleansing agents reported in 1994 to the Toxicological Information Service of Seville, Spain. *Vet. Hum. Toxi.* **38,** 435–437.

Reys, L. L. (1992). Importance of information in forensic toxicology. *Am. J. Forensic Med. Pathol.* **13**(1), 33+.

Rich, R. C., Conn, W. D., and Owens, W. L. (1993). An indirect regulation of environmental hazards through the provision on information to the public: the case of SARA, Title III. *Policy Studies J.* **2**(1), 16–34.

Richardson, M. (1998). ''Environmental Toxicology Assessment: Birch Assessment Services for Information Chemicals.'' Taylor and Francis, Inc., Bristol, CT.

Ridings, J. E., *et al.* (1996). Computer prediction of possible toxic action from chemical structure: an update on the DEREK system. *Toxicology* **106**(1–3), 267–279.

Ridley, D. D. (1996). ''Online Searching: A Scientists Perspective: A Guide for the Chemical and Life Sciences.'' University of Sydney, Sydney, Australia.

Roberfroid M. (1995). Toxicology: a science and an art. *Toxicology in Vitro,* **9**(6), 839–844.

Roll, M. H. (1990). The OSHA communication standard and state right-to-know laws. *School Business Affairs,* **56**(7), 26–30.

Romano, P., Aresu, O., Parodi, B., Malacarne, D., Castagneto, G., Parodi, S., and Ruzzon, T. (1991). Analysis and comparison of information and data recorded in carcinogenicity and genotoxicity databases. *Environ. Health Perspect.* **96,** 113–120.

Ronald, K., and Nicholls, P. (1992). Historical development of environmentalism and recorded environmental information in the United States. *Green Library J.* **1**(2), 4–14.

Ross, J. B. (1992). Prevention of occupational disease: problems of data collection for adequate surveillance [editorial; comment]. *Can. Med. Assoc. J.* **147**(10), 1443–1445.

Rosso, P. C. (1996). Tracking the development of biological active substances through citation links. *Abstracts of Papers of the 211th American Chemical Society National Meeting, New Orleans, Louisiana, March 24–28, 1996.* CINF-051.

Roots, E. F. (1992). Environmental information: a step to knowledge and understanding: opening comments. *Environ. Monitoring Assessment* **20**(2/3), 87–89.

Rovers, J. P., Janosik, J. E., and Souney, P. F. (1993). Crossover comparison of drug information online database vendors: Dialog and MEDLARS. *Ann. Pharmacother.* **27**(5), 634–639.

Rudman, J. (1994). *Forensic Scientist I.* (Career Examination Series C-2937). National Learning Corporation, Syosset, NY.

Rudman, J. (1994). *Forensic Scientist II.* (Career Examination Series C-2938). National Learning Corporation, Syosset, NY.

Russell, H., Miller, T., and Wang, Y. Y. (1996). Resource agencies with information on toxic substances health effects. In *Toxicology and Risk Assessment: Principles, Methods, and Applications* (A. M. Fan, and L. W. Chang, Eds.), pp. 679–723. Dekker, New York.

Russom, C. L., *et al.* (1995). Use of knowledge bases and QSARs to estimate the relative ecological risk of agrichemicals: a problem formulation exercise. *SAR QSAR Environ. Res.* **4**(2/3), 83–95.

Safyan, S. A. (1990). Access to information for environmentalists: a library perspective. *Can. Library J.* **47**(5), 337–343.

Sarri, J., Bedard, S., Dufort, V., Hryniewiecki, J., and Theriault, G. (1994). Successful training strategies to implement a workplace hazardous materials information system: an evaluation at 80 plants. *J. Occup. Med.* **36**(5), 569–574.

Scheuplein, R. J. (1995). Information need to support hazard identification and risk assessment of toxic substances. *Toxicol. Lett.* **79**(1–3), 23+.

Scholten, H. J., and de Lepper, M. J. (1991). The benefits of the application of geographical information sys-

tems in public and environmental health. World Health Statistics Quarterly—Rapport. *Trimestriel Statistiques Sanitaires Mondiales* **44**(3), 160–170.

Schultz, D. L. (1989). Toxic chemical disclosure: companies take on the challenge. *Public Relations J.* **45**(1), 13–20.

Scialli, A. R. (1994). Data availability in reproductive and developmental toxicology. *Obstet. Gynecol.* **83**(5, Pt 1), 652–656.

Sekizawa, J., and Hashiba, S. (1991). [A study on toxicological information search: an example from a study on food additives] [Japanese]. *Eisei Shikenjo Hokoku—Bull. Natl. Inst. Hygienic Sci.* **109,** 11–18.

Sexton, K., Wagener, D. K., Selevan, S. G., Miller, T. O., and Lynarger, J. A. (1994). An inventory of human exposure-related data bases. *J. Exposure Anal. Environ. Epidemiol.* **4**(1), 95–109.

Sheey, H. (1995). European environmental information source book. *J. Government Info.* **22**(5), 489–491.

Shoaf, C. R., and Guth., D. J. (1990). Air risk information support center. In *Proceedings of the Symposium on the Access and Use of Information Resources in Assessing Health Risks from Chemical Exposure* (P.-Y. Lu, J. S. Wassom, W. H. Fraland, and C. DeRosa, Eds.), pp. 205–210. U.S. Environmental Protection Agency and Oak Ridge National Laboratory, Oak Ridge, TN (ORNL Conf-9006324).

Shrode, F. Environmental resources: news in brief of environmentally-related WWW sites, electronic journals, publications, and other resources. *Electronic Green J.* **7,** November 1997, http://www.lib.uidaho.edu:70/docs/egj07/schrode.htm; **6,** December 1996, http://www.lib.uidaho.edu:70/docs/egj06/index.htm; **5,** June 1996, http://www.lib.uidaho.edu:70/docs/egj05/egj-toc.html; **4,** December 1995, http://www.lib.uidaho.edu:70/docs/egj04/egj-toc.html.

Shuler, J. (1994). The Right-to-Know Act goes to Washington: toxic release inventory on CD-ROM. *Computers Libraries* **14,** 52–53.

Siegel, S. (1990). Information applications. In *Proceedings of the Symposium on the Access and Use of Information Resources in Assessing Health Risks from Chemical Exposure* (P-Y. Lu, J. S. Wassom, W. H. Fraland, and C. DeRosa, Eds.), pp. 109–112. U.S. Environmental Protection Agency and Oak Ridge National Laboratory, Oak Ridge, TN (ORNL Conf-9006324).

Siegel, S. (1990). Information resources for assessing health effects from chemical exposure: challenges, priorities, and future issues. In *Proceedings of the Symposium on the Access and Use of Information Resources in Assessing Health Risks from Chemical Exposure* (P.-Y. Lu, J. S. Wassom, W. H. Fraland, and C. DeRosa, Eds.), pp. 227–230. U.S. Environmental Protection Agency and Oak Ridge National Laboratory, Oak Ridge, TN (ORNL Conf-9006324).

Silliman, J. E. (1997). ATMI voluntary chemical data form: A case study in cooperation. *Textile Chem. Colorist* **29**(10), 17–18.

Simon, P., *et al.* (1995). Revelations from a meta database system on environmental health problems. *Medinfo* **8**(Pt 1), 610.

Sinclair, S. L. (1996). *Solvents—New, Used, and Hazardous in Health and Industry. Index of New Information and Research Bible of Current Reviews.* ABEE Publishers, Washington, D.C.

Sipes, I. G. (Ed.) (1997). *Comprehensive Toxicology.* Elsevier Science, New York.

Skeie, M. (1994). Health, safety, and information technology. *Speaking Out* (*column*) **56**(6), 29.

Silverstein, T. P. (1998). Toxics information. *Chem. Eng. News* **76**(10), 2.

Simon, P., Menesi, L., Fekete, A., and Varga, G. (1995). Revelations from a meta database system on environmental health problems. *Medinfo* **8**(Pt 1), 610.

Smith, R. L. (1996). Risk-based concentrations: prioritizing environmental problems using limited data. *Toxicology* **106**(1–3), 243–266.

Snow, B. (1997). *Drug Information: A Guide to Current Resources.* Scare Crow Press, Lanham, MD.

Society of Hospital Pharmacists of Australia. (1995). Guidelines for information sources of poisons information centres. *Aust. J. Hospital Pharmacy.* **25**(2), 163–165.

Sparrow, M. K. (1991). From data warehouse to information craft shop: the changing shape of information support for environmental protection. *Environ. Int.* **18**(1), 3–9.

Stallones, L., Nuckols, J. R., and Berry, J. K. (1992). Surveillance around hazardous waste sites: geographic information systems and reproductive outcomes [A Review]. *Environ. Res.* **59**(1), 81–92.

Stafford, D. T., and Logan, B. K. (1990). Information resources useful in forensic toxicology. *Fundam. Appl. Toxicol.* **15**(3), 411–419.

Stancikova, P. (1992). Environmental information in Czechoslovakia. *Information Dev.* **8**(3), 142–146.

Stayner, L. T., Meinhart, T., and Hardin, B. (1990). Risk assessment activities at NIOSH: information resources and needs. In *Proceedings of the Symposium on the Access and Use of Information Resources in Assessing Health Risks from Chemical Exposure* (P.-Y. Lu, J. S. Wassom, W. H. Fraland, and C. DeRosa, Eds.), pp. 119–122. U.S. Environmental Protection Agency and Oak Ridge National Laboratory, Oak Ridge, TN (ORNL Conf-9006324).

Stoss, F. (1996). ATSDR toxicological profiles available for 40 common hazardous substances. *ES&H News* (Society for Technical Communication, Environmental, Safety and Health Communication Professional Interest Committee). **2**(1), 1–3.

Stoss, F. W. (1995). Get the lead (information) out. *ES&H News* (Society for Technical Communication, Environmental, Safety and Health Communication Professional Interest Committee) **1**(4), 1, 4–5.

Stoss, F. W. (1994–1995) EPA: communicators tool box. *ES&H News* (Society for Technical Communication, Environmental, Safety and Health Communication Professional Interest Committee) **1**(2), 5–7.

Stoss, F. W. (1994–1995) EnviroHealth: A new information clearinghouse. *ES&H News* (Society for Technical Communication, Environmental, Safety and Health Communication Professional Interest Committee) **1**(2), 8.

Stoss, F. W. (1994). National Center for Environmental Health—NCEH. *ES&H News* (Society for Technical Communication, Environmental, Safety and Health Communication Professional Interest Committee) **1**(1), 4.

Stoss, F. W. (1991). Environment online: the greening of databases. Part 1. General interest databases [and] environmental terms and phrases: a suggested list. *Database* **14**(4), 13–27.

Stratman, J. F., *et al.* (1995). Risk communication, metacommunication, and rhetorical stases in the Aspen-EPA Superfund controversy. *J. Business Tech. Commun.* **9**(1), 5–41.

Szymczyk, I., Czerczak, S., and Wnuk, M. (1995). Information sources on carcinogenic agents [Polish]. *Medycyna Pracy* **46**(3), 289–300.

Takahashi, K., Hoshuyama, T., Ikegami, K., Itoh, T., Higashi, T., and Okubo, T. (1996). A bibliometric study of the trend in articles related to epidemiology published in occupational health journals. *Occup. Environ. Med.* **53**(7), 433–438.

Tal, A. (1997). Assessing the environmental movement's attitudes towards risk assessment. *Environ. Sci. Technol.* **31**(10), 470A–476A.

Tasker, T. U. (1994). *Hazardous Substances in Health, Business, and Industry: Index of New Information and Research Bible of Current Reviews.* ABBE Publishers, Washington, DC.

Thayer, A. M. (1993). Growing exchange of information spurs pollution prevention efforts. *Chem. Eng. News* **71**(30), 8–25.

Travers, L. A. (1990). The challenge of information access. In *Proceedings of the Symposium on the Access and Use of Information Resources in Assessing Health Risks from Chemical Exposure* (P.-Y. Lu, J. S. Wassom, W. H. Fraland, and C. DeRosa, Eds.), pp. 49–52. U.S. Environmental Protection Agency and Oak Ridge National Laboratory, Oak Ridge, TN (ORNL Conf-9006324).

Trestrail, J. H., 3d, and Lampe, K. F. (1990). Title mushroom toxicology resources utilized by certified regional poison centers in the United States. *J. Toxicol. Clin. Toxicol.* **28**(2), 169–176.

Tucker, W., *et al.* (1994). Site-specific rules for risk assessment. *Environ. Protection* **5**(11), 19, 22–25.

Underwood, N. A., and Caputo, M. R. (1996). Environmental and agricultural policy effects on information acquisition and input choice. *J. Environ. Econ. Management* **31**(2), 198–218.

Voigt, K. (1995). Environmental informatics: Methodology and applications of environmental information—processing. *Online CD-ROM Rev.* **19**(3), 182.

Voigt, K., and Brueggemann, R. (1994). *Scoring Approach for Environmental Databases* (*at the German National Research Centre for Environment and Health:*) *Proceedings of the 15th National Online Meeting.* Online, Inc., New York.

Voigt, K., Pepping, T., and Kotchetova, W. M. (1992). Testing of online databases in the information system for environmental chemicals with a testset of 68 chemicals. *Chemosphere* **247,** 857–866.

Walker, B., Jr. (1995). Board of Scientific Counselors of the Agency for Toxic Substances and Disease Registry (ATSDR) finds no evidence to support the allegations of poor science and unethical conduct of ATSDR. *Arch. Environ. Health* **50**(3), 252–254.

Waters, M. D., Stack, H. F., Garret, N. E., and Jackson, M. A. (1990). Quantitative genetic activity graphical profiles for use in chemical evaluation. In *Proceedings*

of the Symposium on the Access and Use of Information Resources in Assessing Health Risks from Chemical Exposure (P.-Y. Lu, J. S. Wassom, W. H. Fraland, and C. DeRosa, Eds.), pp. 61–70. U.S. Environmental Protection Agency and Oak Ridge National Laboratory, Oak Ridge, TN (ORNL Conf-9006324).

Watts, C., Anderson, D., and Kadec, S. (1995). Environmental information: Snapshots through time. *Bull. Am. Soc. Info. Sci.* **21**(4), 9–10.

Weinstock, M. P. (1992). Beyond the right-to-know. *Occup. Hazards* **54**(4), 43–45.

Wells, B. B. (1990). *The Potential for Linking Environmental and Health Data*. National Governors' Association, Washington, DC.

Wiegman, O., Gutteling, J. M., Boer, H., and Houwen, R. J. (1989). Newspaper coverage of hazards and the reactions of readers. *Journalism Q.* **66**(4), 846–852+.

Wexler, P. (1990). Toxicological information series, II. A survey of toxicology information *Fundam. Appl. Toxicol.* **14**(4), 649–657. [Published erratum appears in *Fundam. Appl. Toxicol.* **15**(3), 631, 1990.]

Wexler, P. (1990). The framework of toxicology information. *Toxicology* **60** (1/2), 67–98.

Wexler, P. (1990). Finding and using toxics information. *Whole Earth Rev.* **66,** 120–121.

Wexler, P., Lum, M., and Kissman, H. (1989). Toxicology information for the medical practitioner. *J. Med. Practice Management* **5**(1), 19–26.

Wiltse, J. (1990). EPA's program for risk assessment guidelines: cancer classification issues. In *Proceedings of the Symposium on the Access and Use of Information Resources in Assessing Health Risks from Chemical Exposure* (P.-Y. Lu, J. S. Wassom, W. H. Fraland, and C. DeRosa, Eds.), pp. 97–102. U.S. Environmental Protection Agency and Oak Ridge National Laboratory, Oak Ridge, TN (ORNL Conf-9006324).

Wood, F. E., Berrie, A. T., Plampin, H. R., and Wilkinson-Tough, M. L. (1989). Evaluations using test queries of chemical hazards databases and databanks. *J. Information Sci. Principles Practice* **15**(4/5), 269–276.

Wood-Black, F. and Pasquarelli, T. (1997). CH&S Netways: university and academic online resources. *Chem. Health Safety* **4**(4), 37.

Wood-Black, F. K. (1997). CH&S Netways: drowning in the flood? Life preservers for keeping current in today's information torrent. *Abstracts of the 214th American Chemical Society National Meeting, Las Vegas, NV, September 7–11, 1997,* CHAS-014.

Wood-Black, F., and Pasquarelli, T. (1997). CH&S Netways: hazardous materials. *Chem. Health Safety.* **4**(3), 8.

Wood-Black, F., and Pasquarelli, T. (1997). CH&S Netways: potpourri of commercial sites. *Chem. Health Safety,* **4**(6), 8.

Wood-Black, F., and Pasquarelli, T. (1997). CH&S Netways: staying up-to-date with air quality regulations. *Chem. Health Safety* **4**(3), 27.

Wood-Black, F., and Pasquarelli, T. (1997). CH&S Netways: finding alternatives and minimizing waste. *Chem. Health Safety* **4**(2), 9.

Wood-Black, F. and Pasquarelli, T. (1991). CH&S Netways: e-mail lists. *Chem. Health Safety* **4**(1), 29.

Wood-Black, F., and Pasquarelli, T. (1996). CH&S Netways: using the Net more efficiently. *Chem. Health Safety* **3**(6), 6.

Wood-Black, F., and Pasquarelli, T. (1996). CH&S Netways: zeroing in on elusive information. *Chem. Health Safety* **3**(5), 26.

Wood-Black, F., and Pasquarelli, T. (1996). CH&S Netways: expand your information base. *Chem. Health Safety* **3**(4), 24.

Zubkoff, P. L., Burns, L. A., and Walentowicz, R. (1997). The exposure models library: a selection of fate, transport, and ecological models for exposure assessments. *Abstracts of Papers of the 213th American Chemical Society National Meeting, San Francisco, California, April 13–17, 1997,* CINF-032.

Material Safety Data Sheets

Anonymous. (1996). OHS MSDS on disc—(CD-ROM KR-OnDisc). *Online* **17**(10), 10.

Anonymous. (1995). CMA goes online with MSDS Central. *Environ. Manager* (*EM*) **6**(10), 13–17.

Anonymous. (1995). DMA and DDA sponsored educational workshop in New Orleans on FDA, OSHA, and MSDS. *Proofs* **78**(1), 12–13.

Anonymous. (1994). Dial-up services ease compliance. *Graphic Arts Monthly* **67**(6), 32+.

Anonymous. (1994). Keeping America afloat. *Am. Printer* **213**(6), 32+.

Anonymous. (1994). MSDS/Right-to-Know update. *Sanitary Maintenance* **52**(7), 24.

Anonymous. (1994). The MSDS: read before filing. *In-Plant Reprod* **44,**(4), 20+.

Anonymous. (1994). Panorama—coatings MSDS CD retrieval system. *J. Coatings Technol.* **66**(829), 15+.

Anonymous. (1993). FC on the scene: AAEC tackles tough issues—MSDS and bar codes are among the issues being addressed by this important group. *Farm Chem.* **156**(10), 34+.

Anonymous. (1993). Easier latest in CD-ROM technology in assist coatings industry, as FSCT and NPCA introduce Coatings MSDS System. *J. Coatings Technol.* **65**(821), 15+.

Anonymous. (1993). Gaining a better understanding of MSDS. *J. Am. Vet. Med. Assoc.* **203**(5), 600+.

Anonymous. (1993). Getting a better understanding of MSDS. *J. Am. Vet. Med. Assoc.* **203**(5), 600+.

Anonymous. (1993). MSDS. *NCO J.* **3**(2), 8+.

Anonymous. (1993). Material Safety Data Sheets. *Information Intelligence Online Newslett.* **14**(12), 11+.

Ayers, S. (1996). *Understanding MSDS* (*Material Safety Data Sheets*). Detrick Lawrence, Kingston.

Bradshaw, G. (1995). Material Safety Data Sheets: the key to hazard communication. *Executive Housekeeping Today* **16**(8), 6+.

Brezinski, D. (1995). Guest viewpoint: Panorama enters MSDS realm. *Am. Paint Coatings J.* **78**(41), 51+.

Castro, D. G., and Alonso, J. C. (1996). Using process knowledge and MSDS information with current and proposed regulations as a waste minimization and cost-control tool. *Environ. Regul. Permitting* **5**(4), 59+.

Chemical and Pharmaceutical Press. *MSDS for Crop Protection Chemicals* (1993), *Update 1* (1994), *Update 2* (1994), *Update 3* (1994). Chemical and Pharmaceutical Press, Inc., New York. Series also published and distributed by John Wiley & Sons (now out of print).

Cote, R., Davis, H., Dimock, C., Korpan, M., Loewen, K., and Segal, L. M. (1998). The evaluation and hazard classification of toxicological information for workplace hazardous materials information system: Materials Safety Data Sheets. *Reg. Toxicol. Pharmacol.* **27**(1), 61–74.

Croft, S. D. (1996). Writing Material Safety Data Sheets using the ANSI standard. *Technical Commun.* **43**(2), 172+.

Dehmel, J.-C., and Patrick, K. (1995). What MSDS should present about NORM radioactivity: technical and regulatory issues. *Ceramic Eng. Sci. Proc.* **16**(1), 147.

DiCarlo, R. (1995). Material safety data sheets, computers, and the universities: hard copy is mandated, but computerized retrieval of MSDS information is the norm. *Chem. Health Safety* **2**(1), 28–29.

Donley, E. M. (Ed.). (1994). Trends in environmental computer applications: desperately seeking MSDS software. *Environ. Software* **9**(2), 147+.

Drew, R. (1993). Between the sheets. *Aust. Safety News* **64**(2), 40+.

Hauser, R. L., McKeever, R. B., Krause-Singh, J., and Elverum, J. A. (1993). Hazard ratings of flammable and toxic vapors. *Professional Safety* **38**(7), 24+.

Helmrich, D. M. (1996). Managing the MSDS mess. *Occup. Health Safety* **65**(3), 47–50.

Holcomb, M. L. (1996). *Material Safety Data Sheet: handbook for the preparation of MSDS worldwide.* International Toxicology, Eugene, OR.

Humphrey, B. (1996). Hazardous substance safety awareness. *Tech Directions* **56**(3), 35+.

Ignatowski, A. J., and Weiler, E. D. (1995). Managing Material Safety Data Sheets world-wide. *Am. Ind. Hygiene Assoc. J.* **56**(7), 698+.

Kaufman, J. A. (1995). Have you read a good MSDS lately? *Chem. Health Safety* **2**(2), 33.

Kirsch, R. (1996). The case for the generic MSDS. *Occup. Health Safety* **65**(8), 66–67.

Kolp, P. W., Williams, P. L., and Burtan, R. C. (1995). Assessment of the accuracy of Material Safety Data Sheets. *Am. Ind. Hygiene Assoc. J.* **56**(2), 178+.

Krasowska, F. (1996). MSDS on the Internet. *Occup. Health Safety* **65**(5), 22–25.

Kumar, A., DeSouza, F., and Vashisth, S. (1996). Software for Material Safety Data Sheets. *Environ. Prog.* **15**(2), S-17–S-22.

Marsick, D. J., and Byrd D. M., III (1990). Toxicological Information Series, III: resources for Material Safety Data Sheet (MSDS) preparation. *Fundam. Appl. Toxicol.* **15**(1), 1–5.

Mattheis, D. K. (1992). A national MSDS repository. *Am. Ind. Hygiene Assoc. J.* **53**(9), 607+.

Paul, M., and Kurtz, S. (1994). Analysis of reproductive health hazard information on Material Safety Data Sheets for lead and ethylene glycol ethers. *Am. J. Ind. Med.* **25**(3), 403+.

Ritzel, D. O. (1996). Voyage on the Internet: uncover new information on Material Safety Data Sheets. *Safety Health*, **154**(5), 111+.

Schueller, R., and Romanowski, P. (1994). Material Safety Data Sheets. *Cosmet. Toiletries* **109**(5), 47+.

Stevens, A. (1992). Toxicology information resources and online databases for material safety data sheet preparation. 204th American Chemical Society National Meeting, Washington, DC, August 23–28, 1992. *Abstr. Papers Am. Chem. Soc.* **204**(1/2).

Tompkins, N. C. (1992). Easier MSDS slides into view. *Occup. Health Safety* **61**(12), 38+.

Van Camp, A. J. (1990). Material Safety Data Sheets: online and CD-ROM sources. *Online* **14**(2), 97–99. Also in *Environment Online: The Greening of the Databases—The Complete Environmental Series from Database Magazine* (P. Hane, Ed.), pp. 97–99. Eight Bit Books, Wilton, CT, 1992.

Wang, H., and Yan H. (1997). Set your sites on MSDS providers. *Safety Health* **155**(1), 58–59.

Weiler, E. D., Geist, J. A., and Land, E. (1995). Summarize your MSDS. *Chem. Health Safety* **2**(4), 22–24.

Wrench, C. (1994). Software review: OHS MSDS on disk. *Am. Ind. Hygiene Assoc. J.* **55**(2), 163+.

This Page Intentionally Left Blank

CHAPTER

12

An Overview of U.S. Chemical and Environmental Control Laws and Regulations and Helpful Information Sources

MAURY BANDURRAGA

She had never forgotten that, if you drink much from a bottle marked ''poison,'' it is almost certain to disagree with you, sooner or later.

(Lewis Carroll, *Alice in Wonderland*)

United States laws are developed by action of elected officials or by ballot initiative, which includes the purpose and goals of the legislative or initiative change. Regulations are then established by government regulatory agencies to carry out these mandates. In some cases, where regulations have not been established, the law is used as the primary tool to ensure compliance. Where a more formal and complex regulatory structure has been established, the regulations and accompanying guidance are generally used as the reference points for regulatory interactions.

Starting in the early 1970s, there has been an explosion of new U.S. and international laws addressing environmental and chemical safety concerns as well as many updates (through a reauthorization process) to previously established laws. These laws have been enacted at both the federal and the state level. In some cases, regions (air quality regulations in Southern California) or municipalities (detergent phosphate regulations in Chicago) have also promulgated their own environmental or chemical control laws to respond to local issues.

Many countries which previously lacked environmental or chemical control laws now have these types of laws (e.g., the European Union and much of Asia). In addition, several international treaties on chemical use and environmental release (e.g., on chlorofluorocarbons) have been developed and signed which have led to domestic legislation and regulation and changes in use, handling, or labeling of chemicals in the United States. This chapter provides an overview of both U.S. chemical and environmental laws and regulations and provides background and access to useful information sources for toxicologists and regulatory professionals.

Chemical laws generally fall into one of four groups: (i) chemical control and notification laws, including preapproval by the government of a chemical before marketing, import, export, or manufacture; (ii) restrictions on uses, release and handling; (iii) labeling of products and chemicals; and (iv) workplace or occupational controls.

Laws governing consumer and industrial chemical use are compiled annually in the U.S. *Statutes at Large* (U.S. Government Printing Office, Washington, DC) and codified in the *U.S. Code* (U.S. Government Printing Office, Washington, DC). The U.S. *Federal Register* (Office of the Federal Register, Washington, DC) is issued 5 days a week except on federal holidays and provides rules and regulations as well as notices, proposed rules, and presidential proclamations (Executive

Orders). Annually, the regulations are codified in a publication called the *Code of Federal Regulations* (CFR; Office of the Federal Register, Washington, DC). Most of these documents are available online through information service vendors or via the Internet.

Legislative histories of various bills and acts provide valuable background materials and insight into the rationale for the law appearing in final form. The Congressional Information Service (CIS) annual *Index to Congressional Publications and Public Laws* (Congressional Information Service, Washington, DC) prepares a yearly summary which catalogs, abstracts, and indexes publications issued by Congress. Published congressional hearings are also important sources of information and can be accessed through the Congressional Publications office.

Major U.S. laws pertaining to chemical use, environmental protection, and safety are listed in Table 12.1, with the full name, commonly used acronym, the CFR citation, and the agency responsible for administration of the law. A brief overview is provided on the right side of the table. If reference to the original laws (both PL number and USC code reference) is needed, these can be found at the beginning of each CFR citation.

The intent of this summary is to provide an abbreviated overview of U.S. chemical and environmental control laws and regulations and not to provide formal legal guidance. Because these laws and regulations frequently are amended or revised, one should consult the most recent version of the applicable laws and appropriate legal counsel when making business decisions impacted by these laws or regulations. In addition, compliance requirements and reporting format change over time [e.g., the increased use of electronic reporting to the Environmental Protection Agency (EPA)].

As mentioned previously, Table 12.1 is an overview of some, but not all, U.S. laws and regulations which cover potential toxicology work. Laws are constantly changing, and the work of international standard-setting bodies such as the World Health Organization (WHO) and Organization for Economic Co-Operation and Development (OECD) are having an increasing impact. Several other US laws, not covered here, are also pertinent to toxicologists, depending on the area of work, including the Atomic Energy Act, the Federal Caustic Poison Act, the Federal Meat Inspection Act, Lead-Based Paint Poison Prevention Act, and the Radiation Control for Health and Safety Act.

TRACKING PUBLICATIONS

Many public and private groups track and publish current information about U.S. legislative and regulatory issues and proposals. Public access to the *Federal Register* and federal agency publications can be gained via the Internet. Some state information (e.g., California Prop. 65) is also available on the Internet. More detail on how to access these sites is provided in Chapter 6.

Industry trade associations track and share information about current legislative and regulatory activity for their members and often provide training opportunities on implementation of new legislative and regulatory requirements. Company membership in industry or environmental or professional associations provides a very effective way for industrial toxicologists or regulatory professionals to receive training, to track and assess the impact of proposed or implemented laws and regulations, and to provide input on these issues. Some of these industry trade associations with active involvement on regulatory and legislative issues include the Chemical Manufacturers' Association, Soap and Detergent Association, American Forestry and Paper Association, National Drug Manufacturers Association, Grocery Manufacturers Association, Flavor and Extract Manufacturers' Association, and Cosmetic, Toiletry & Fragrance Association.

Similarly, consumer and environmental activists also track and share information on both national and international issues. Most of these groups share information via their World Wide Web sites, newsletters, media press releases, and member alerts to request input on legislative activity. The Center for Science in the Public Interest (CSPI) is a group which actively monitors consumer food-related issues, whereas other groups, such as Environmental Defense Fund (EDF) and Natural Resources Defense Council (NRDC), track and try to influence environmental and chemical control issues. Labor coalitions frequently track and try to influence labor-related issues involving OSHA and EPA information sharing requirements and chemical exposure, classification, and standard-setting issues.

Several science policy and research groups, notably the International Life Sciences Institute and American Industrial Health Council, also track and share information about national and international legislative or regulatory proposals in their areas of concern. These include safety testing methodologies, risk assessment standards, and chemical classification. For more information on membership or activities, please contact any of these organizations directly (via the *Directory of Associations* in your public library, or Chapter 15).

Many private vendors have also established newsletters, training manuals, reference documents, tracking systems (via hard copy, electronic, or the Internet), and legislative or regulatory databases to serve safety and regulatory professionals. These databases contain final FR rules, preambles, guidance documents, statutes and CFRs, and other helpful documents. Contact the vendors listed in Table 12.2 for cost, detailed con-

TABLE 12.1 Summary of Major U.S. Federal Chemical and Environmental Laws

Law	Overview of impact
Chemical, product, and packaging control laws	
Consumer Product Safety Act (CPSA) [16 CFR 1015–1402] Consumer Product Safety Commission (CPSC)	The CPSC was developed in 1970 to protect the public against unreasonable risk of injury associated with consumer products, to develop safety standards, and to promote research into the causes and prevention of product-related deaths, illness, and injuries. Regulates safety of household consumer products not regulated under FIFRA, FDA, or other regulatory agencies. Provides provisions for recall of defective or hazardous consumer products.
Federal Hazardous Substances Act (FHSA) [16 CFR 1500–1512] CPSC	Provides authority to CPSC to regulate hazardous substances used by consumers, either by chemical (e.g., turpentine, antifreeze, and charcoal) or characteristic (e.g., toxic, corrosive, irritant, flammable, or radioactive). Provides precautionary labeling standards and definitions of acute and chronic hazard characteristics for consumer products not regulated by EPA (under FIFRA) or FDA (under FFDCA). Requires reporting of hazards not known to CPSC and response to reported consumer concerns.
Poison Prevention Packaging Act (PPPA) [16 CFR 1700–1704] CPSC	Authorizes CPSC to set standards for the packaging of hazardous household or other consumer product use (e.g., prescription or nonprescription drug products), except for FIFRA-regulated products, to prevent childhood poisoning through use of child-resistant closures and packaging. CPSC regulations list packaging requirements and test protocols to be used for specific types of pharmaceuticals or household products.
Toxic Substances Control Act (TSCA)—1976 [40 CFR 700–799] Environmental Protection Agency (EPA)	This law was passed in 1976 and was designed to''close the gap'' in other laws and regulations involving chemical and environmental exposure and safety. TSCA regulates chemicals and mixtures of chemicals not regulated by other acts including FIFRA (covering pesticides), FDA (food, drugs, and cosmetics), NRC (nuclear and radiochemical materials) and the BTAF (alcohol, tobacco, and firearms). Many animal and environmental safety test protocols have been developed as a result of TSCA.
	Section 4 requires manufacturers or processors to test''existing'' chemicals (on the TSCA inventory and in current commercial use) for which EPA does not have sufficient safety data.
	Section 5 specifically requires manufacturers and importers to submit premanufacture notification (PMN) to the EPA prior to commercializing chemicals not already on the EPA's TSCA inventory of existing chemical substances, and Section 5 gives the EPA the ability to control use and exposure to the new substances if needed.
	Sections 6 and 9 allow the EPA to ban or control use of chemicals [e.g., polychlorobiphenyls (PCBs) and asbestos] that may present an unreasonable risk of injury to health or the environment.
Federal Insecticide, Fungicide and Rodenticide Act (FIFRA) [40 CFR 150–189] EPA	FIFRA regulates all pesticides (both household and agricultural) marketed in the United States or exported. Requires registration of active ingredients and formulated products and EPA review of product safety and efficacy testing. Mandates pesticide packaging, directions for use, and labeling requirements. EPA may suspend, cancel, or restrict pesticides posing a risk to humans or the environment. Some states, such as California and Texas, have their own pesticide registration requirements in addition to the federal requirements.

(*continues*)

TABLE 12.1 (*continued*)

Law	Overview of impact
Food Quality Protection Act (FQPA)—1996 [Public Law 104–170] Food and Drug Administration (FDA) and EPA	FQPA amends the FFDCA by applying a new safety standard to residues in both raw and processed foods and removes pesticide residues from the definition of''food additive''; thus, the Delaney clause for food additives (no level of a carcinogen is safe) no longer applies to these residues. FQPA also requires that all exposures to a pesticide must be considered, not just those from one source, and pesticides can be evaluated as a group, not separately, if they have common mechanisms of action. FQPA also shifts regulation of household disinfectants to FDA from EPA. FQPA requires EPA and FDA to review all current pesticide uses, with additional safety factors for pesticides coming into contact with special populations such as children. Screening programs for estrogenic effects are also required. Consumer information (in grocery stores) is also required to communicate pesticide exposure and safety.
Federal Food, Drug, and Cosmetic Act (FFDCA) [21 CFR 1–1300] FDA	FFDCA requires regulatory approval of new drugs before marketing and provides FDA with authority to set regulatory standards (chemical use, labeling, efficacy, and stability testing) for food, food additives, some widely used drug actives, cosmetics, and medical devices for therapeutic use. The 1902 Biologics Act gave the federal government authority over interstate commerce. The 1906, the Federal Food and Drug Act established the concepts of misbranding and adulteration. In 1938, the Food, Drug and Cosmetic Act added premarket clearance requirements for new drugs and required evidence of drug safety prior to marketing. The 1958 Food Additives Amendment grand-fathered food additives which had been in common use prior to 1958 [generally regarded as safe (GRAS) and prior sanction]. It also established the GRAS and Food Additive Petition processes and the Delaney clause, which specified that there is no deminimis (i.e., safe) level of a carcinogen that could be used in food. The 1962 Kefauver–Harris Drug Amendments provided for regulation of drugs during investigational stages: requiring an Investigational New Drug Application (IND) and proof of efficacy prior to marketing. These amendments also established procedures for good manufacturing practice. Amendments in 1984 allowed for marketing of generic equivalents to proprietary drugs after patents have expired via the Abbreviated New Drug Applications (ANDA) process.
Fair Packaging and Labeling Act (FPLA) [16 CFR 500–503] Federal Trade Commission (FTC)	Regulates advertising claims and package labeling for truthful and non-misleading marketing of all consumer products, including net contents, product identity, and use information.
Flammable Fabrics Act (FFA) [16 CFR 1602–1632] CPSC	In 1973, responsibility for FFA transferred from FTC to CPSC. FFA was authorized to protect the public from hazards of dangerously flammable clothing apparel. Companies distributing these consumer products must test them using FFA protocols and certify that they meet FFA standards. CPSC has authority to investigate and ban products (including imports) not meeting the standard.
Controlled Substances Act (CSA) [21 CFR 1300–1316] Drug Enforcement Agency (DEA)	Provides DEA authority to regulate listed controlled drug actives to prevent illicit distribution and use. Site registration, detailed controls, record keeping, and reporting to DEA are required to prevent misuse.
Domestic Chemical Diversion Act (DCDA) [21 CFR 1309–1310] DEA	The DCDA controls import, export, and domestic distribution of list 1 and list 2 chemicals, identified as potential precursors or solvents used in the production of illicit drugs. Site registration is required for sites transferring or receiving list 1 materials, except for R&D or end use. Import or export of both list 1 and list 2 materials requires prior DEA approval via Form 486 submission.

Environmental Laws	
Clean Air Act (CAA) [40 CFR 50–80] EPA	Passed in 1963, amended in 1972, 1977, and 1990. Sets national air quality standards and requires permitting to set standards for sources that create air pollution. Also regulates emission of air pollutants for motor vehicles. State and local governments have primary enforcement responsibility, with federal penalties for noncompliance (e.g., loss of federal highway funds and inability to obtain air permits for new sources). HAPs (hazardous air pollutants) reporting and control is the result of recent amendments to the CAA and requires all sites to inventory, report, and control sources of site emissions of listed hazardous chemicals in order to improve air quality.
Clean Water Act (CWA) [40 CFR 100–140, 400–470] EPA	Amends the Federal Water Pollution Control Act of 1972: provided funding for the municipal sewage treatment construction, established pollution limits for industrial and municipal sources, and is designed to improve water by classifying rivers and other bodies of water in the United States.
Safe Drinking Water Act (SDWA) [40 CFR 140–149] EPA	Provides EPA with authority to set drinking water standards (chemical limits) to protect public health, to conduct research on the impact and causes of drinking water contamination, and to require local water utilities to provide the public with reports of any violations. States may develop more stringent programs than the federal EPA but must inform EPA of their plans.
Resource Conservation and Recovery Act (RCRA) [40 CFR 240–271] EPA	Amends the 1965 Solid Waste Disposal Act and provides authority to state and federal EPA to regulate management, transportation, and disposal of solid and hazardous waste. Waste is classified as hazardous either by incorporation of a listed material or by characteristic (e.g., corrosive, flammable, and toxic). RCRA specifies test protocols, analytical methods, and standards to determine waste classification. Further amended by the Hazardous and Solid Waste Amendments of 1988 (HSWA).
Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) [40 CFR 300–374 EPA	Also known as the ''Superfund'' law: provides authority to force cleanup of past releases into air, water, and land. The process used is to identify ''responsible parties'' to pay for cleanup of past landfills or dump sites. Spills of CERCLA ''reportable quantities'' (RQs, which vary by volume depending on chemical) must be reported for extremely hazardous materials.
Superfund Amendments Reauthorization Act of 1986 (SARA) [40 CFR 300–399] EPA	Title III (Section 313) is an amendment of CERCLA which requires annual reporting of environmental releases, recycling, and pollution prevention for over 600 Toxic Release Inventory (TRI) listed chemicals. Sections 311 and 312 require annual reporting of storage sites and quantities for listed materials for emergency planning and right-to-know purposes.
Hazardous Materials Transportation Act (HMTA) [49 CFR 106–107, 171–179] Department of Transportation (DOT)	Provides DOT with authority to regulate domestic shipment of hazardous materials by air, road, and rail. DOT specifies packaging, labeling, and shipping standards for listed and characteristic hazardous material. The Coast Guard regulates water shipment in U.S. waters. Recent DOT action has been taken to harmonize U.S. with United Nations standards for labeling, packaging, and shipment of hazardous material. International authorities (IMO for water and ICAO for air) mandate standards for international shipment.
Occupational Safety and Health Act (OSHA) [29 CFR 1910–1926] Department of Labor (DOL), Occupational Safety and Health Administration (OSHA)	OSHA sets enforcement standards for exposure to hazardous materials and other health and safety concerns, and it classifies and regulates potential human carcinogens. OSHA also administers the Hazard Communication Standard requiring industry to assess hazards of chemicals and inform workers via training and Material Safety Data Sheets (MSDSs). The National Institute for Occupational Safety and Health (NIOSH) is a research advisory group to OSHA and provides research, education, and training in the field of occupational health.

(*continues*)

TABLE 12.1 (*continued*)

Law	Overview of impact
National Environmental Policy Act (NEPA) [42 USC 4321 et seq.] Council on Environmental Quality (CEQ)	Requires environmental impact statements and established the CEQ, which reviews programs and develops and recommends environmental policies to the president. Assists the administration in preparing an annual Environmental Quality Report.
Several key state and local laws and regulations	
California Safe Drinking Water and Toxics Enforcement Act—Proposition 65 (Prop. 65) [22 CCR 12,000–14,000] State of California's Office of Environmental Health Hazard Assessment (OEHHA)	A ballot initiative passed by voters in 1986, Prop. 65 requires warning for drinking water contamination or consumer products providing state-defined significant risk from exposure to one or more of 700 listed carcinogens or reproductive or developmental toxicants. Thus, both California manufacturing sites and products sold there (that may be manufactured elsewhere) are impacted. Naturally occurring chemicals, not further processed, are exempt only in foods. Litigation has confirmed that Prop. 65 applies to all FDA-regulated products in addition to other consumer or industrial products. Chemicals are added to the Prop. 65 list by Science Advisory Board (SAB) determination, Authoritative Body referral (IARC, NTP, FDA, and EPA), or mandated labeling (e.g., if EPA or FDA requires similar warnings on product labels for pesticides or an FDA-regulated product). Prop. 65 regulations requires a factor of 1 in 100,000 lifetime risk for carcinogens, whereas the law requires a safety factor of 1000 for developmental and reproductive toxicity. Public and private citizen suits are allowed and have been frequently used for enforcement.
New Jersey Right-to-Know New Jersey Department of Environmental Protection (NJ DEP)	Requires worker notification and labeling of the top five ingredients of all mixtures in bulk containers in certain industrial facilities in addition to MSDSs.
New Jersey Pollution Prevention NJ DEP	Requires tracking and reporting of material accounting, worker exposure, and pollution prevention for TRI-listed chemicals used in chemical and some other industrial facilities.
International Treaties	
Montreal Protocol with Copenhagen Amendments	Phases out use of listed chloro-fluorocarbons from consumer or industrial use to prevent ozone depletion. Recent amendments to the Clean Air Act provided implementing legislation.
Chemical Weapons Treaty (CWT) Arms Control Disarmament Agency (ACDA) in the Department of Defense (DOD) and Bureau of Export Administration (BXA) in the Department of Commerce (DOC)	Ratification by 65 countries placed this treaty in force in March 1997. The United States ratified the treaty in June 1997. CWT requires annual reports by companies manufacturing large quantities of organic chemicals or importing, exporting, or processing listed chemical weapon precursors or solvents used to make chemical weapons. Allows multinational inspection (both regular and challenge) of facilities to confirm compliance. Regulations are under development. CWT can limit import and export of listed chemicals to nonparticipating countries.

TABLE 12.2 Publications, Reference Manuals, and Electronic Products

Publication	Agency coverage and frequency	Electronic availability
Washington Business Information, Inc.: 703-247-3421		via Newsnet: 800-345-1301
Product Safety Letter	CPSC biweekly update	
Regulatory Watchdog Service	FTC biweekly update	
Inside Washington Publishers: 703-416-8500		
Inside EPA's Risk Policy Report	Monthly newsletter on EPA science and risk policies	
FDA Week	Weekly newsletter on FDA policy, regulations, and enforcement activities.	
F-D-C Reports, Inc.: 800-332-2181		Some reports available by CD-ROM or online services
The Rose Sheet	Newsletter on FDA activities for the toiletries, fragrances, and skin care industry	
The Tan Sheet	Newsletter with nonprescription pharmaceutical and nutrition news	
The Pink Sheet	Newsletter with prescription pharmaceutical and biotechnology news	
CRC Press: 202-887-6320		
Pesticide and Toxic Chemical News	EPA—FIFRA and TSCA weekly tracking	
Food Chemical News	FDA—food chemical weekly update	
Food Chemical News Guide: 202-544-1980	List of all FDA food and color additives with a useful summary of regulatory status—alphabetical, hard-copy book updated weekly	CD-ROM version
Pesticide Chemical News Guide	Pesticide reference that lists tolerances, interim tolerances, action levels, and proposed tolerances for pesticide residues in food and feed (monthly updates)	
Food Labeling and Nutrition News	Dietary supplements, dietary guidelines, packaging, and food regulatory issues (weekly)	
John Wiley & Sons: 212-850-6479	EPA	
Environmental Manager	Monthly newsletter	
TSCA Compliance Guide and Service	Rules and compliance guidance (quarterly updates)	
McKenna & Cuneo: 202-496-7761		http://www.mckennacuneo.com
Environmental Health & Safety Bulletin	Monthly newsletter covers developments in environmental, health, and safety laws and regulations	
IHS Health Information		http://www.ihshealth.com
Food and Drug Library: 800-525-5539	FDA-focused information (newsletter and electronic), full-text searchable products that can be accessed via Internet or CD-ROM versions; covers legislation, CFR, *Federal Register,* FDA manuals, guidance documents, and warning letters for food, drugs, cosmetics, and medical devices	

(*continues*)

TABLE 12.2 (*continued*)

Publication	Agency coverage and frequency	Electronic availability
Food and Drug Law Institute: 202-371-1420		
FDLI's Compilation of Food and Drug Laws (1996)	Volumes I and II cover major laws affecting the food and drug industry	http://fdli.org
Government Printing Office: 202-512-1800		
Requirements of Laws and Regulations Enforced by the U.S. FDA (''Blue Book'') (1997)	Guidance document summarizes the principal requirements of laws enforced by FDA	
CTFA Cosmetic Ingredient Dictionary, 5th ed. (1996, November)	Nomenclature for ingredient labels	
Food and Drug Administration, Office of Premarket Approval: 202-418-3100		http://vm.cfsan.fda.gov/~dms/opa-toc.html
Food Additive Petitions: Information and Guidance	Copies of regulations and agency guidelines on petitions for food and color additives and GRAS affirmation	
Institute of Food Technologists		http://www.ift.org/divisions/food_law/index.html
Food Laws and Regulations Division	Courses offered on food law; background information on legislation, regulations, and guidance documents; web links to other sites with relevant information	
Environmental Law Institute: 800-433-5120	EPA	
The Environmental Forum	Journal	
ELR—The Environmental Law Reporter	Case summaries, news and analysis, statutes, and administrative materials	
Toxic Substances & Pesticides Regulation Deskbook	Analyses, statute, and guidance on TSCA and FIFRA, EPA documents, and reference material	
Environmental Law Deskbook, 1994–1995 Edition	24 environmental and conservation statutes	
Practical Guide to Environmental Management, 6th ed.	Environmental management tool	
Environmental Protection Agency		http://www.epa.gov
Office of Pollution Prevention and Toxics (OPPT)—TSCA Assistance Office (TAO): 202-554-1404		see EPA News/Newsletters
Chemicals in Progress Bulletin	Update several times a year on OPPT activities—TSCA and SARA	http://www.epa.gov/opptintr/
Activities Update	Bimonthly updates on general EPA activities	http://www.epa.gov
OPPT Newsbreak: 202-260-3944	Provides (via Internet) access to a summary of major environmental issues coverage by national newspapers	library-tsca@epamail.epa.gov
The Bureau of National Affairs (BNA): 800-372-1003	Multiagency	Via BNA CD-ROM or Lexis Nexis (800-543-6862): additional information on these weeklies can be found at http://www.bna.com
Chemical Substances Control	Compliance reference	
Environment Reporter	Rules plus weekly updates on federal and state activity	
Chemical Regulation Reporter	Rules plus weekly updates on federal and state activity	
Hazardous Materials Transportation	Text of rules plus updates	
Index to Government Regulation	Index to all chemical federal regulations	
Occupational Safety and Health Reporter	Rules plus updates	
Product Safety and Liability Reporter	CPSC rules and weekly updates	
Toxic Substances Control Primer: Federal Regulation of Chemicals in the Environment	Reference on major environmental chemical control laws and regulations	

Dakota Consulting Group: 317-844-0831		http://www.dakotacg.com
Daily Regulatory Reporter	A ''regulatory information news service for professionals''; includes a daily Internet summary of all federal environmental, health, safety, and risk regulatory activity from the previous day and agency press releases	
Nonprofit Gateway to access federal information from EPA and 14 other federal agencies	Topics include ''right-to-know,'' pollution prevention, *Federal Register* notices, links to laws, regulations, and policies	http://www.nonprofit.gov/
Government Institutes: 301-921-2300	EPA, OSHA, DOT	Updates and some rules via CD-ROM
Environmental Law Handbook	Reference manual	
Environmental Law Index to Chemicals, 1996 Edition	Guide to regulations by chemical	
Book of Lists for Regulated Hazardous Substances, 1996 Edition	90 regulatory lists covering RCRA, CERCLA, CAA, CWA, SDWA, TSCA, OSHA, and FIFRA	
CFR Chemical Lists on CD-ROM	CD-ROM version of *Book of Lists*	
Environmental Statutes CD-ROM: Title 29 (OSHA), 40 (EPA), and 49 (DOT)	Reference manual, CD-ROM, and disk	
Federal Insecticide, Fungicide, and Rodenticide Act: Compliance/ Enforcement Guidance Manual	FIFRA guidance	
RCRA Policy Compendium	EPA guidance documents	
Toxicology Handbook	EPA handbook for regional officers	
Chemical Data for Workplace Sampling & Analysis (OSHA's Chemical Information File, 1996)	Database on 1400 regulated chemicals on disk	
IRIS-CD: EPA's Integrated Risk Information System	EPA database with risk assessment information for 500 chemicals	
J. J. Keller & Associates: 800-558-5011	DOT, OSHA, and EPA (waste/spills)	
Hazardous Materials Guides	Regulations and guidance	
Occupational Exposure Guide	OSHA rules on hazardous substances; updated lists	
Hazard Communication Guide	Reference manual	
Right-to-Know Training Kit	Training tool to meet OSHA requirements	
Emergency Action Guides	Emergency team guidance	
American Environmental Institute: 800-277-6765		
Prop.65 News	Monthly newsletter tracking California Prop. 65 litigation, regulation, and issues	http://www.prop65news.com
California Chamber of Commerce, 1994: (916) 444-6670		
Proposition 65 Compliance	Reference manual	
Ariel Corporation: 301 907-7771		http://arisun.arielres.com
International Chemical Regulatory Monitoring System (ICRMS)	Excellent summary of chemical regulations searchable by name, CAS No., molecular formula, and synonym	Available in several electronic formats
Roytech	Hard-copy updates of chemical regulations, searchable by chemical name and CAS No.	

(*continues*)

TABLE 12.2 (*continued*)

Government Agency Information	
Agency resource	**Coverage and Internet access if available**
U.S. Government Information for Business Publications, Periodicals, Electronic Products: 202-512-1800	
U.S. Code on CD-ROM	Covers all 50 titles to January 4, 1993
Managing Consumer Complaints: Responsive Business Approaches to Consumer Needs, 1992	Procedures to review and respond to consumer complaints and meet federal and state regulatory requirements
Consumer Product Safety; Responsive Business Approaches to Consumer Needs, 1992	Handbook reviews product safety and liability laws and regulations and guidance for a product safety program
SIGCAT CD-ROM Compendium, 1994	Tracks government information products available on CD-ROM
U.S. Government Information Products on Environmental Science and Methods	Summary of print and electronic format products on EPA rules, chemicals, waste, environmental health, and enforcement
Federal Legislative Information	Thomas online links at http://thomas.loc.gov
Federal Register	http://www.access.gpo.gov/su_docs/aces/aces140.html
Code of Federal Regulations	http://www.access.gpo.gov/nara/cfr/index.html
Occupational Safety and Health	http://www.osha.gov
Consumer Product Safety Commission	http://www.cpsc.gov
EPA	http://www.epa.gov
Integrated Risk Information System (IRIS) Information hotline: 513-569-7254 IRIS is also available via National Library of Medicine's TOXNET (*Tox*icology Data *Net*work) and via diskettes [Electronic Handbook Publishers, Inc.: (206) 836-0958]	EPA health risk and regulatory information for over 650 chemicals, including both carcinogenic and noncarcinogenic risk assessment data for the oral and inhalation routes of exposure. IRIS also contains EPA drinking water health advisories and information on environmental standards and regulations
Toxic Substances Control Act Assistance Information Service (TSCA Hotline): 202-554-1404	
EPA's *Chemical in Progress Bulletin:* 202-260-3725 for hard copy	http://www.epa.gov/opptintr/ChemLibCIP/
EPA Office of Prevention, Pesticides and Toxic Substances	http://www.epa.gov/opptintr/
U.S. Food and Drug Administration Center for Food Safety and Applied Nutrition	A catalog of publications and other materials available from FDA and other agencies and nongovernmental sources
Information materials for the Food and Cosmetic Industries	http://www.cfsan.fda.gov/~dms/industry.html
Industry Activities Staff: 202-205-5251	
FDA's Food and Cosmetic Regulatory Responsibilities (1995)	A summary of the legal requirements affecting the manufacture and distribution of food and cosmetic products within and imported into the United States. http://vm.cfsan.fda.gov/~dms/regresp.html
Cosmetic Handbook (August 1995)	
California EPA OEHHA (Office of Environmental Health Hazard Assessment)	Prop. 65 information including background information, chemical list, and regulations. http://www.oehha.ca.gov/prop65/

tent, and resource information. Information on access is correct as of time of writing, but changes occur rapidly. Additional electronic and regulatory monitoring information sources are also provided in other chapters of this book.

TRAINING COURSES

Training courses in chemical and environmental regulations are available from many of the organizations listed in Tables 12.1 and 12.2 (e.g., Environmental Law Institute, Government Institutes, J. J. Keller & Associates and Executive Enterprises [(212) 645-7880]. The Food and Drug Law Institute (FDLI) and International Food Technology (IFT) provide training in food ingredient and product regulations. FDLI also provides training in other FDA-regulated areas. Some federal and state agencies also provide training information and courses (contact them directly for information).

References

Berger, D. A., and Harris, C. (1990). *The SARA Title III Compliance Handbook.* Executive Enterprises Handbook. Washington, DC.

Campbell, M. (1994). Chemical regulation in Europe and the United States: International implications. In *Chemical Safety* (M. Richardson, Ed.), pp. 513–531. VCH, Weinheim, Germany.

Committee on Food Chemicals Codex (1996). *Food Chemicals Codex,* 4th ed. National Academy Press, Washington, DC.

Condray, J. R., and Fuller, G. B. (1991). Regulation of environmental chemicals. *J. Environ. Sci Health Environ. Carcinog. Ecotoxicol. Rev.* **C8**(2), 215.

Cooper, R. M. (Ed.) (1991). *Food and Drug Law*. Food and Drug Law Institute, Washington DC.

Dennison, M. S. (1992). Hazmat reporting requirements. *Environ. Prot.* **3**(9), 16.

Eiermann, H. J. (1992, August). Cosmetic ingredient labeling: An American experience. *Cosmet. Toiletries* **107**(8), 57–63.

Food and Drug Administration (FDA) (1996, May). *FDA Investigations Operations Manual.* FDA, Washington, DC.

Fort, D. D. (1996). Environmental laws and risk assessment. In *Toxicology and Risk Assessment* (A. M. Fan and L. W. Chang, Eds.), pp. 653–677. Dekker, New York.

Garrett, T. L. (Ed.) (1992). *The Environmental Law Manual.* American Bar Association, Washington, DC.

Hayes, D. J. (1992). TSCA: The sleeping giant is stirring. In *The Environmental Law Manual*, p. 362. American Bar Association, Washington, DC.

Holcomb, M. L. (1995). *International Toxicology—Worldwide Regulatory Toxicology Support.* International Toxicology. Eugene, OR.

Jellinek, S. D. (1989). Information needs for TSCA and FIFRA. *Chem. Inf., Proc. Int. Conf.* p. 79–91.

Lewis, R. J., Sr. (1989). *Food Additives Handbook.* Van Nostrand–Reinhold, New York.

Lewis, S. (1990). Federal statutes. In *Fighting Toxics: A Manual for Protecting Your Family. Community & Workplace,* p. 165, National Toxics Campaign. Washington, DC.

Lu, P.-Y., and Wassom, J. S. (1994). Information resources for chemical toxicology and regulation. *J. Hazardous Materials* **39**(2), 225–243.

Marcus, D. (1992). OSHA's Hazard Communication Standard. In *The Environmental Law Manual*, p. 354. American Bar Association, Washington, DC.

McGeorge, L. J., Krietzman, S. J., and Dupuy, C. J. (1992). National survey of drinking water standards and guidelines for chemical contaminants. *J. Am. Water Works Assoc.* **84**(3), 72.

Mintzer, E. S., and Osteen, C. (1997, January–April). New uniform standards for pesticide residues in food. *Food Safety,* 18–26.

Pease, W. (1996, Spring). Risk 3: Identifying chemical hazards for regulation: The scientific basis and regulatory scope fo California's Proposition 65 list of carcinogens and reproductive toxicants. *http://www.fplc.edu/RISK/vol3/spring/pease.htm.*

Rovelli, D. F., and Bedoukian, R. H. (1992). TSCA and TSCA compliance. *Perfumer Flavorist* **17**(5), 95–106.

Shapiro, M. (1990). Toxic substances policy. In *Public Policies for Environmental Protection,* pp. 195–241. Resources for the Future. Congressional Information Service, Washington, DC.

Shu, H. (1993). Regulatory aspects of the development of new chemical entities in the United States. In *Multi-Company Multi-Country Clinical Trials* (R. Simmons, Ed.), pp. 58–96. Interpharm Press, Buffalo Grove, IL.

Stever, D. W. (1986). *Law of Chemical Regulation and Hazardous Waste,* 3 vols. CBC Products. (Updated three times per year)

Thunder, J. M., and Lewis, C. A. (1997). *Federal Chemical Regulation: TSCA, EPCRA, and the Pollution Prevention Act*. Bureau of National Affairs.

Uram, C. Proposition 65: No safe harbour? *Nat. Resour. Environ.* **4**(3), 16.

Walls, M. P. (1990). Disclosure responsibilities for exporters. *Nat. Resour. Environ.* **4**(3), 10.

Wexler, P. (Ed.) (1988). *Information Resources in Toxicology,* Legislation and Regulatory Issues (p. 245–253) and Regulation of Chemicals in the United States: Information in the Regulatory Process (p. 254–260) M. Karstadt, 2nd ed. Elsevier, New York.

This Page Intentionally Left Blank

CHAPTER

13

Regulation of Chemicals in the United States

MAURY BANDURRAGA

Expect poison from the standing water.

(William Blake, *The Marriage of Heaven and Hell*)

United States chemical regulations impact regulatory professionals and toxicologists working with chemicals or products to be marketed in the United States. This review defines the regulatory process used to develop these regulations, provides perspective on when these chemical regulations apply, and provides more details on the requirements. The major federal agencies discussed in this chapter are the Environmental Protection Agency (EPA), the Food and Drug Administration (FDA), the Occupational Safety and Health Administration (OSHA), and the Consumer Product Safety Commission (CPSC).

THE U.S. REGULATORY PROCESS

The rule-making process employed by U.S. federal and state agencies generally follows a common format; however, there is wide variation in the manner and timing of how this format is employed by specific agencies. The typical federal process is outlined in Table 13.1 and includes at least one or more opportunities to respond to the agency during a formal comment period after a proposed rule is published. During this response time, formal written comments are requested on the government's proposal and both specific and general issues.

Information is also gathered from stakeholders during public hearings, through notice and comment, and through submission of relevant information to the public docket (or record file) created as part of the regulatory process. Comments are requested on issues including definitions, potential economic impact, precedent setting for other issues, and data gaps.

A current agency trend to deal with more controversial regulations is to initiate informal information gathering with stakeholders [via an Advanced Notice of Proposed Rule-Making], before the formal regulatory process of notice and comment begins. State processes generally parallel the federal process; however, unlike the federal regulatory process, public comments are not always responded to in the state registers as part of publication of the final rule.

The federal government has many requirements that need to be met during the rule-making process. Regulations must have an economic impact assessment, and regulations over a certain level of economic impact must have an independent evaluation by the General Accounting Office, Office of Management and Budget. Requirements have also recently been imposed by Congress to evaluate impact on small business (regulatory flexibility assessment), and a separate 60-day review by a congressional group to ensure major new regulations are consistent with original legislative intent began in June 1996.

If stakeholders disagree with the final outcome of the regulatory process, judicial challenge can be used (to argue that the regulatory process was not followed or an incorrect assessment of impact was made). This step can delay implementation and enforcement if the court agrees to a stay. In some cases, judicial challenge

TABLE 13.1 Summary of U.S. Federal Chemical Regulatory Process

Initial data collection and analysis, after enabling legislation is established or in response to a legislative requirement
Agency decision to initiate regulation
Proposed regulation drafted: publication of proposed rule or Advance Notice of Proposed Regulation (ANPR) in the *Federal Register*
Comment period for the proposed rule and/or public hearing
Comments analyzed and responded to; proposed rule revised. If significant changes are made to the proposed rule or as follow-up to the ANPR, the proposed rule may be reproposed for additional comment on new areas.
Publication of the final rule in the *Federal Register*
Implementation and enforcement

on the principles can be made without a stay of implementation and enforcement.

PUBLIC ACCESS TO DATA AND THE U.S. REGULATORY PROCESS

The general principle of public access via a transparent process and the ability to obtain data from the open record holds across all U.S. regulatory areas. The Freedom of Information Act (FOIA) allows the public to request information on government activities, including agency actions and documents. Many agencies have a public file room with public access to help meet this need. Agencies do vary in their requirements to classify and protect confidential business information; therefore, submissions need to be evaluated against the confidentiality provisions of each regulation, with legal guidance. If confidential documents are submitted, then ''sanitized'' public copies must also be submitted for public access. In some cases, documents substantiating confidentiality claims must be submitted at the same time as the documents; in other cases, they need to be submitted only when requested by the agency.

REGULATORY AUTHORITIES FOR U.S. CHEMICAL CONTROL

Regulatory authority over chemicals in the United States stems from the intended use of the chemical, the intended purpose of the product in which the ingredient is used, and the claims that are made about chemical and product function. For example, the same chemical (e.g., citric acid) may be governed by many different government agencies, depending on whether the ingredient or product made with it is considered and the end use. For example, if the citric acid end use is in a food, cosmetic, or drug product, FDA will have jurisdiction over both the ingredient and the product.

In contrast, for a nonpesticide consumer household product, the ingredient is regulated by EPA under the Toxic Substances Control Act (TSCA), whereas the product is governed by CPSC. If the ingredient was alcohol, then the Bureau of Tobacco, Alcohol, and Firearms would govern alcohol use in beverages. EPA (under FIFRA) would regulate citric acid or ethanol if used as an active ingredient of a pesticide or disinfectant and the final products and their labeling.

Another example of complexity with regulatory boundaries is that of a synthetic surfactant derived from synthetic fatty acid or petroleum product sources versus a soap (fatty acid salt) derived from natural sources (e.g., coconut oil). ''Soaps'' are exempted from FDA-regulations used in typical bar soaps for simple skin cleaning purposes only, but synthetic detergents in the same skin care products are subject to FDA regulation. For example, if there are no claims for the product beyond ''cleaning'' skin or other surfaces, the soap ingredient is regulated by TSCA and the soap product is regulated by CPSC. However, if a synthetic surfactant is used, and cosmetic (makes skin softer or more beautiful) or antibacterial (kills germs on skin) claims are made, both the ingredient and the product are regulated by FDA as a cosmetic or over-the-counter (OTC) drug (for antibacterial claims). In this circumstance, the FDA regulated surfactant ingredient, and the product in which it is contained, would be exempt from many TSCA regulations.

Conversely, the same synthetic surfactant used in a household detergent or cleaning product (if not pesticidal, e.g., ''kills germs on inanimate surfaces'' claims are made) would be regulated by TSCA and the product would fall under CPSC jurisdiction. If pesticidal claims were made for the household product, then the active ingredient and the product would need to be registered with EPA and regulated by FIFRA. The complexity of the regulatory categorization and subsequent ''registration,'' ''notification,'' and labeling and compliance requirements stem from the basic intent of use, product type, and claims made about the material.

Similarly, if nutritional claims and use are made for a food component, then it is regarded as a food or food additive, depending on historical status. However, if drug claims are made for the same item, it is then regulated as a drug (e.g., treats or improves a disease condition in humans or animals).

Being clear about product and chemical role and how the regulatory boundaries are drawn is essential

to know what regulatory arena applies. While many regulatory arenas are designed not to overlap (e.g., many parts of FDA, FIFRA, and TSCA), there are other regulatory arenas (e.g., Prop. 65, TSCA import certification regulations, DEA, CERCLA, SARA, CWT, and CAA) in which there are no such barriers and chemicals are subject to the regulation, no matter what their function or form.

Much regulatory or legal expertise is needed to ensure compliance and meet product or ingredient regulatory requirements. Consultation with appropriate legal or regulatory experts is advised to ensure new requirements and changes in laws and regulations are noted.

Table 13.2 summarizes major regulatory areas, types of chemicals and products regulated, and requirements to approve a chemical for use in a product. Three basic approaches to approval of chemical use in products are taken by U.S. regulatory agencies. These same approaches are mirrored around the world, albeit with

TABLE 13.2 U.S. Regulatory Authority for Chemical Control[a]

Regulatory agency	Intended use of chemicals	Purpose and examples	Requirements before chemical use
Food and Drug Agency (FDA)	Food ingredients	Provides nutrition for humans or animals	On GRAS (generally recognized as safe) list (now added by notification), petition for food additive accepted by agency, or approved by prior sanction of the agency (grandfathered). Many GRAS substances or other regulated food substances have limits of use (purpose, level in food, and derivation).
	Food and color additives	Direct additives preserve or enhance food (e.g., as a preservative, emulsifier, and colorant)	
		Indirect additives have the potential to come in contact with food (e.g., food wraps, plastic containers, and cans) but are not designed for direct food use	
	Cosmetics	Beautifies or cleans humans or animals (e.g., shampoo surfactant, lipstick colorant, and perfume)	CTFA ingredient listed or covered by monograph specifying needed studies; submission of cosmetic finished formula information to FDA
	Drugs (prescription and over-the-counter)	Provides health benefit or treatment [e.g., cough/cold remedy, topical ointment, kills germs on skin (antimicrobial hand-wash)]	Covered by existing monographs or separate petitions [new drug applications (NDAs)]
	Medical devices	Devices used to diagnose or treat humans or animals	
Environmental Protection Agency (EPA)—FIFRA	Pesticide or disinfectant	Kill germs, insects, or other pests on inanimate surfaces (e.g., roach spray and agricultural pesticides)	Register active and product; EPA approval of label and extensive safety and efficacy testing
Bureau of Tobacco, Alcohol, and Firearms (BTAF)	Tobacco, alcohol, and firearms (explosives)	Cigarettes, beer, TNT, and research alcohol	Licensing
Nuclear Regulatory Commission (NRC)	radioactive materials	^{14}C, ^{3}H, and uranium	Site licensing and inspection
Drug Enforcement Agency (DEA)	Controlled substances, certain equipment, listed precursor, and essential chemicals	Use in drug and nondrug applications; import/export, domestic distribution, and manufacturing and R&D sites	Site registration and chemical tracking and reporting
EPA—TSCA	All chemicals in commerce	Exemptions from new chemical regulations exist for R&D materials, articles (a formed item whose form dictates function, e.g., a wooden shelf), and chemicals regulated by other agencies listed previously. Examples of chemicals regulated by TSCA are industrial chemicals used as components of laundry detergents, household cleaners, car antifreeze, and air fresheners.	Premanufacture notification prior to commercialization if ''new'' chemical is not on TSCA inventory of existing substances (~80,000 chemicals) Notification (PMN) process varies for different categories; e.g., limited marketing, some polymers, and limited site or volume chemicals.

[a] Due to the complexity of many regulatory issues, this table is intended for general guidance and background; for specific regulatory questions or legal status, please consult your own legal counsel.

slight variations and different emphasis on usage. In part these differences are dependent on local resources to review new product and chemical uses and on existing standards. Chapter 12 provides a general overview and information resources on these international requirements.

POSITIVE LIST APPROACH

The first approach to product and chemical approval in the United States is the use of approved chemical lists [the TSCA Inventory or the FDA or FEMA generally recognized as safe (GRAS) lists] or regulatory rules called ''monographs'' for established product and chemical areas. This can be a ''positive list'' approach; a chemical can't be used, or a product can't be made unless the chemical or product is ''listed'' or covered by a listing that the agency has developed as part of the regulatory process.

For example, the FDA has a list of GRAS commonly used food ingredients that are acceptable for use in food under listed conditions. FDA also has a process in place to consider other food materials as GRAS (adding them to the ''list''), via either a regulatory notification or an external review process.

The TSCA Inventory is the list (both public and confidential) of substances grandfathered (by virtue of documentation of their use in commerce prior to 1977) on the EPA TSCA Inventory list published in 1979 or added since via a notification and review process. The process of adding chemicals to the list is discussed in more detail later.

The FDA also commonly uses monographs to deal with the use of ingredients in various product types (e.g., antimicrobial hand soaps, sunscreens, and various types of OTC or prescription medication). These monographs specify product and chemical testing and use requirements, packaging, labeling, safe levels, and stability, efficacy, and safety testing. These are generally used in areas where there is a long history of safe usage, a high degree of safety testing, and a desire by the agency to reduce the burden and effort spent regulating this area by individual product and chemical by developing clear ''ground rules'' for safe use. In some cases, tentative final monographs are used as the practical regulatory tool until a final monograph can be approved.

REGISTRATION PROCESS TO ADD CHEMICALS TO THE LIST

A second approach is the use of ''registration'' or ''petition'' documents to obtain regulatory approval for chemical use prior to human exposure. FDA petitions (for new drug applications and food additive petitions) and EPA FIFRA (active pesticide and product) registrations use this approach for new active and product approvals. The regulatory agencies generally specify information and safety testing that must be submitted with these applications. Companies must wait for an affirmative response from the agency before marketing these substances, and product packaging, labeling, and usage instructions are reviewed and approved in addition to product and chemical safety data. Environmental assessment is also required.

NOTIFICATION PROCESS

A third approach is the notification process, as typified by the premanufacture notification (PMN) process required by EPA under TSCA before first commercial manufacture or import of a chemical for a use subject to TSCA, either alone or as part of a mixture. The mixture does not require a regulatory filing; only the chemical components of the mixture which are not on the TSCA Inventory require filing.

Unlike some monograph requirements or the registration process, there is no statutory requirement for specific safety studies to be performed or submitted. Instead, all available safety and safety-related data (e.g., physical–chemical properties, analytical characterization, and MSDS) must be submitted at the time of notification. Many PMNs submitted do not include safety studies. EPA uses structure–activity analysis and modeling to predict fate and effects for these chemicals based on data on related structures. High-volume, wide-exposure chemicals tend to receive more EPA scrutiny and, as appropriate, there tends to be more safety studies submitted with them, based on guidance provided by EPA.

The PMN submitter does not receive an affirmative response to the notification from EPA. Instead, if 90 days elapses without EPA action to control the chemical or require additional information, the chemical can be commercialized without restriction. If more information is needed, this may necessitate ''stopping the 90-day clock'' to respond or to do more safety testing. In some cases, the EPA will approve limited uses of a new chemical after this process, with increasing use allowed if required data are submitted [via the Consent Order or SNUR (significant new use rule process)]. In other cases, the PMN submitter may decide that the time and effort to produce the additional information, or to comply with potential Consent Order or SNUR restrictions (which can affect labeling, worker precautions, product uses, record keeping, and cost), do not

warrant continuing the regulatory process and they will withdraw the PMN from review.

TSCA has several sets of exemptions from the premanufacture notification requirements (Section 5) to streamline the process for polymer, low-volume, or site-limited materials, considered lower risk to the public. These still require notifications; however, the process is shorter and less complex. There is also an R&D exemption for substances not commercially marketed but used in laboratories for safety, analytical, and performance testing purposes.

Despite the lack of statutory safety testing requirements, EPA has developed a list of chemical categories of ''concern'' that receive a higher level of scrutiny from the agency. With each chemical group is a list of recommended safety tests and the notification review is facilitated if the agency receives the information it is seeking. The TSCA Assistance Office should be contacted for an up-to-date listing (202-554-1404).

HISTORY OF FEDERAL CHEMICAL CONTROL LAWS AND AGENCIES

Table 13.3 provides a brief historical overview of the major chemical control laws and agencies. More information can be found in the references listed in this chapter and Chapter 12.

TABLE 13.3 Time Line of Key Federal Chemical Control Laws by Agency

Administrative agency and date founded	Key laws and regulations and year passed
Food and Drug Administration, 1907	The Biologics Control Act, 1902 Food and Drugs Act, 1906 Certified Color Regulations, 1907 Federal Food Drug and Cosmetic Act, 1938 Durham–Humphrey Amendment (prescription drugs), 1951 Pesticides Amendment, 1954 Food Additive Amendment (Delaney Clause), 1958 Color Additive Amendment, 1960 Kefauver–Harris Drug Amendments, 1962 Fair Packaging and Labeling Act, 1966 Animal Drug Amendments, 1968 Radiation Control for Health and Safety Act, 1968 Over-the-Counter Drug Review, began 1972 Regulation of Biologics (serum, vaccines, and blood products), transferred to FDA in 1972 Medical Device Amendments, 1976 Saccharin Study and Labeling Act, 1977 Infant Formula Act, 1980 Tamper-Resistant Packaging Regulations 1982 Food Quality Protection Act, 1996
Environmental Protection Agency, 1970	Federal Insecticide, Fungicide and Rodenticide Act, 1947 Clean Air Act, 1970 Pesticide tolerance responsibility transfers from FDA, 1970 Safe Drinking Water Act, 1974 Toxic Substances Control Act (TSCA), 1976 Resource Conservation and Recovery Act, 1976 Clean Water Act, 1977 Comprehensive Environmental Response, Compensation, and Liability Act, 1980
Consumer Product Safety Commission, 1973	Caustic Poison Act, 1927 Flammable Fabrics Act, 1953 Federal Hazardous Substances Act, 1960 Child Protection Act, 1966 Poison Prevention Packaging Act, 1970 Consumer Product Safety Act, 1972

IMPACTS ON TOXICOLOGISTS OF U.S. LAWS AND REGULATIONS

Many of the previously mentioned laws and agency regulations impact the day-to-day work of the industrial, government, or academic toxicologist. For example, there are animal and clinical testing requirements to demonstrate safety and efficacy of new chemicals or packaging materials, depending on intended use. While testing new products or chemicals, or reviewing test data generated, there are requirements on reporting and recording data that affect the toxicology professional. Several of these requirements are listed in Table 13.4. This list is not comprehensive but is provided to give an overview of the potential regulatory impacts. Consult a legal adviser or regulatory professional to meet your specific need.

CURRENT U.S. CHEMICAL REGULATORY ISSUES

An increased focus in the U.S. regulatory arena in the past few years has resulted in several legislative and regulatory proposals to expand chemical use reporting under SARA (Superfund Amendment Reauthorization) TRI (Toxic Release Inventory) reporting or TSCA (Inventory Update Reporting) laws and regulations. Several proposals support expanded industry reporting of chemical use and production from cradle to grave, with increased public information sharing. Due to the reported ''success'' of chemical release reduction via TRI reporting for chemical releases at industrial sites based on public pressure, activists and

TABLE 13.4 TSCA Reporting and Record-Keeping Requirements That Impact Toxicologists Working in the United States on Chemicals or Products Intended for Sale in the United States

Agency and regulation	Area impacted	Regulatory requirement
EPA		
TSCA 8(a)	Use and manufacture of a listed chemical	After EPA lists an 8(a) reporting requirement, manufacturers and importers (which TSCA regards as the same as manufacture) must report volumes and uses.
TSCA 8(b)	TSCA inventory update reporting	Every 4 years the EPA requires manufacture and import volume reporting for all organic chemicals (nonpolymer) over a volume threshhold (10,000 lbs/year). These data are used to set testing priorities for classes of chemicals.
TSCA 8(c)	Consumer and employee health effect allegations	Allegations of health effects from TSCA subject chemicals must be recorded and kept on file for 30 years (employee) and 5 years (consumer) and reported to EPA if requested.
TSCA 8(d)	Health and safety study and environmental study monitoring data reporting	Upon request (EPA publishes in Federal Register), companies must submit studies on listed 8(d) chemicals, must also notify EPA within 30 days of initiating a new study on a listed chemical, and must report the study once complete.
TSCA 8(e)	Substantial risk to health or the environment	Upon receiving data which indicate that a TSCA subject chemical may cause a substantial adverse effect (e.g., it is teratogenic, mutagenic, carcinogenic, or has contaminated the environment), a ''knowledgeable'' person must report this information to EPA within 15 working days if the data have not been previously reported. Personal liability may ensue if this action is not taken. Some companies have set up procedures for 8(e) reporting to help individuals discharge their personal liability and understand the reporting requirements.
Section 4	Test rules	EPA has developed testing protocols and requires industry to test certain listed chemicals and classes of chemicals to address concerns about existing chemicals in the marketplace. These test rules generally follow 8(a), 8(b), and 8(d) reporting and/or voluntary data call-ins. Testing costs are shared by all manufacturers and importers.
Sections 12 and 13	Export and import	EPA and Customs have reporting and record-keeping requirements to legally import or export chemicals or products containing chemicals.

government propose that similar chemical reductions would occur upon reporting of chemical use.

Industry has opposed this non-risk-based expansion of chemical reporting for many reasons, including the fact that increased volume use of a particular chemical does not necessarily equate with increased risk to the public at large or a population nearby a manufacturing site. Physical chemical form, properties, handling, conversion to other materials with different hazard characteristics, and many other factors control potential risks. Another reason for opposition is the concern that this information constitutes extremely valuable business information that could be lost to other industry competitors or foreign countries which do not have similar requirements.

Other areas of increased focus have been on children's health and other sensitive population health issues, estrogenic effects of chlorinated hydrocarbons and industrial by-products, and environmental justice issues (disproportionate location of manufacturing sites and waste handling facilities in poor neighborhoods, potentially causing health effects). These activities have led to reallocation of agency funding and staffing and new legislative proposals in Congress. The Food Quality Protection Act requires esterogenic testing and consideration of children's health issues when setting pesticide tolerances.

Interest has also been expressed in expanding California's Proposition 65, a consumer product labeling and chemical control initiative and regulation, to other states or federally. Similar legislation and ballot initiatives have been proposed in Ohio, Texas, and Massachusetts during the past few years—so far unsuccessfully. Federal legislation (the ''Pallone bill'') has also

been proposed in the past 2 years which echoes and expands Prop. 65 and expands right-to-know authority on chemical use reporting, but this has not made it out of committee.

References

Campbell, M. (1994). Chemical regulation in Europe and the United States: International implications. In *Chemical Safety* (M. Richardson, Ed.), pp. 513–531. VCH; Weinheim, Germany.

Karstadt, M. (1986). Regulation of chemicals in the United States. In *Public Heath and Preventive Medicine* (J. M. Last, Ed.), 12th ed. Appleton-Century-Crofts, East Norwalk, CT.

Lu, P.-Y., and Wassom, J. S. (1994). Information resources for chemical toxicology and regulation. *J. Hazardous Materials* **39**(2), 225.

Shapiro, M. (1990). Toxic substances policy. In *Public Policies for Environmental Protection*, pp. 195–241. Resources for the Future. Congressional Information Service, Washington, DC.

Wexler, P. (Ed.) (1988). *Information Resources in Toxicology*. Regulation of Chemicals in the United States: Information in the Regulatory Process (M. Karstadt), 2nd ed., p. 254. Elsevier, New York.

This Page Intentionally Left Blank

CHAPTER

14

Resources for Hazard Communication Compliance

DANIEL MARSICK AND PAT DSIDA

After the first glass you see things as you wish they were. After the second, you see things as they are not. Finally, you see things as they really are, and this is the most horrible thing in the world. (attributed to Oscar Wilde, in Conrad, Barnaby, III, *Absinthe: History in a Bottle*)

The Hazard Communication standard, promulgated in 1983, requires chemical manufacturers and importers to provide information to employees on all hazardous chemicals used in the workplace through labels, material safety data sheets (MSDSs), and training programs. The MSDS that accompanies each hazardous chemical is the primary vehicle for transmitting detailed hazard information and becomes the first part of a hazard communication program. Both labels and training are based on the information contained in the MSDS. To be effective, the MSDS must be complete, accurate, and up-to-date.

Now, most companies have fashioned their individual approaches to Hazard Communication compliance. This can range from noncompliance to verification of all received MSDSs. Corporate liability often drives a MSDS approach rather than mere compliance. However, the Occupational Safety and Health Administration (OSHA) cites Hazard Communication violations more often than any other OSHA standard.

MSDS record keeping is easier and depends heavily on the formatting and searching capability of computer technology. Many electronic options are available, including the Internet, intranet, fax-on-demand, 1-800 worker hotlines, and scanning. The price of computer hardware has dropped to such an extent that, in many cases, scanning an MSDS not only avoids the liability of manual data inputting but also is often cheaper, though not always desirable. General tools for both verification and construction will be discussed, followed by specific tools for MSDS construction.

Verifying the coverage scope of chemicals under Hazard Communication and other U.S. and global health and safety regulations can help minimize compliance costs in large businesses and avoid penalties for overlooking listings. These chemicals can be located through chemical lists of automated systems (Table 14.1).

MSDS COLLECTIONS

Both for verification and for construction, MSDS collections can save time and research effort. One can only hope, though, that the MSDS chosen is complete and as up-to-date as possible. Most MSDS collections are composed of many chemical data sheets that are collected from manufacturers and/or enhanced with additional information found in the literature. Some of these better MSDS collections contain a substantial amount of information on lesser-known chemicals and could prove a one-stop source for hazard information.

Current printed MSDS collections are almost nonexistent due to the search capability and formatting possibilities of electronic media and the wider availability of CD-ROM readers. Many of the former printed collec-

TABLE 14.1 Regulated Chemicals Information

The Chemical Advisor	Canadian Centre for Occupational Health and Safety (CCOHS)	Hamilton, Ontario, Canada
LOLI	ChemADVISOR, Inc. Micromedex, Inc.	Pittsburgh, PA Englewood, CO
National Chemical Inventories	Chemical Abstracts Service	Columbus, OH
NLM SuperList	National Library of Medicine	Bethesda, MD
Registry of Toxic Effects of Chemical Substances	Micromedex, Inc. CCOHS	Englewood, CO Hamilton, Ontario, Canada
Ariel Insight (formerly ICRMS)	Ariel Research Corp.	Bethesda, MD

tions are now available on CD-ROM. Some trade associations, though, still distribute printed MSDS collections for their members.

Current electronic collections can provide from 850 to more than 100,000 MSDSs (Table 14.2). The generic collections can be most useful to members of the general public who think they may be exposed but are unable or unwilling to obtain the manufacturers' MSDSs. However, portions of these collections can be used to verify the information in a manufacturer's submitted MSDS.

Liability considerations have encouraged employers and some vendors to gather and use manufacturers' MSDSs, in preference to generic collections. Due in part to updating and other maintenance problems, centrally maintained repositories of these MSDSs are being touted in the marketplace. Several vendors have large updated collections that they make available through a local library [personal computer (PC), minicomputer, or main frame) and can be downloaded or fax-on-demand. Other vendors promote local CD-ROM PC databases or large PC databases with intranet search capability. Intranet search software is an intranet application based on standard worldwide web technologies and protocols adapted for internal use within an organization. CD-ROM products include the *Code of Federal Regulations* and other information besides the MSDS. One company has 24-hr modem access, emergency response, training and personnel tracking, and custom reports.

TABLE 14.2 MSDS Collections

MDL OHS Safety Systems	San Leandro, CA
Sigma–Aldrich	Milwaukee, WI
Canadian Centre for Occupational Health and Safety (CCOHS)	Hamilton, Ontario, Canada
Dolphin Systems	Lake Oswego, OR
AT&T Global MSDS Network Service—AXXIS Petroleum Solutions	St. Paul, MN
Genium Publishing Co.	Schenectady, NY

Note. Additional MSDS collections are listed by Donley Technologies (Colonial Beach, VA) and Best's Safety Directory (1998 ed., A. M. Best Co., Oldwick, NJ).

For many years, the Chemical Manufacturers Association (CMA) in conjunction with the U.S. Department of Transportation maintained manufacturers' chemical information in the CHEMTREC system (http://www.cmahq.com/cmawebsite.nsf/pages/chemtrec) in the event of a chemical emergency. Over time, manufacturers' started to submit MSDSs to CHEMTREC. These MSDS were eventually optically scanned to make their retrieval easier. The Canadian government has long encouraged companies in Canada to submit their MSDSs to a central repository. This eventually was put on a CD-ROM and a proprietary Internet database and is publicly available through the Canadian Centre for Occupational Health and Safety (CCOHS).

Many universities use the Internet in maintaining their MSDS collection, gathering vendor MSDSs, and posting some of their collection for university use. For example, the University of Utah (URL: http://www.chem.utah.edu/msds/msds.html) has an MSDS collection on the Internet. Vendors are also putting product MSDSs on the Internet. The most notable is the J. T. Baker collection (URL: http://siri.org/msds/mf/baker/list.html). Most of these Internet collections can be accessed by using common Internet search engines and home pages, such as OSHWEB (URL: http://www-iae.me.tut.fi/cgi-bin/oshweb.pl), Vermont SIRI MSDS collection (URL: http://hazard.com/msds/), University of Kentucky (URL: http://www.chem.uky.edu/resources/msds.html), or Labsafe (URL: http://www.labsafety.com/techhelp.ctr/thclinks.htm). As in many ''free'' MSDS collections, updates can be few and far between. The accuracy and comprehensiveness of this information is not necessarily enhanced because of its appearance on the Internet.

Some companies and government contractors also use the Internet as storage for their collected MSDSs. Because of a perceived liability and other considerations, these collections are often only available to employees and other authorized individuals.

MSDS REFERENCES

Though somewhat dated, some comprehensive texts, such as the ILO *Encyclopedia of Occupational Safety & Health*, *Patty's Industrial Hygiene and Toxicology*, ACGIH *Documentation of Threshold Limit Values and Biological Exposure Indices*, and the NIOSH/OSHA *Occupational Health Guidelines for Chemical Hazards*, can be used to confirm data reliability from an electronic source or to expand on the data found in the MSDS for a specific chemical. Some of these texts can be found in Table 14.3. Government documents (through the National Technical Information Service or the U.S. Government Printing Office), scientific and technical journals, and organization publications (CMA, etc.) may also be helpful.

As supplemental information sources, commercially available databanks and databases can be useful. A thorough list of publicly available online databases is available elsewhere in this book.

MSDS CONSTRUCTION

It is easier to start with an equivalent industrial MSDS, if found, and then research the literature and/or personal contacts for up-to-date information. Such an MSDS can be often be found on the Internet and in automated commercial MSDS collections, both generic and manufacturers. Lacking such an MSDS, one can examine bibliographic databases and other data sources. Lastly, if little or no data are found, use personal contacts, such as primary investigators (found in professional society directories), trade associations such as the CMA, and professional societies and service organizations, such as the American Chemical Society and the National Safety Council. Other resources include people in similar industries; government hotlines, such as the EPA RCRA Hotline (1-800-424-9346); information centers, such as the OSHA Technical Data Center (1-202-693-2350); and clearinghouses, such as the NIOSH Clearinghouse for Occupational Safety and Health (1-800-356-4674). Typical government hotlines and offices can be found in government publications, safety magazines, and telephone directories. Knowledgeable federal government officials can be located through agency telephone directories available from the U.S. Government Printing Office or through commercial directories. Some state governments also provide assistance in the form of data sheets such as the New Jersey Fact Sheets or information centers. The Society for Chemical Hazard Communication (SCHC) is a nonprofit organization that promotes the improvement of the business of hazard communication for chemicals and provides guidance or technical expertise to private, nonprofit groups and to government. It has compiled and made available on the internet (www.schc.org) a very useful reference list for MSDS construction. The SCHC in Annandale, Virginia, can be contacted directly at 703-658-9246 or electonically at SCHCLori@aol.com.

MSDS CONSULTANTS

For a small business, the use of a one-time consultant or consulting service for MSDSs or other safety and health paperwork may be more cost-effective than the

TABLE 14.3 Comprehensive Texts

Source	Publisher	Year
Dangerous Properties of Industrial Materials	Wiley, New York	1996
IARC Monographs on the Evaluation of the Carcinogenic Risk of Chemicals to Humans	International Association for Research in Cancer, Lyon	1978–1998
NIOSH/OSHA Occupational Health Guidelines for Chemical Hazards (and supplements)	U.S. Government Printing Office, Washington, DC	1981, 1988, 1992
Documentation of the Threshold Limit Values and Biological Exposure Indices (and updates)	American Conference of Governmental Industrial Hygienists	1993 (1996–1998)
Handbook of Environmental Data on Organic Chemicals, 3rd ed.	Wiley, New York	1996
Patty's Industrial Hygiene and Toxicology	Wiley, New York	1991–1995
NIOSH Pocket Guide to Chemical Hazards	U.S. Government Printing Office, Washington, DC	1997
Illustrated Handbook of Physical–Chemical Properties and Environmental Fate for Organic Chemicals	CRC Press, Boca Raton, FL	1992–1997
ILO Encylopedia of Health and Safety	International Labour Office, Geneva	1997

training or dedication of a staff member to the task. Though many MSDS database suppliers purport to make the task easier for small businesses, there is still a cost in training time and time away from profit-making activities. Fortunately, there are several sources of consultant listings. The most well-known in the safety and health field are the annual listing in the January edition of the *American Industrial Hygiene Association Journal* (AIHA, Fairfax, VA) and the SCHC (www.schc.org) list. Local chambers of commerce and trade associations also maintain lists of consultants. As in the hiring of any outside help, let the buyer beware. Be sure to check the credentials and experience of the potential consultant. Most important, can you and your staff work closely with a particular consultant? Personality conflicts and communication problems can affect the work of the most seasoned consultant.

INTERNATIONAL HARMONIZATION

Major differences exist between countries in the chemical criteria (e.g., at what level of lethal dosage is a chemical classified as highly toxic) and in the specific requirements for MSDSs for the same product. This has caused much heartache for international businesses and those businesses expanding internationally. This was also recognized by the International Labor Office (ILO) and at the 1992 United Nations Conference on Environment & Development (UNCED), also called the Earth Summit. The ILO sets standards in the form of conventions and recommendations. ILO's mandate to protect worker safety led to the 1989 resolution concerning international harmonization of classification and labeling systems and the 1990 adoption of Chemicals Convention No. 170 and Recommendation No. 177. Recommendation No. 177 encourages the use of the MSDS headings and sections discussed in the ANSI Z400.1 standard.

The Earth Summit in 1992 recommended a globally harmonized hazard classification and compatible labeling system, including MSDSs, by the Year 2000. A Coordinating Group for the Harmonization of Chemical Classification Systems (CG/HCCS) was established within the International Program on Chemical Safety (IPCS), with the ILO as its secretariat. A joint project on the harmonization of chemical hazard/risk assessment terminology is a major effort of the IPCS. Established in 1995, the Inter-Organization Programme for the Sound Management of Chemicals (IOMC) also coordinates the chemical harmonization efforts of six international organizations, including the three cooperating organizations of IPCS (UNEP, WHO, and ILO), FAO, OECD, and UNIDO. Steady progress is being made in standardizing the chemical criteria between countries.

ELECTRONIC DATA BANKS

Data bank	Provider
ICID	NTIS, Springfield, VA
Hazardous Substances Data Bank	National Library of Medicine, Bethesda, MD
CCOHS	Canadian Centre for Occupational Health and Safety, Hamilton, Ontario Canada
TOMES PLUS	Micromedex, Inc., Englewood, CO
IRIS	U.S. EPA, Cincinnati, OH
RTECS	NIOSH, Cincinnati, OH
TSCATS	NTIS, Springfield, VA

Note. Additional list of environmental databases can be obtained from Donley Technologies (Colonial Beach, VA) and NTIS (Springfield, VA).

DETAILED ADDRESSES

Toxicity Data on Regulated Chemicals

Ariel Research Corp.
7910 Woodmont Ave., Suite 900
Bethesda, MD 20814
Phone: 301-907-7771
Web: http://www.arielresearch.com

CCOHS
250 Main Street East
Hamilton, Ontario L8N 1H6, Canada
Phone: 800-668-4284
Web: http://www.ccohs.ca

ChemAdvisor, Inc.
750 William Pitt Way
Pittsburgh, PA 45238
Phone: 412-826-3750
Web: http://www.chemadvisor.com

Chemical Abstracts Service
American Chemical Society
P.O. Box 3012
Columbus, OH 43210
Phone: 614-447-3600
Web: http://www.cas.org

Government Institutes
4 Research Place, Suite 200
Rockville, MD 20850
Web: http://www.govinst.com

National Library of Medicine
Specialized Information Services
8600 Rockville Pike
Bethesda, MD 20894
Phone: 301-496-1131

U.S. Government Printing Office
Superintendent of Documents
732 North Capitol St., N.W.
Mailstop SM
Washington, DC 20402
Phone: 202-512-1800
Web: http://www.access.gpo.gov

MSDS Collections

A. M. Best Co.
Oldwick, NJ 08858
Phone: 908-439-2200

AXXIS Petroleum Solutions
1380 Energy Lane, Suite 112
St. Paul, MN 35108
Phone: 612-641-0321

Chemical Manufacturers Association
1300 Wilson Blvd.
Arlington, VA 22209
Phone: 703-741-5000

Dolphin Software, Inc.
9 Monroe Parkway, Ste. 150
Lake Oswego, OR 97035
Phone: 503-635-6455

Donley Technologies
Box 152
Colonial Beach, VA 22443
Phone: 804-224-9427

Genium Publishing Corp.
1145 Catalyn St.
Schnectady, NY 12303
Phone: 518-377-8854

MDL Information Systems
14600 Catalina St.
San Leandro, CA 94577
Phone: 510-895-1313

Sigma–Aldrich Chemical Co.
1001 W. St. Paul Ave.
Milwaukee, WI
Phone: 800-231-8327

Software Systems

Hazard Information Services
St. Paul–Ramsey Medical Center
640 Jackson St.
St. Paul, MN 55101

ImageTrak Software
P.O. Box 26106
Greenville, SC 29616-9965
Phone: 888-635-5707

Image Wave Corp.
P.O. Box 4504
Lago Vista, TX
78645-9974
Phone: 512-267-9705
MSDSFinder

Textrieve Software Division
Labelmaster
1931 Second Ave., Suite 300
Seattle, WA 98101
MSDS Wizard/REG-Trieve
Phone: 800-578-4955

References[1]

American Conference of Governmental Industrial Hygienists (ACGIH) (1993). *ACGIH Documentation of Threshold Limit Values and Biological Exposure Indices*. ACGIH.

International Labor Office (ILO) (1998). *ILO Encyclopedia of Safety and Health*. ILO, Geneva.

NIOSH/OSHA Occupational Health Guidelines for Chemical Hazards. U.S. Government Printing Office, Washington, DC.

Patty's Industrial Hygiene and Toxicology (1991–1995). Wiley, New York.

Silk, J. C., and Kent, M. B. (Eds.) (1995). *Hazard Communication Compliance Manual*. Bureau of National Affairs, Washington, DC.

[1] A bibliography of recent journal articles on MSDS is provided in Chapter 11.

This Page Intentionally Left Blank

CHAPTER

15

Organizations

P. J. (BERT) HAKKINEN, FREDERICK W. STOSS, BETH BEHRENDT, AND PHILIP WEXLER

There would be meat stored in great piles in rooms; and the water from leaky roofs would drip over it, and thousands of rats would race about on it. It was too dark in these storage places to see well, but a man could run his hand over these piles of meat and sweep off handfuls of the dried dung of rats. These rats were nuisances, and the packers would put poisoned bread out for them, they would die, and then rats, bread, and meat would go into the hoppers together. This is no fairy story and no joke; the meat would be shovelled into carts, and the man who did the shoveling would not trouble to lift out a rat even when he saw one—there were things that went into the sausage in comparison with which a poisoned rat was a tidbit.

(Upton Sinclair, *The Jungle*)

The organizations listed in this chapter are government agencies, professional societies, trade associations, research institutes, and others involved with toxicology and human and environmental risk assessment activities. Many publish newsletters and other types of documents (see Chapters 4 and 5 for additional information), and many have Internet World Wide Web (www) sites. They are primarily based in the United States, but groups from other countries have also been listed if judged to be of worldwide interest.

Concerning U.S. governmental organizations, we aimed for a fairly thorough representation at the federal level. Doing the same for state, regional, and local jurisdictions would have swelled this chapter out of proportion. There exist overlaps in jurisdiction among agencies that have toxicology and related disciplines in their missions. For instance, a given chemical may be subjected to different regulatory requirements depending on its use (e.g., food additive, manufacturing solvent, or chemical emulsion) or on its classification (e.g., analytical reagent, stored as a bulk stock chemical, or chemical or toxic waste). This has led to much of the regulatory confusion among the agencies and the industries they regulate, and it has contributed to the public's lack of understanding about the science and policies related to chemicals and other materials in the environment. These complex and sometimes controversial issues are addressed by various interagency coordinating groups and councils, as discussed under Special Groups listed at the end of this chapter.

The nongovernmental organizations (typically designated as nonprofit organizations) fall into two major categories: (i) special interest groups that aim to influence policy- and decision makers and elected officials and (ii) public interest groups that attempt to serve as advocates for specific positions on issues. These organizations include professional associations and societies, independent and trade associations, accrediting and certifying boards, and private research and policy groups.

Individual industrial, consulting, and other for-profit environmental toxicology interests have not been included in this chapter. However, many of the trade associations listed here serve specific manufacturing and business interests. The membership ranks of professional societies and associations are rich with representatives from business and industry.

Private industries provide important sources of data and information related to toxicology and related disciplines of environmental and occupational medicine and health. The issues of Right-to Know laws, Toxic Release Inventory and emergency preparedness, and ISO 14,000 standards are generating new source data and information such as material safety data sheets, environmental auditing reports, and specific requirements for disclosure of environmental information in corporate annual reports and other documents. These activities serve as important sources of publicly available, nonconfidential, corporate data and information.

Adding to the confusion, particularly to the regulatory and policy aspects of toxicology, are state, county, and municipal agencies and departments in the United States providing additional levels of regulatory compliance and, to a degree much less than federal agencies, support for basic and applied scientific and technical research support. It is well beyond the scope of this book to provide as detailed an inventory of environmental and health agencies for each state, territory, county, and municipality as has been provided for the federal government. However, it is most fitting to include here a description of the following major sources from which local agencies providing environmental and health services can be found. These resources can be contacted to determine to what extent they provide services, publications, directories, conferences, workshops, training, and information products related to toxicology and environmental or occupational health. More detailed descriptions and points of contact are provided for these sources of information:

- Air and Waste Management Association (AWMA)
- Association of Local Air Pollution Control Officials (ALAPCO)
- Association of State and Territorial Health Officials (ASTHO)
- National Association of Counties (NACo)
- National Association of County and City Health Officials (NACCHO)
- National Association of State Information Resource Executives (NASIRE)
- National Conference of Local Environmental Health Administrators (NCLEHA)
- National League of Cities (NLC)
- National Wildlife Federation (NWF)
- State and Territorial Air Pollution Program Administrators (STAPPA)

Also, standard phone books can be fruitful sources for locating federal, state, county, city, and other local government agencies.

Hotlines and clearinghouses are additional organizational entities that are especially useful in serving the public in matters related to toxicology. EPA maintains extensive lists of clearinghouses (www.epa.gov/epahome/clearing.htm) and hotlines (www.epa.gov/epahome/hotline.htm) in areas such as acid rain, air risk, asbestos, exposure assessment modeling, hazardous waste, and safe drinking water.

Organizations, it should be noted, are composed of people. This underscores the fact that information comes essentially from individuals. Collegial networks are extremely important for finding out about recent developments in toxicology. You may have a particular query that cannot be answered by the scientific literature or a database. Your best bet might be to get in touch with an expert, who may be located perhaps, by virtue of being the author of an article or being listed in a database. Getting on Internet mailing lists is also helpful. The SOT maintains a list of media resource specialists, toxicology experts, who are willing to assist journalists in providing accurate toxicological information (www.toxicology.org/medexperts.htm). One assumes that legitimate requests from other professionals will also be honored.

DIRECTORIES FOR LOCATING STATE, COUNTY, AND LOCAL SOURCES

Piper Resources (3208 West Lake Street, Suite 187, Minneapolis, MN 55416; phone: 612-825-9312; e-mail: piper@piperinfo.com; Web, http:www.piperinfo.com) produces the State and Local Government on the Net Website, which is a comprehensive, and frequently updated directory of Web links to government sponsored and government controlled resources on the Internet. In addition, Web search engines can be used to help identify organizations of interest. The annual compilation of The National Wildlife Federation's Conservation Directory provides extensive inventories of international, national, state, and provincial agencies and non-profit organizations related to environmental quality, natural resources conservation, and wildlife conservation. Topics covered include chemical pollution, environmental health and justice, and toxicology.

Other useful directories include the following (because publishers and producers are constantly changing print directories into electronic formats it is best to check the publisher/producer for the availability of these resources in CD-ROM or other online formats):

- **Federal Regulatory Directory,** Congressional Quarterly, Washington, DC
- **Federal Yellow Book,** Leadership Directories, Washington, DC

- **Government Phone Book USA** (formerly **The Government Directory of Addresses and Telephone Numbers**), Omnigraphics, Inc., Detroit, MI
- **State Yellow Book,** Leadership Directories, Washington, DC
- **The United States Government Manual,** U.S. Government Printing Office, Washington, DC
- **Washington Information Directory,** Congressional Quarterly, Washington, DC

HOW TO FIND ADDITIONAL ORGANIZATIONS

There are many directories that provide access to organizations and agencies devoted to toxicology and related health and environmental resources. These resources can be used to identify organizations not listed here and can be used to identify additional points of contact for specific program areas or projects. The Gale Research Company (Detroit, MI) publishes a series of directories that can be mined for topics related to toxicology. Among these are:

- **Consultants and Consulting Organizations Directory**
- **Directory of Databases**
- **Encyclopedia of Associations** (U.S. national organizations, international organizations, and regional, state, and local organizations)
- **Government Research Centers Directory**
- **International Research Centers Directory**
- **Research Centers Directory**

Many of these Gale directories are available as a subscription service via Gale's ''GaleNet'' www home page at http://galenet.gale.com/ (e.g., the Associations Unlimited database contains information for more than 440,000 U.S. national, regional, state, and local and international nonprofit organizations, and the Gale's *Ready Reference* includes 11 of Gale's most popular reference directories on associations, newsletters, research centers, databases, etc.).

The *World Directory of Environmental Organizations*, 5th ed. (T. C. Trzyna, E. Marigold, and J. K. Osborn, Eds.) is a cooperative project of the International Center for the Environment and Public Policy at the California Institute of Public Affairs (an affiliate of the Claremont Graduate School), the Sierra Club, and IUCN—The World Conservation Union (members include over 800 governmental and nongovernmental organizations in 131 countries). This book, published by Earthscan Publications Limited, describes over 3200 governmental and nongovernmental organizations in over 200 countries interested in environmental problems such as toxic pollution and climate change. It can be ordered via the World Wide Web by accessing IUCN's ''World Conservation Bookstore'' (http://www.uicn.org/bookstore; e-mail: info@books.iucn.org; phone: 44-1223-277894) or Earthscan's World Wide Web home page (http://www.earthscan.co.uk; e-mail: earthinfo@earthscan.co.uk; phone: 44-171-278-0433).

INFOTERRA, the global environmental information exchange network of the United Nations Environment Programme, operates through a system of government designated focal points. This database is available online at http://www.epq.gov/earlink1.

DIRLINE, an online directory from the National Library of Medicine (http://sis.nlm.nih.gov/dirline), is quite useful for locating organizations related to toxicology and related disciplines.

Microinfo Information Services (http://www.microinfo.co.uk) provides a directory of environmental information resources in the European Union (EU).

Best Environmental Directories, an index of WWW indexes of environmental sources on the Internet, classified by 250 subjects and types (from air to water and from selected lists to meta-databases) is available in the following languages: English, French, Dutch, Italian, and German. The English, French, and Dutch indexes are updated every week (only the best known starting point for each category and type is kept in the list). The German and Italian indexes are several months old (only the links are verified, but new directories are not added). In addition, the English and French versions are optionally accompanied with comments, also updated every week. General site starting point (English version): http://www.ulb.ac.be/ceese/meta/cds.html. Science and Environmental Health Network (Rt. 1, Box 73, Windsor, ND 58424) (phone: 701-763-6286; e-mail: 75114.1164@compuserve.com) maintains a directory of environmental health-related resources and services.

LISTING OF ORGANIZATIONS

Academy of Toxicological Sciences (ATS)
c/o David J. Brusick
Covance Laboratories Inc.
9200 Leesburg Pike
Vienna, VA 22182-1699
Phone: 703-893-5400
E-mail: david.brusick@covance.com

Members include toxicologists certified as fellows by this organization. Formed in 1981 ''to honor and certify toxicologists who have achieved peer recognition for their expertise and sound scientific judgment.''

(The) Acrylonitrile Group
1330 Connecticut Avenue, NW, Suite 300
Washington, DC 20036
Phone: 202-659-0060
E-mail: an@soc.ua.com

Members include producers and users of acrylonitrile concerned with health, safety, environmental, and regulatory matters associated with this chemical.

(U.S.) Agency for Toxic Substances and Disease Registry (ATSDR)
1600 Clifton Road
Atlanta, GA 30333
Phone: 888-42-ATSDR
E-mail: ATSDRIC@cdc.gov
Web: http://www.atsdr.cdc.gov

An agency of the U.S. Department of Health and Human Services, ATSDR's mission is to prevent exposure and adverse human health effects and diminished quality of life associated with exposure to hazardous substances from waste sites, unplanned releases, and other sources of pollution present in the environment. ATSDR's functions include public health assessments of waste sites, health consultations concerning specific hazardous substances, health surveillance and registries, response to emergency release of hazardous substances, applied research in support of public health assessments, information development and dissemination, and education and training concerning hazardous substances.

Air and Waste Management Association (AWMA)
One Gateway Center, Third Floor
Pittsburgh, PA 15222
Phone: 800-270-3444 or 412-232-3444
E-mail: info@awma.org.
Web: http://www.awma.org

Nonprofit, technical and educational association with over 17,000 members in over 65 countries whose vision is to be the premier international environmental organization promoting global responsibility. Members include toxicologists and others in industry, academia, government agencies, and elsewhere. AWMA provides networking among government agencies at federal, state, county, and municipal levels and interactions among government agencies, industries, businesses, and academics. The May 1997 issue of the AWMA news and issues magazine, *EM*, provides a directory of federal, state, and local agencies dedicated to air pollution control and waste management activities. Other publications include newsletters, a journal (*Journal of the Air & Waste Management Association*), and a publications catalog.

Alkyl Amines Council (AAC)
1100 New York Avenue, NW, Suite 1090
Washington, DC 20005
Phone: 202-414-4100
E-mail: aac@socma.com

Members include manufacturers and users of alkyl amines. Affiliated with the Synthetic Organic Chemical Manufacturers Association (SOCMA).

American Academy of Clinical Toxicology (AACT)
Pittsburgh Poison Center
3705 5th Avenue
Pittsburgh, PA 15213
Phone: 412-692-6669
E-mail: krenzee@chplink.chp.edu
Web: http://clintox.org

Members include physicians and others interested in clinical toxicology. Publishes the journal *Clinical Toxicology*.

American Academy of Environmental Medicine (AAEM) (formerly the Society for Clinical Ecology)
Box CN 1001-2001
New Hope, PA 18938
Phone: 316-684-5500
E-mail: aaem@bellatlantic.net
Web: http://www.healthy.net/pan/pa/NaturalTherapies/aaem

Founded in 1965, this association of physicians and others interested in the clinical aspect of environmental medicine promotes an understanding of environmental illness and methods of controlling environmental illness. Produces educational aids such as tapes and audiovisual presentations and provides database searches and member information. Publications include a newsletter and the *Journal of Nutritional and Environmental Medicine*.

American Academy of Forensic Sciences
410 N. 21st Street, Suite 203
Colorado Springs, CO 80901-0669
Phone: 719-636-1100
Web: http://www.aafs.org

Members include toxicologists and others concerned with the forensic sciences. Publications include a newsletter and the *Journal of Forensic Sciences*.

American Academy of Veterinary and Comparative Toxicology (AAVCT)
Dr. Larry Kerr, Secretary
University of Tennessee
Knoxville, TN 37901
Phone: 423-974-5701
E-mail: lkerr@utk.edu

Members include veterinarians and others interested in toxicology and in veterinary comparative toxicology. Publishes *Veterinary and Human Toxicology*.

American Association for Clinical Chemistry (AACC)
(formerly the American Association of Clinical Chemists)
2101 L Street, NW, Suite 202
Washington, DC 20037-1526
Phone: 202-857-0717
Web: http://www.aacc.org

Members include clinical laboratory scientists and others interested in clinical chemistry. Sponsors various programs, including ones on continuing education and quality control. Includes divisions on clinical toxicology and molecular pathology. Publishes books, a newsletter, a journal, and other documents.

American Association for Laboratory Animal Science (AALAS)
9190 Crestwynd Hills Drive
Memphis, TN 38125
Phone: 901-754-8620
Web: http://www.aalas.org

Non-profit organization of over 7800 members whose mission is to serve society through education and the advancement of responsible laboratory animal care and use. Offers a certification program, training materials, and two journals (*Contemporary Topics in Laboratory Animal Science* and *Laboratory Animal Science the International Journal of Comparative and Experimental Medicine*).

American Association of Occupational Health Nurses (AAOHN)
2920 Brandywine Road, Suite 100
Atlanta, GA 30341
Phone: 770-455-7757
Web: http://www.aaohn.org

An organization of registered professional nurses employed in a variety of public and private settings that addresses the needs for occupational and environmental health matters. Provides a certification process for demonstrating specialty skills in occupational health nursing.

American Association of Poison Control Centers (AAPCC)
3201 New Mexico Avenue, NW, Suite 310
Washington, DC 20016
Phone: 202-362-7217
Web: http://www.aapcc.org

Members include individuals and organizations interested in the operation of poison control centers. Aids in obtaining information on substances that may cause accidental poisonings or other acute toxic effects and how to manage such exposures. Offers educational program and training aides and maintains a national database on accidental exposures.

American Board of Chelation Therapy (ABCT)
1407B North Wells
Chicago, IL 60610
Phone: 800-356-2228

Covers information about chelation therapy, which uses metal binding and bioinorganic agents to pick up and remove calcium, lead, and other toxic heavy metals from the bloodstream.

American Board of Environmental Medicine (ABEM) and the International Board of Environmental Medicine (IBEM)
65 Wehrle Drive
Buffalo, NY 14225-1021
Phone: 716-837-1320
Fax: 716-833-2244

Established in 1988 as an accrediting agency for medical doctors and osteopaths, examining, evaluating, and certifying individuals in the field. Publishes the *Register of the American Board of Environmental Medicine,* an annual directory.

American Board for Occupational Health Nurses (ABOHN)
10503 N. Cedarburg Road
Mequon, WI 53092-4403
Phone: 414-242-0704

Establishes standards and confers certification in occupational health nursing. Maintains specialty database with information and directories related to occupational health nursing.

American Board of Toxicology (ABT)
P.O. Box 30054
Raleigh, NC 27622
Phone: 919-847-8601
E-mail: abtox@mindspring.com

Members include toxicologists certified by this organization. Formed in 1979 to enhance the science of toxicology by establishing standards for professional practice by certification of individuals in general toxicology.

American Board of Veterinary Toxicology (ABVT)
Dr. Robert H. Poppenga, Secretary-Treasurer
University of Pennsylvania
New Bolton Center
382 W. State Road
Kennett Square, PA 19348

Phone: 610-444-5800
E-mail: poppenga@vet.upenn.edu
Web: http://www.abvt.org

Affiliated with the American Veterinary Medical Association. Seeks to further education and progress in veterinary toxicology and to encourage research and training. Offers certification via an examination.

American Chemical Society (ACS)
1155 16th Street, NW
Washington, DC 20036
Phone: 202-872-4600
Web: http://www.acs.org

Members include chemists and others. Publications include three journals with emphasis on toxicology topics (*Chemical Health & Safety*, *Chemical Research in Toxicology*, and *Environmental Science and Technology*). The Division of Chemical Toxicology is a probationary ACS division.

American College of Forensic Examiners (ACFE) (formerly American Board of Forensic Examiners)
611 East Wells Street
Milwaukee, WI 53202
Phone: 414-226-2169
E-mail: acfe@execinc.com
Web: http://www.acfe.com

Covers information about the forensic sciences. Publishes a newsletter.

American College of Laboratory Animal Medicine (ACLAM)
Dr. Melvin W. Balk, Executive Director
96 Chester St.
Chester, NH 03036
Phone: 603-887-2467
E-mail: mwbaclam@gsinet.net
Web: http://www.aclam.org

Activities include certification of specialists on laboratory animal medicine, support of education in laboratory animal science and medicine, and the advancement of biomedical research.

American College of Medical Toxicology (ACMT) (formerly American Board of Medical Toxicology)
777 E. Park Drive
P.O. Box 8820
Harrisburg, PA 17105-8820
Phone: 717-558-7846
Web: http://www.acmt.net

Members include physicians interested in clinical (medical) toxicology. Publishes a newsletter.

American College of Occupational and Environmental Medicine (ACOEM)
1114 N. Arlington Heights Rd.
Arlington Heights, IL 60004
Phone: 847-818-1800 ext. 152
Web: http://www.acoem.org

Professional association of approximately 6500 physicians with related interests in occupational and environmental health and medicine. Has developed a continuing education course, Core Curriculum in Environmental Medicine. Provides board certification training and examinations.

American College of Toxicology (ACT)
9650 Rockville Pike
Bethesda, MD 20814
Phone: 301-571-1840
E-mail: ekagan@act.faseb.org
Web: http://actox.org

Its goal is to bring together people having common interests in toxicology, with a commitment to address current and future toxicological issues. Members include individuals interested in toxicology and related disciplines. Holds an annual meeting, and publications include a newsletter and journal (*International Journal of Toxicology*, formerly the *Journal of American College of Toxicology*).

American Conference of Governmental Industrial Hygienists (ACGIH)
1330 Kemper Meadow Drive
Cincinnati, OH 45240
Phone: 513-742-2020
E-mail: mem@acgih.org or pubs@acgih.org
Web: http://www.acgih.org

Members include individuals interested in industrial hygiene and in exchanging ideas and promoting standards and techniques in industrial health. Publishes a journal (*Applied Occupational and Environmental Hygiene*) and numerous other documents including Threshold Limit Values and Biological Exposure Indices. A ''Publications Catalog'' updated periodically contains extensive listings, descriptions, and instructions for ordering ACGIH information and information from other authors and organizations on toxicology, industrial hygiene, hazardous materials/waste, ergonomics, and other topics. Information includes journals, books, pamphlets, brochures, CD-ROMs, software, videos, audiotapes, posters, and slides.

American Crop Protection Association (ACPA) (formerly the National Agricultural Chemicals Association)

1156 15th Street NW, Suite 400
Washington, DC 20005
Phone: 202-296-1585
Web: http://www.acpa.org

Members include companies producing or formulating agricultural chemical products (e.g., fumigants, scalicides, plant sprays and dusts, defoliants, soil disinfectants, weed killers, insecticides, and rodenticides). Publishes a bulletin and other documents. [Also see listing for International Group of National Associations of Manufacturers of Agrochemical Products (GIFAP).]

American Fund for Alternatives to Animal Research (AFAAR)
c/o Dr. Ethel Thurston, 175 W. 12th Street, No. 16-G
New York, NY 10011
Phone: 212-989-8073

Offers grants to develop and teach *in vitro* substitutes for tests currently involving animals and disseminates information of this research to regulatory agencies, researchers, and others. Publishes a newsletter and other documents.

American Industrial Health Council (AIHC)
2001 Pennsylvania Avenue, NW, Suite 760
Washington, DC 20006
Phone: 202-833-2131
E-mail: membershipservices@aihc.org

Members include companies interested in human and environmental risk assessments. Mission is ''to promote the sound use of scientific principles and procedures in public policy for the assessment and regulation of risks associated with human health effects and ecological effects.'' A bulletin published weekly by fax contains notices of new toxicology and risk assessment information for chemicals and other information. A newsletter is published monthly.

American Industrial Hygiene Association (AIHA)
2700 Prosperity Avenue, Suite 250
Fairfax, VA 22031
Phone: 703-849-8888
Info-fax-on-demand (publications update): 703-641-4636
Web: http://www.aiha.org

AIHA is a resource for information on occupational and environmental health and safety issues. Founded in 1939, AIHA is an organization of more than 12,000 professional members dedicated to the anticipation, recognition, evaluation, and control of environmental factors arising in or from the workplace that may result in injury, illness, or impairment or that may affect the well-being of workers and members of the community.

American Library Association (ALA)
Office of Literacy and Outreach Services (OLOS)
American Library Association
50 E. Huron
Chicago, IL 60611
Phone: 800-545-2433
Web: http://www.ala.org

The American Library Association (ALA) is the voice of America's libraries and the millions of people who depend on them. Its 57,000 members are primarily librarians, but also trustees, publishers, and others who support the work of the association. ALA affiliates are public, school, academic (college and university), government, and other libraries. The ALA Task Force on the Environment (http://www.jessamyn.com/srrt/tfoe/) produces the irregular, online newsletter, GreeNotes. TFOE programs at the ALA Annual Meeting have included topics related to environmental justice, chemicals in the community, environmental health, community–library linkages, as well as other general environmental topics.

American Lung Association
1740 Broadway
New York, NY 10019
Phone: 800-586-4872
Web: http://www.lungusa.org

Since 1904, the American Lung Association has been working to ensure that people breathe easier. Their mission is to prevent lung disease, asthma, and other respiratory illnesses, including those associated with environmental causes.

American Petroleum Institute (API)
1220 L Street, NW
Washington, DC 20005-4070
Phone: 202-682-8000
Web: http://www.api.org

Members include corporations in the petroleum and allied industries. Activities include environmental and health topics related to petroleum, including research programs. Publishes a newsletter, manuals, booklets, and other documents. See especially their Web site's information related to environment, health, and safety (http://www.api.org/ehs).

American Public Health Association (APHA)
800 I St.
Washington, DC 20001-3710
Phone: 202-777-APHA (2742)
E-mail: comments@apha.org
Web: http://www.apha.org

The APHA is the oldest and largest organization of public health professionals in the world, representing

more than 50,000 members from over 50 occupations of public health. The association and its members have been influencing policies and setting priorities in public health since 1872, including all aspects of environmental health concerns.

American Society for Clinical Pharmacology and Therapeutics (ASCPT)
117 W. Ridge Pike, Suite 2
Conshohocken, PA 19428-1216
Phone: 610-825-3838
E-mail: ASCPT@aol.com
Web: http://www.ascpt.org

Members include scientists interested in therapeutic drug and toxicology monitoring. Publishes a journal (*Clinical Pharmacology and Therapeutics*).

American Society for Pharmacology and Experimental Therapeutics (ASPET)
9650 Rockville Pike
Bethesda, MD 20814-3995
Phone: 301-530-7060
E-mail: aspetinfo@aspet.faseb.org
Web: http://www.faseb.org/aspet

Members include scientists interested in pharmacology and toxicology monitoring. Publishes several journals (e.g., *Drug Metabolism and Disposition*).

American Society for the Prevention of Cruelty to Animals (ASPCA)

[See National Animal Poison Control Center (NAPCC)]

American Society for Testing and Materials (ASTM)
100 Barr Harbor Drive
West Conshohocken, PA 19428-2959
Web: http://www.astm.org

ATSM's mission statement reads ''To be the foremost developer and provider of voluntary consensus standards, related technical information, and services having internationally recognized quality and applicability that: promote public health and safety, and the overall quality of life; contribute to the reliability of materials, products, systems, and services; and facilitate national, regional, and international commerce.'' ASTM has developed and published over 10,000 technical standards, which are used by industries worldwide. ASTM members develop the standards within the ASTM consensus process. Technical publications, training courses, and Statistical Quality Assurance programs are other ASTM products; ASTM services include the ASTM Institute for Standards Research. Many ASTM technical committees relate to toxcology and environmental health and safety.

American Type Culture Collection (ATCC)
10801 University Blvd.
Manassas, VA 20110-2209
Phone: 703-365-2700
E-mail: news@atcc.org
Web: http://www.atcc.org/

Independent, nonprofit organization dedicated to the acquisition, preservation, and distribution of microorganisms, viruses, cell cultures, fungi, yeasts, protozoa, plant tissue culture, and recombinant DNA materials. Offers *in vitro* toxicology and other workshops.

Aniline Association (AA)
1100 New York Avenue, NW, Suite 1090
Washington, DC 20005
Phone: 202-414-4100

Members include manufacturers of aniline. Conducts tests on the health and environmental effects of aniline and disseminates information. Affiliated with the Synthetic Organic Chemical Manufacturers Association (SOCMA).

Animal Welfare Information Center (AWIC)
U.S. Department of Agriculture, Agricultural Research Service
National Agriculture Library
10301 Baltimore Ave., 5th Floor
Beltsville, MD 20705-2351
Phone: 301-504-6212
E-mail: awic@nal.usda.gov
Web: http://www.nal.usda.gov/awic

Government organization interested in improved animal care and use in research, teaching, and testing. Publishes a newsletter and other documents.

The Animal Welfare Institute
P.O. Box 3650
Washington, DC 20007
Phone: 202-337-2332
Fax: 202-338-9478
E-mail: awi@animalwelfare.com
Web: http://www.animalwelfare.com

Devoted to all aspects of animal welfare, including animals used in experimental research settings and alternatives to use of animals in laboratories.

Argonne National Laboratory (ANL)
9700 S. Cass Avenue
Argonne, IL 60439
Phone: 630-252-2000
Web: http://www.anl.gov

Provides basic and applied research and development activities related to environmental health issues within the Environmental Research Division.

Association for Assessment and Accreditation of Laboratory Animal Care (AAALAC International)
11300 Rockville Pike, Suite 1211
Rockville, MD 20852-3035
Phone: 800-926-0066 and 301-231-5353
E-mail: accredit@aaalac.org
Web: http://www.aaalac.org

Private, nonprofit organization that promotes the responsible treatment of animals in science through a voluntary accreditation program. Accredits animal programs in research centers, universities, hospitals, and commercial and nonprofit organizations worldwide. Accreditation is a voluntary process for institutions to demonstrate a commitment to responsible, high-quality animal care and use.

Association of Environmental Health of Soils
150 Fearing Street
Amherst, MA 01002
Phone: 413-549-5170
Web: http://www.aehs.com

AEHS provides a network to exchange information across disciplines and affiliations sharing a common interest in the broadly defined area of soils and health. AEHS members represent the many disciplines involved in making decisions and solving problems affecting soils, including chemistry, geology, hydrogeology, law, engineering, modeling, toxicology, regulatory science, public health, and public policy.

Association of Government Toxicologists (AGT)
R. Daniel Benz, Membership Chair
4921 Walking Fern Drive
Rockville, MD 20853-1343
Phone: 202-418-3048
Fax: 202-418-3126
E-mail: rdb@cfsan.fda.gov

The AGT was founded in 1983 to promote and facilitate the acquisition and utilization of knowledge in toxicology and to provide opportunities for government toxicologists to meet and exchange ideas. Persons who are employed by the federal government and who are qualified in toxicology or a related field are eligible to be full members. Persons who were once employed by the federal government, who are employed by a state government in a nonacademic position, or who are full-time federal government contractors and who are qualified in toxicology or a related field are eligible to be associate members.

Association International de la Savonnerie, de la Detergence et des Produits d'Entretien (AISE)
Square Marie-Louise 49
B-1000 Brussels, Belgium
Phone: 32-3-230-8371
E-mail: a.i.s.e@euronet.be

European association of the cleaning, detergent, maintenance, and soap product industries. Members include national associations of manufacturers in 20 countries and some companies. Concerned with all fields of the manufacture and use of household products, including human and environmental health, and risk assessment. Publishes an annual review and other documents.

Association of Local Air Pollution Control Officials (ALAPCO)
444 N. Capital Street, NW, Suite 307
Washington, DC 20001
Phone: 202-624-7864
Web: http://www.4cleanair.org

Encourages and facilitates communication and cooperation among federal, state, and local regulatory agencies, including issues related to toxic air pollutants. Works closely with state and territorial air pollution program administrators.

Association of Occupational and Environmental Clinics (AOEC)
1010 Vermont Avenue, NW, Suite 513
Washington, DC 20005
Phone: 202-347-4976
Web: http://152.3.65.120/oem/aoec.htm

Established in 1987 to improve the practice of occupational and environmental health through information sharing and collaborative research. Publications include a newsletter.

Association of State and Territorial Health Officials (ASTHO)
1275 K Street, NW, Suite 800
Washington, DC 20005
Phone: 202-371-9090
Web: http://www.astho.org

Provides services and programs to coordinate broad health-related functions and activities at the local community level. Works with other national organizations dealing with health issues, such as the National Association of County and City Health Officials.

Association of University Environmental Health Sciences Centers (AUEHSC)
Dr. William Thilly
MIT
50 Ames St., Bldg. E-18, Room 666
Cambridge, MA 02139
Phone: 617-253-6221

E-mail: thilly@mit.edu
Web: http://www.envmed.rochester.edu/wwwrlp/niehsc

An independent consortium of research institutions supported by grants from the National Institute of Environmental Health Sciences. It serves as a forum for exchange of information, collaboration, and cooperation among the centers.

Association of University Programs in Occupational Health and Safety (AUPOHS)
President
Dr. Monroe Keyserling
IOE Building
1205 Beal Ave.
University of Michigan
Ann Arbor, MI 48109-2117
Phone: 734-763-0563
E-mail: wmkeyser@umich.edu

Founded in 1977, serves universities offering graduate training, research training (doctoral and postdoctoral), and continuing education for occupational health and safety professionals. AUPOHS is a forum for the exchange of information among graduate students in occupational medicine, occupational health nursing, industrial hygiene, and industrial safety engineering. Coordinates activities with the National Institute for Occupational Safety and Health.

Basic Acrylic Monomer Manufacturers Association (BAMM)
1350 Eye Street, NW, Suite 200
Washington, DC 20005
Phone: 202-962-9400

Members include U.S. manufacturers of basic acrylic monomers. Sponsors and publishes research and disseminates health, safety, and environmental information.

British Industrial Biological Research Association (BIBRA)
Woodmansterne Road
Carshalton, Surrey SM5 4DS, United Kingdom
Phone: 44-0-181-652-1000
E-mail: help@bibra.co.uk
Web: http://www.bibra.co.uk

Members include British chemical manufacturers. Activities include development of summaries of data for numerous chemicals and a monthly current awareness journal ''in all areas of chemical toxicology,'' including summaries of key scientific findings and key legislative changes worldwide.

British Rubber Manufacturers' Association (BRMA)
90 Tottenham Ct. Road
London W1P OBR, United Kingdom
Phone: 44-0-171-580-2794

Members include British manufacturers of rubber and polyurethane. Publications include a ''Toxicity and Safe Handling of Rubber Chemicals'' booklet.

Brookhaven National Laboratory (BNL)
P.O. Box 5000
Upton, NY 11973-5000
Phone: 516-344-8000
Web: http://www.bnl.gov/

Brookhaven National Laboratory is operated by Associated Universities, Inc., and provides research directed to risk assessment within the programs of the Environmental & Waste Technology Center (http://www.dne.bnl.gov/ewtc/risk.htm) and environmental health from the Environment, Safety, and Health Program (www.bnl.gov/bnlweb/ESH.html).

Canadian Centre for Occupational Health and Safety (CCOHS)
250 Main Street East
Hamilton, Ontario, Canada, L8N 1H6
Phone: 416-572-2981 or 800-263-8276
E-mail: custserv@ccohs.ca
Web: http://www.ccohs.ca

Covers occupational safety and health information. Publishes a newsletter.

Canadian Network of Toxicology Centres (CNTC)
2nd Floor, Bovey Bldg.
Gordon Street
University of Guelph
Guelph, Ontario N1Q 2W1
Phone: 519-837-3320
E-mail: cntc@upguelph.ca
Web: http://www.uoguelph.ca/cntc/

Goals include promoting communication among CNTC member scientists and the public and to educate Canadians about toxicology.

Center for Environmental Communication Studies (CECS)
University of Cincinnati
P.O. Box 210184
Cincinnati, OH 45221-0184
Phone: 513-556-4001
E-mail: depoe@uc.edu or duffiejj@emial.uc.edu
Web: http://www.uc.edu/cecs/

The goal is to enhance the understanding and quality of communication processes and practices among citizen,

industry, and government participants in environmental and health policy formation and implementation. Publishes a newsletter.

Center for Health, Environment, and Justice (CHEJ)
150 S. Washington, Suite 300
P.O. Box 6806
Falls Church, VA 22040
Phone: 703-237-2249
E-mail: cchw@essential.org
Web: http://www.essential.org/cchw

CHEJ, formerly the Citizens Clearinghouse for Hazardous Waste (CCHW), was founded in 1981 by Lois Gibbs, the leader of the campaign at Love Canal. This national group works with grassroots community groups on a variety of environmental issues such as toxic waste, solid waste, air pollution, incinerators, medical waste, radioactive waste, pesticides, sewage, and indstrial pollution. Publishes two periodicals—*Everyone's Backyard* and *Environmental Health Monthly*.

Center for Science in the Public Interest (CSPI)
1875 Connecticut Avenue, NW, Suite 300
Washington, DC 20009
Phone: 202-332-9110
E-mail: cspi@cspinet.org
Web: http://www.cspinet.org

Group that examines the effects of science and technology on society and policy development. Primary focus relates to food safety and nutrition at the national level. Emphasis is related to testing procedures for food additives, labeling requirements, and advertising practices. Supports a host of educational activities and information programs related to food safety issues. Publications include a newsletter (*Nutrition Action Healthletter*) published 10 times a year.

(U.S.) Centers for Disease Control and Prevention (CDC)
1600 Clifton Road, NE
Atlanta, GA 30333
Phone: 404-639-3311
Web: http://www.cdc.gov

CDC is charged with protecting the public health of the nation through 11 major operating components including those which have specific jurisdiction over matters related to toxicology and environmental and occupational health and medicine: the National Center for Environmental Health (NCEH) and the National Institute for Occupational Safety and Health. Centers with indirect or peripheral jurisdictions include CDC's Epidemiology Program Office, International Health Program Office, National Immunization Program Office, Public Health Practice Program Office, National Center for Prevention Services, National Center for Injury Prevention and Control, National Center for Chronic Disease Prevention and Health Promotion, National Center for Health Statistics. The CDC Childhood Lead Poisoning Prevention Program (http://www.cdc.gov/nceh/programs/lead/lead.htm) is one of several environmental health initiatives of NCEH and a focal point for the topic of lead poisoning. CDC works closely with state and local health departments and environmental agencies to develop comprehensive programs dealing with environmental and occupational health problems, including issues related to environmental, chemical, and radiation emergencies.

Chemical Education Foundation (CEF) [formerly the National Association of Chemical Distributors Educational Foundation (NACDEF)]
1560 Wilson Boulevard, Suite 1250
Arlington, VA 22209
Phone: 730-527-6223
Web: http://www.chemed.org

Dedicated to promoting product stewardship activities and produces a range of materials to help companies meet their commitment to handle chemicals safely throughout a product's life cycle (usage, storage, transportation, disposal, and recycling). CEF also produces materials geared toward communities and the general public. Publishes a quarterly newsletter (*Stewardship News*) and other documents.

Chemical Industry Institute of Toxicology (CIIT)
Six Davis Drive
P.O. Box 12137
Research Triangle Park, NC 27709-2137
Phone: 919-558-1310
E-mail: CIITinfo@ciit.org
Web: http://www.ciit.org

An independent nonprofit toxicology research institute whose members include chemical, pharmaceutical, and other corporations (as of late 1998, 36 member companies and the members of the Chemical Manufacturers Association). Activities include research related to human risk assessments of chemicals, e.g., development and validation of testing methods, development of data used in risk assessments, and the doctoral and postdoctoral training of toxicologists. Publishes a newsletter and other CIIT information-sharing documents, and also publishes its original research in peer-reviewed journals and elsewhere.

Chemical Manufacturers Association (CMA)
1300 Wilson Boulevard
Arlington, VA 22209
Phone: 703-741-5000
Web: http://www.cmahq.com

Members include corporations in the chemical and chemical-using (e.g., consumer product) industries. Activities include human, environmental, risk assessment, and regulatory topics related to chemicals. Holds information-sharing conferences and publishes newsletters and numerous other documents. A ''Publications and Resources Catalog'' updated yearly contains extensive listings, descriptions, and instructions for ordering information on CMA's Responsible Care, emergency planning and emergency response, international regulatory affairs, state chemical associations, compliance assistance, air topics, environmental topics, occupational health and safety, plant operations and process safety, product stewardship, risk science and regulations, etc. Other information includes newsletters, booklets, brochures, forms, guides, reports, manuals, posters, videos, exhibits, and teaching kits, some of which are only available to members of CMA. Also includes information from non-CMA sources. The catalog is available from CMA Publications Fulfillment, 341 Victory Drive, Herndon, VA 20170 (Phone: 703-709-0166).

(U.S.) Chemical Safety and Hazard Investigation Board
2175 K Street N.W.
Washington, DC 20037-1809
Phone: 202-261-7600
E-mail: info@csb.gov
Web: http://www.chemsafety.gov

An independent federal agency whose mission is to provide industries that manufacture, use, or otherwise handle chemicals with information to enable identification and mitigation of operational conditions that compromise safety. It conducts investigations and reports on findings regarding causes of chemical accidents, evaluates and advises Congress on the effectiveness of and any duplication of effort among other federal agencies in preventing industrial accidents, conducts special studies, and develops and communicates recommended actions to improve the safety of operations involved in the production, transportation, industrial handling, use, and disposal of chemicals.

Chemical Specialties Manufacturers Association (CSMA)
1913 Eye Street, NW
Washington, DC 20006
Phone: 202-872-8110
E-mail: info@csma.org
Web: http://www.csma.org

Members include manufacturers, marketers, formulators, and suppliers of household, industrial, and personal care chemical specialty products. Publishes various documents including test methods and standards and compilations of laws and regulations.

Children's Environmental Health Network
5900 Hollis Street, Suite R3
Emeryville, CA 94608
Phone: 510-597-1393
Fax: 510-597-1399
E-mail: cehn@cehn.org
Web: http://www.cehn.org

This organization is a national project providing services, programs, and information resources for the multidisciplinary promotion of an environmental health advocacy campaign dedicated to children from prenatal development to adolescents.

Chlorobenzene Producers Association (CPA)
1100 New York Avenue, NW, Suite 1090
Washington, DC 20005
Phone: 202-414-4160

Members include manufacturers of chlorobenzene. Covers health and environmental effects of chlorobenzene and disseminates information. Affiliated with the Synthetic Organic Chemical Manufacturers Association (SOCMA).

CIS International Occupational Safety and Health Information Centre (ILO-CIS)
CH-1211 Geneva 22, Switzerland
Phone: 41-22-799-6740
E-mail: cis@ilo.org
Web: http://www.ilo.org/public/english/90travai/cis

Part of the United Nations International Labour Organization, CIS provides regulatory, educational, technical, and scientific information on occupational safety and health. CIS also produces the *Safety and Health at Work—ILO-CIS Bulletin.*

Color Pigments Manufacturers Association (CPMA)
P.O.Box 20839
Alexandria, VA 22320
Phone: 703-684-4044
Fax: 703-684-1795

Covers toxicity of inorganic and organic color pigments. Publishes newsletter, bulletins, handbooks, directories, and other documents.

Columbia Environmental Research Center
4200 New Haven Road
Columbia, MO 65201
Phone: 573-875-5399
Fax: 573-875-1896
Web: http://www.cerc.usgs.gov/

A U.S. Geological Survey (USGS) research facility, CERC has a national mission of expertise in toxicology

and chemistry, and a regional mission of ecosystem science for large rivers and other ecosystems in the Central Region of the USGS.

(U.S.) Consumer Product Safety Commission (CPSC)
4330 East–West Highway
Bethesda, MD
Phone: 301-504-0580
E-mail: info@cpsc.gov
Web: http://www.cpsc.gov

CPSC protects the public against risks of injury or harm from consumer products. Education and information programs assist consumers to evaluate the safety of consumer products and reduce the overlapping and often confusing federal, state, and local regulations and guidelines. CPSC research activities relate to the causes and prevention of consumer product-related deaths and injuries. CPSC conducts routine surveillance programs to ensure compliance with safety standards and issues recall notices for defective or potentially hazardous consumer products. CPSC evaluates and develops standards and guidelines for safety issues and regulations for labeling and packaging related to the Poison Prevention Packaging Act and the Federal Hazardous Substances Act. Toxicology-related activities are found primarily in the CPSC divisions for Compliance (Phone: 301-504-0621), Engineering Sciences (Phone: 301-504-0504), Epidemiology and Health Sciences (Phone: 301-504-0957), and the National Injury Information Clearinghouse (Phone: 800-638-2772 or 301-504-0424). The National Injury Information Clearinghouse is a national data collection program that analyzes and evaluates the occurrence of injuries, deaths, and other incidents related to consumer and recreational products. Data are collected from complaints by consumers, coroner's reports, death certificates, newspaper accounts, and hospital emergency room reports; statistical analyses and reports are prepared.

Cosmetic Ingredient Review (CIR)
1101 7th Street, NW, Suite 310
Washington, DC 20036
Phone: 202-331-0651
E-mail: cirinfo@ctfa.org
Web: http://www.ctfa.org

A self-regulatory cosmetic industry organization sponsored by the Cosmetic, Toiletry, and Fragrance Association. The goal is the assurance of the safety of cosmetic ingredients. Publications include final reports on the safety of various cosmetic ingredients and the *Journal of the American College of Toxicology*.

Cosmetic, Toiletry, and Fragrance Association (CTFA)
1101 17th Street, Suite 300
Washington, DC 20036-4702
Phone: 202-331-1969
Web: http://www.ctfa.org

Members include cosmetic, toiletry, and fragrance companies. Covers toxicology, regulatory, and other information. Publishes newsletters and numerous other publications and software.

(U.S.) Council on Environmental Quality (CEQ)
Old Executive Office Building, Room 360
Washington, DC 20502
Phone: 202-456-6224
Web: http://www.whitehouse.gov/CEQ

The Council on Environmental Quality (CEQ) was established under authorization of the National Environmental Policy Act of 1969. CEQ develops and recommends to the President national policies to ensure the quality of the environment and to develop strategies to further environmental quality. CEQ continually analyzes changes and trends in the environment. CEQ reviews and evaluates federal government programs to determine their impact to environmental quality. CEQ assists the President in preparation of Environmental Quality, Annual Report to Congress. Environmental Quality presents extensive tabulated trends data, including subjects and topics related to toxicology and environmental health. CEQ is also responsible for overseeing the implementation of the National Environmental Policy Act (NEPA).

Counseling and Advice on Reproductive Exposures (CARE Northwest)
P.O. Box 357920
CHDD
Seattle, WA 98195-7290
Phone: 206-543-2465
E-mail: brbrown@u.washington.edu

Counseling and Advice on Reproductive Exposures is a nonprofit telephone consultation service located at the University of Washington providing information on the effects of environmental agents in pregnancy and lactation and dedicated to the prevention of birth defects resulting from environmental exposures. Target response groups are health care professionals and the public in the northwest United States. Affiliated with the University of Washington's Center for Human Development and Disability.

(U.S.) Department of Agriculture (USDA) (see also National Agricultural Library)
14th Street and Independence Avenue, SW
Washington, DC 20250
Phone: 202-720-2791
Web: http://www.usda.gov

The Department of Agriculture is a very large and diverse agency involved with a myriad of toxicology and environmental health activities. Major USDA programs include oversight and research in areas related to food safety and inspection, animal health and inspection, food poisoning, and food quality. CDC also supports research for veterinary medicine, including use of drugs and pharmaceuticals by food-producing animals and residue analyses of edible products, such as meats, poultry, and dairy products. Specific USDA programs studies and monitors toxicological properties of mycotoxins and other naturally occurring toxins and poisonous forage plants. Other USDA programs provide extensive research related to the monitoring, use, and control of pesticides include toxicology and health analyses to target and nontarget species, and health effects to pesticide applicators. The National Agricultural Library is the largest comprehensive agricultural information program in the world. Additional USDA information services and support are provided by the USDA's national network of county cooperative extension bureaus (easily located in the county government section of standard telephone directories or from public libraries). These programs are administrated through more than 630 individual state land-grant universities, veterinary colleges, and other college and university programs and state and county agencies. These cooperative extension services serve as the critical link between the USDA and agricultural professionals and individuals or community and neighborhood groups, and provide information related to efficacy and impacts of pesticides and other agricultural chemicals. These programs can be located at the USDA's Cooperative State Research, Education, and Extension Service Web site, http://www.reeusda.gov.

(U.S.) Department of Defense (DoD)
The Pentagon
Washington, DC 20301-1155
Phone: 703-545-6700
Web: http://www.defense

The Department of Defense (DoD) integrates environmental safety, occupational health and medicine, forensic and pathological services, and other toxicology-related aspects of chemical and biological warfare, chemical and toxic waste cleanup at DoD bases and facilities, and other health and safety issues related to exposure of military personnel to chemicals and biological agents. The Strategic Environmental Research and Development Program (SERDP) (http://www.nttc.edu/env/dod_serdp.html) identifies, develops, and transitions environmental technologies that relate directly to defense mission accomplishment. The Defense Technical Information Center (DTIC) (http://www.dtic.mil) is the central DoD facility providing access to and facilitating the exchange of scientific and technical information. DTIC offers a wide variety of products and services. DTIC is part of the Defense Information Systems Agency (DISA) (http://www.disa.mil/disahomejs.html). The Chemical and Biological Information Analysis Center (CBIAC) (http://www.cbiac.apgea.army.mil/), serves as the DoD focal point for information related to chemical warfare/chemical and biological defense (CW/CBD) technology. The Department of Veterans Affairs (http://www.va.gov/) provides additional coverage to environmental health issues, including those of Persion Gulf War veterans, and veterans exposed to Agent Orange.

(U.S.) Department of Energy (DOE)
Forrestal Building
1000 Independence Avenue, SW
Washington, DC 20585
Phone: 202-252-5000
Web: http://www.doe.gov

The Department of Energy works with other federal agencies, industries, and the public on issues related to providing delivery of energy resources. DOE maintains extensive programs related to environmental and health issues. DOE's Environmental Management Program focuses on activities for the assessment of impacts and cleanup of chemical, radioactive, and mixed wastes at DOE research facilities. The Office of Energy Research (OER) manages DOE's basic and applied research programs including those related to biological and environmental research. OER oversees activities of the five DOE-sponsored multiprogram National Laboratories (see individual listings). DOE toxicology research is conducted through OER's Office of Health and Environmental Research, including DOE's support of the Human Genome Project. DOE's Office of Scientific and Technical Information (OSTI, P.O. Box 62, Oak Ridge, TN 37831; phone: 423-576-1323; Web: http://www.doe.gov/osti) serves as the central repository for energy-related information resources from DOE-sponsored programs, the open literature, and from the 14 member nations of the Energy Technology Data Exchange (ETDE). These information resources comprise the DOE Energy Science and Technology Database, portions of whch are available from several publicly available sites, such as the DOE Information Bridge and the DOE Energy Files, a virtual Library of Energy Science and Technology. The DOE OpenNet initiative provides access to more than 275,000 declassified documents on DOE research, including that dealing with human radiation experiments during and

after the development of atomic weapons by the Manhattan Project.

(U.S.) Department of Health and Human Services (DHHS) (also see other DDHS listings)
200 Independence Avenue, SW
Washington, DC 20201
Phone: 202-619-0257
Web: http://www.dhhs.gov

Created as the Department of Health, Education, and Welfare in 1953 and reorganized in 1980, DHHS carries out programs related to the health, welfare, and income security plans and programs. Among DHHS programs are activities to promote the general public health and advance the understanding through many toxicology and environmental health operating divisions, including the Office of Public Health and Science, the Agency for Toxic Substances and Disease Registry, the Centers for Disease Control and Prevention, and the National Institutes of Health.

(U.S.) Department of Housing and Urban Development (HUD), Office of Lead Hazard Control
451 7th Street, SW, Room B-133
Washington, DC 20410
Phone: 202-755-1785
Fax: 202-755-1000
Web: http://www.hud.gov:80/lea/

The Office of Lead Hazard Control evaluates and reviews the scientific and medical information related to lead exposure and assists in the development of policy development, abatement and treatment programs, regulations, research, and training. Activities include community outreach and education among the building and construction industries, the public, state and local agencies. General, consumer information resources available to warn individuals about the dangers and risks associated with exposure to lead-based paints and other sources. Public education information includes resources about detecting lead, reducing exposure, and cleaning up contaminated sites and areas is provided in reports, brochures, pamphlets, and information flyers (English and Spanish versions).

(U.S.) Department of Interior
1849 C Street, NW
Washington, DC 20240
Phone: 202-208-3171
Web: http://www.doi.gov

The Department of Interior is responsible for the protection of the nation's natural resources, including the effects of chemicals and toxic threats to plants and animals. The Fish and Wildlife Service (FWS) (http://www.fws.gov) is responsible for the conservation and protection of fish and wildlife and their respective habitats, including the effects of pesticides, chemical contaminant, and other toxic threats to these resources. The U.S. Geological Survey (USGS) (http://www.usgs.gov) provides comprehensive geographic and cartographic services, including the production of resources and delivery of services to analyze chemicals in the environment, groundwater and aquifer protection, the movement of chemical contaminants through waters and soils. The USGS works closely with other federal programs, such as ATSDR, DOE, and EPA, to monitor and analyze health effects data related to Superfund sites. The Biological Resources Division (http://www.nbs.gov) supports a large number of ecotoxicology. The development of the National Biological Information Infrastructure (formerly the National Biological Survey) is a major activity. The Fish and Wildlife Morbidity Information Survey is a work in progress by the National Wildlife Health Center (http://www.emtc.usgs.gov/nwhchome.html).

(U.S.) Department of Transportation
400 7th Street, SW
Washington, DC 20590
Phone: 202-366-4000
Web: http://www.dot.gov

The DOT coordinates all federal transportation programs, including those ensuring the safety and health of persons using or impacted by transporation systems. These activities have DOT coordinating policies and practices impacting on environmental quality, such as regulating the transport of hazardous materials, including classes of toxic materials (49 CFR 171-179). DOT also participated in emergency response activities, publishing the Emergency Response Guidebook. The U.S. Coast Guard's Marine Safety and Environmental Protection Program (http://www.uscg.mil/hq/g-m/gmhome.htm) oversees public health aspects of transportation issues for the marine environment. The National Response Center (http://www.nrc.uscg.mil/) is the sole federal point of contact for reporting oil and chemical spills. The Coast Guard maintains the Chemical Hazards Response Information System (CHRIS) (http://www.uscg.mil/hq/g%2Dm/mor/articles/chris.htm), providing nomenclature, chemical and physical properties, fire hazard, and biological effects data on more than 1200 chemicals. The DOT Office of Hazardous Materials Safety (http://hazmat.dot.gov/) is the national focal point for DOT's hazardous materials regulatory program.

Doris Day Animal League
227 Massachusetts Avenue, NE, Suite 100
Washington, DC 20002

Phone: 202-546-1761
E-mail: ddal@aol.com
Web: http://www.ddal.org

One of the largest animal rights organizations in the U.S. ''Works to protect animals and the people who love them.'' Gathers and disseminates information on animal testing intended to improve federal and state legislation and regulations. Publishes a quarterly magazine.

Ecological and Toxicological Association of the Dyes and Organic Pigments Manufacturers Industry (ETAD) (formerly the Ecological and Toxicological Association of the Dyestuffs Manufacturing Industry)
Clarastrasse 4
CH-4005 Basel 5, Switzerland
Phone: 41-61-6909966

Members include companies in 12 countries that manufacture synthetic organic dyestuffs and pigments. Affiliated with the Synthetic Organic Chemical Manufacturers Association. Activities include studies of the toxicology of dyestuffs and pigments.

Entomological Society of America (ESA)
9301 Annapolis Road
Lanham, MD 20706-3115
Phone: 301-731-4535
Web: http://www.entsoc.inter.net

Members include entomologists and others. One of several sections is on biochemistry and toxicology. Publications include two journals, a newsletter, and other documents.

Environmental Carcinogenesis Information Center (ECIC)

[see Oak Ridge National Laboratory, Environmental Carcinogenesis Information Center (ECIC)]

Environmental Defense Fund (EDF)
257 Park Avenue South
New York, NY 10010
Phone: 800-684-3322
E-mail: EDF@edf.org
Web: http://www.edf.org

EDF covers a broad range of regional, national, and environmental issues. It is dedicated to protecting the environmental rights (e.g., clean air and water, healthy, nourishing food, and a flourishing ecosystem) of all people. Produces the Chemical Scorecard program (http://www.scorecard.org).

Environmental Health Center (EHC)
National Safety Council
1025 Connecticut Avenue, NW, Suite 200
Washington, DC 20036
Phone: 202-293-2270 or 800-424-5323
Web: http://www.nsc.org/ehc

The Environmental Health Center is a division of the National Safety Council (see separate listing) and provides information and services related to the human health aspects of chemicals in the environment. EHC specifically manages the National Lead Information Center.

Environmental Law Institute (ELI)
1616 P. Street, NW, Suite 200
Washington, DC 20036
Phone: 202-939-3800
Web: http://www.eli.org

Played a pivotal role in shaping the fields of environmental law, policy, and management within the U.S. and abroad. ELI is an internationally recognized, not-for-profit, research and education center. It provides training courses and seminars, research programs, and policy recommendations.

Environmental Mutagen Society (EMS)
Elizabeth S. Von Halle
Membership Director
113 Wendover Circle
Oak Ridge, TN 37830-8239
Phone: 615-483-5805
Fax: 615-574-9888
E-mail: vonhalle@icx.net
Web: http://www.ems-us.org

The EMS was founded by the late Dr. Alexander Hollaender, who was also the director of the Biology Division of Oak Ridge National Laboratory for its first 20 years. The EMS has been the primary scientific society that has fostered research on the basic mechanisms of mutagenesis as well as on the application of this knowledge in the field of genetic toxicology. The EMS has grown to over 1100 members, of whom more than 200 are from outside the United States, It is affiliated with the International Association of Environmental Mutagen Societies (IAEMS), which has about 2500 members from over 50 countries. The membership is composed of a unique mix of academic, government, and industrial scientists and policy makers. In addition, the EMS publishes the highly regarded journal *Environmental and Molecular Mutagenesis*.

Environmental & Occupational Health Sciences Institute (EOHSI)
681 Frelinghusen Road
Piscataway, NJ 08855

Phone: 908-445-0110
Web: http://eohsi.rutgers.edu

Develops environmental and occupational health education materials for schools, the workplace, and community, including videos and teaching guides, fact sheets, and newsletters.

(U.S.) Environmental Protection Agency (EPA)
401 M Street, SW, Waterside Mall
Washington, DC 20460
Phone: 202-260-2090
Web: http://www.epa.gov

The Environmental Protection Agency (EPA) coordinates environmental activities for the federal government. EPA is the primary agency for identifying and controlling threats to the environment, establishing and enforcing regulations, guidelines, and standards. EPA activities are coordinated with other federal agencies and with agencies from state, county and other local agencies, departments and bureaus. EPA's toxicology research, monitoring, risk assessment, policy, and related activities are directed from many agency program areas, including, but not limited to the Office of Air and Radiation; Office of Water; the Office of Solid Wastes and Emergency Response, the Office of Pollution Prevention and Toxics (OPPT), and the Office of Research and Development (ORD). ORD maintains the National Health and Environmental Effects Research Laboratory, the National Exposure Research Laboratory, and the Office of Health and Environmental Assessment (including the Human Health Assessment Group and the National Center for Environmental Assessment). EPA maintains ten regional offices. The EPA Library Network is a coordinated network of information resource centers (formerly called libraries) facilitates access to its own collections of books, reports, journals, and other information resources through its Online Library System. The EPA Information Resources Centers also assist in maintaining special clearinghouses, information dockets, hotlines, and the weekly e-mail service, Internet Newsbrief (InternetNB@epamail.epa.gov). Specialized toxicology collections are located in the OPPT Library (which produces the daily e-mail service, OPPT Newsbreak [http://www.epa.gov/opptintr/oppt_nb.txt]); the Office of Quality, Planning, and Standards Library; the Andrew W. Breidenback Environmental Research Library (which houses the Jerry Starra collection on risk assessment), and the National Health and Environmental Effects Research Laboratory Library. The U.S. National Focal Point for the United Nations Environment Programme's INFORTERRA is located in the EPA Headquarters Information Resources Center. The EPA Center for Environmental Information and Statistics (http://www.epa.gov/ceis) was created in 1998 to facilitate community outreach and information access to EPA data and information resources, including the EPA's Toxic Release Inventory.

Environmental Safety (ES)
c/o Bill Drayton
1700 N. More Street, Suite 1920
Arlington, VA 22209
Phone: 703-527-8300
E-mail: wdrayton@arhoka.org

ES is an advisory committee of former U.S. EPA officials, lawyers, public health officials, and environmental specialists. The primary goal is to ensure that U.S. EPA and other federal agencies take active steps toward implementing their environmental protection responsibilities. Collects and disseminates information and works with states to develop and test alternative approaches to implementing environmental laws.

Ernest Orlando Lawrence Berkeley National Laboratory (LBL)
1 Cyclotron Road
Berkeley, CA 94720
Phone: 510-486-4000
Web: http://www.lbl.gov

This U.S. Department of Energy (DOE) funded research facility supports toxicology and environmental health research within programs directed to carcinogenic potency and cancer risk assessment, environmental health and safety. LBL supports the Comprehensive Epidemiological Data Resource (CEDR) project (http://cedr.lbl.gov/), providing public access to health and exposure data concerning DOE facilities and the ongoing DOE Worker Health and Mortality Study.

European Association of Poisons Centres and Clinical Toxicologists (EAPCCT)
c/o Dr. J. Meulenbelt, General-Secretary
National Poisons Control Centre
National Institute of Public Health and the Environment
P.O. Box 1, 3720 BA Bilthruen
The Netherlands
Phone: 31-30-2508561
Web: http://www.eapcct.org

Members include clinical toxicologists and others. The purpose is to improve interactions between clinical toxicologists and poison information specialists. Publishes a newsletter and the (*Journal of Toxicology: Clinical Toxicology*).

European Centre for Ecotoxicology and Toxicology of Chemicals (ECETOC)
Ave. Van Nieuwenhuyse, 4, Bte 6
B-1160 Brussels, Belgium
Phone: 32-2-6753600
E-mail: francis.carpanini@ecetoc.org

Members are individuals and companies in 13 countries from the chemical industry. Collects and disseminates toxicology information relevant to the manufacture, processing, handling, and use of chemicals. It also cooperates with governmental, health, and public bodies concerned with chemicals and their effects on health and the environment. Organizes literature studies and testing programs, and publishes a monthly information sheet.

European Centre for the Validation of Alternative Methods (ECVAM)
TP 580, JRC Environment Institute
21020 Ispra (VA), Italy
Web: http://www.ei.jrc.it/

The main goal is to promote the scientific and regulatory acceptance of alternative methods which are of importance to the biosciences and which reduce, refine, or replace the use of laboratory animals. Interacts with other organizations, sponsors workshops, and publishes documents (e.g., *Current Status and Future Developments of Databases on Alternative Methods*). See the report and recommendations of ECVAM Workshop 25. *ATLA* (*Alternatives to Laboratory Animals*) **25,** 411–422, 1997.

European Chemical Industry Council (CEFIC)
4, ave. E. Van Nieuwenhuyse, bte. 2
B-1160 Brussels, Belgium
Phone: 32-2-6767211
Web: http://www.cefic.be

Members are chemical federations and manufacturers. Represents the chemical industry in Europe, including safety issues, and has numerous working groups on chemicals. Publications include a newsletter and other documents.

European Chemicals Bureau (ECB)
Environment Institute
Joint Research Center
Via Fermi, 1
I-21020 Ispra (VA) Italy
Phone: 39-0332-789893
Fax: 39-0332-785409
Web: http://ecb.ei.jrc.it

Carries out and coordinates the scientific/technical work needed for the implementation of European Union (EU) legislation (directives and regulations) in the area of chemical control. The ECB plays an important role in the assessment, management, and control of risks which may be posed by existing and new chemical substances circulating withing the EU. Major work areas include classification and labeling of dangerous substances, new chemicals—Notification of new substances, testing methods, existing chemicals, and export/import.

European Commission (EC)
rue de la Loi
200 B-1049 Brussels, Belgium
Phone: 32-2-299-1111
Web: http://europa.eu.int

U.S. Contact: European Commission Public Inquiries, 2100 M Street, NW, Washington, DC 20037
Phone: 202-862-9500

Since the Seveso accident in northern Italy in 1977 contaminated a large area with a highly toxic dioxin, increasingly stringent measures have been taken by the European Commission to reduce the risks arising from the manufacture and disposal of chemical substances. Begun in 1986, the European Inventory of Existing Chemical Substances (EINECS) has similar objectives to those of the Toxic Substances Control Act (TSCA) of the United States. EINECS lists all marketed chemical products in the EU, enabling them to be subject to a general procedure for notification, evaluation, and control. The European Commission also maintains the Environmental Chemicals Data and Information Network (ECDIN) databank (http://ecdin.etomep.net). Searchable by chemical name of CAS number, ECDIN ''is designed as an instrument which will enable people engaged in environmental management and research to obtain reliable information on chemical products.''

European Environmental Mutagen Society (EEMS)
c/o Nina Ostenfeldt, Secretary
Genetic and Reproduction Toxicology
H. Lundbeck A/S
Ottiliavej 9
2500 Valby, Copenhagen, Denmark
Phone: 61-175936
E-mail: nos@lundbeck.com
Web: http://193.51.164.11/eems/index.htm

Members include industry and university laboratories and research centers. Promotes research in genetic toxicology and environmental mutagenesis. Affiliated with the Environmental Mutagen Society and International Association of Environmental Mutagen Societies. Publishes a newsletter and other documents.

European Science Foundation (ESF)
1, quai Lezay-Marnesia
F-67080 Strasbourg Cedex, France
Phone: 33-(0)-3-88-76 71 25
E-mail: communications@esf.org
Web: http://www.esf.org

Includes academies and research councils in 20 countries. Among its activities is sponsorship of a fellowship program in toxicology. Publishes a newsletter and other documents.

European Technical Committee for Fluorine (CTEF)
c/o CEFIC
4, ave. E. Van Nieuwenhuyse, bte. 2
B-1160 Brussels, Belgium
Phone: 2-6767240

A part of the European Chemical Industry Council (CEFIC). Members are interested in the safe transport, handling, and toxicology of fluorine and its derivatives.

EUROTOX (Association of European Toxicologists & European Societies of Toxicology)
c/o Prof. E. Hietanen
Department of Clinical Physiology
University of Turku Hospital
Turku, FIN20520, Finland
Phone: 358-2-261-2664
E-mail: eino.hietanen@utu.fi
Web: http://www.uta.fi/eurotox

Members include industry, university, and government toxicologists in 50 countries (about 6000 members, mostly from Western Europe) and 25 national societies (almost all the national societies of toxicology in Europe). The purpose is to encourage and advance research on drug toxicity and other areas of toxicology, including various kinds of toxic effects and testing methods. EUROTOX also seeks to foster toxicology educationally via meetings, symposia, workshops, working groups, and publications, including a newsletter and journal (*Archives of Toxicology*). Affiliated with the Society of Toxicology.

EXtension TOXicology NETwork (EXTOXNET)
Web: http://ace.orst.edu/info/extoxnet

Cooperative effort among various universities (University of California at Davis, Oregon State University, Michigan State University, and Cornell University) to stimulate dialog on toxicology issues and to make toxicology information available. WWW home page includes access to newsletter issues, fact sheets, and chemical profiles, and the entire EXTOXNET content is searchable by keywords or partial words.

(U.S.) Federal Bureau of Investigation (FBI), Cooperative Law Enforcement Services
FBI Laboratory Division
Forensic Science Research and Training Center
10th Street and Pennsylvania Avenue, NW
Washington, DC 20535
Phone: 202-324-3444 or 202-324-3691
Web: http://www.fbi.gov

Provides forensic training to FBI, Drug Enforcement Agency, and other law enforcement personnel with regard to biochemistry, genetics, chemistry, and physics. The Chemistry–Toxicology Unit (phone: 202-324-3000) of the FBI laboratory performs toxicological analyses of evidence found at crime scenes to determine the identity and quantity of toxic chemicals or other exogenous agents in body fluids and organs and food or water.

(U.S.) Federal Emergency Management Agency (FEMA)
500 C Street, SW
Washington, DC 20472
Phone: 202-646-4600
Web: http://www.fema.gov

FEMA serves as a central point of contact for federal agencies, Congress, and the public for all aspects of preparedness, mitigation, and response activities in response to natural disasters and other emergencies. FEMA develops comprehensive plans and policies related to hazard mitigation. The FEMA Response and Recovery Program administers the national disaster relief program, which includes disaster- and emergency-response research, local evacuations, temporary housing, and financial assistance in the event of natural disasters or other national emergency situations. FEMA is responsible for the coordination of emergency response and preparedness at federal, state, and local levels and includes the National Emergency Coordination Center, the Emergency Management Institutes (16825 S. Seton Avenue, Emmitsburg, MD 21727; phone: 301-447-1286) education and training activities, and the National Fire Academy (phone: 301-447-1117) for training fire officials and related professionals in prevention and management strategies, including those related to chemical and other toxic emergencies.

Federation of American Societies for Experimental Biology (FASEB)
9650 Rockville Pike
Bethesda, MD 20814
Phone: 301-530-7000
Web: http://www.faseb.org

Provides logistical support for programs of independent member societies by dissemination of information on biological research through scientific publications and conferences. Among the member societies are the American Physiological Society, American Society for Biochemistry and Molecular Biology, American Society for Pharmacology and Experimental Therapeutics, American Society for Investigative Pathology, and the American Society for Cell Biology.

Flavor and Extract Manufacturers Association of the United States (FEMA)
1620 I Street, NW, Suite 925
Washington, DC 20006
Phone: 202-293-5800
Web: available to FEMA members by subscription

Members include companies manufacturing and selling food flavors and extracts. Publishes an update on regulatory and legislative issues of interest to the flavor industry.

Food and Agriculture Organization of the United Nations (FAO)
Viale delle Terme di Caracalla
00100 Rome, Italy
Phone: 39-6-52251
Web: http://www.fao.org

Founded in 1945, FAO of the United Nations is mandated to raise nutritional standards, improve food and agricultural production, and better the condition of rural populations. FAO also undertakes reviews of hazards of food and food additives. A specific priority of FAO is to promote sustainable agriculture and rural development through programs that do not harm the environment.

(U.S.) Food and Drug Administration (FDA) (also see other FDA listings)
5600 Fishers Lane
Rockville, MD 20857
Phone: 301-443-1544
Web: http://www.fda.gov

The first designation of the FDA name was provided by the 1931 Agriculture Appropriations Act. However, many functions of the department had been implemented throughout the Food and Drug Act of 1906. FDA's mission is to develop and implement programs and activities for protecting the health of the nation against unsafe and impure food, pharmaceuticals and drugs, cosmetics, and other potential chemical hazards. Major FDA programs are administered through the Office of Operations. Center for Drug Evaluation and Research develops policies associated with the safety, effectiveness, and labeling of all drug products, including research related to standards on the composition, quality, safety, and effectiveness of drugs. Data and information on unintentional poisonings and toxicity information related to household products and medicines are facilitated through this center. The Center for Biologics Evaluation and Research regulates biological product controls (e.g., vaccines and diagnostic tests), including the development and monitoring of standards and operating procedures for biological products. Search activities include testing for safety, purity, efficacy, and related parameters for biological products. The Center for Food Safety and Applied Nutrition conducts research and develops standards related to the quality and safety of food, food additives, cosmetics, and colors, including environmental aspects of chemical effects and impacts of food additives. The Center for Veterinary Medicine develops and implements programs related to the safety aspects of veterinary drugs and other aspects of veterinary medicine. The Center for Devices and Radiological Health develops and implements programs to control unnecessary exposure to and ensure the safety of ionizing and nonionizing radiation, develops standards related to the labeling of medical devices for human use and establishment of performance standards and protocols for use of radiological devices, and works with state and local agencies for the safe use of radiation and radiological devices. The National Center for Toxicological Research (http://www/nctr.fda.gov) conducts peer-reviewed scientific research supporting FDA regulatory requirements and needs. Research activities involve fundamental and applied research specifically designed to define biological mechanisms of action underlying the toxicity of products regulated by the FDA.

(U.S.) Food and Drug Administration (FDA), National Center for Toxicological Research (NCTR)
3900 NCTR Road
Jefferson, AR 72079
Web: http://www.fda.gov/nctr

NCTR is a research arm of the FDA. The mission of NCTR is to conduct peer-reviewed scientific research that supports and anticipates the FDA's current and future regulatory needs. This involves fundamental and applied research specifically designed to define biological mechanisms of action underlying the toxicity of products regulated by the FDA. This research is aimed at understanding critical biological events in the expression of toxicity and at developing methods to improve assessment of human exposure, susceptibility, and risk. Scientific goals of NCTR include the de-

velopment of expert knowledge bases to develop predictive tools to support regulatory decision making, developing new strategies for the prediction of toxic effects, and conducting method-, agent-, or concept-driven analytical techniques and data collections to assist national regulatory needs. Specific toxicologic research is directed to expand our understanding of risk assessments of toxic chemicals, identify biochemical markers associated with carcinogenesis, and to further understand reproductive and developmental effects of toxic chemicals. Among the NCTR programs is the Interdisciplinary Toxicology Program (INTOX), an academic program conducted in conjunction with the University of Arkansas for Medical Sciences in which degreed students receive training in toxicology and related disciplines and conduct original research at NCTR facilities to fulfill PhD requirements.

(U.S.) Food and Drug Administration (FDA), Sea Food Products Research Center
22201 23rd Drive, SE
P.O. Box 3012
Bothell, WA 98041-3012
Phone: 206-486-8788
Web: http://vm.cfsan.fda.gov/~frf/sprcpubl.html

Basic research activities focus on the chemical and microbial indicators of the decomposition of seafood products, including the study of marine toxins and the development of analytical procedures to determine the presence of microorganisms (viruses, bacteria, and parasites). Also develops biochemical markers for determination of toxic contamination of seafood products.

(The) Food and Drug Law Institute (FDLI)
1000 Vermont Avenue, NW, Suite 1200
Washington, DC 20005
Phone: 202-371-1420
E-mail: comments@fdli.org
Web: http://www.fdli.org

Nonprofit, educational foundation whose mission is to increase knowledge of the laws, regulations, and policies pertaining to foods, human and animal drugs, medical devices, biological products, radiation-emitting products, and cosmetics. Publishes a newsletter.

Friends of the Earth (FOE)
1025 Vermont Avenue, NW, Ste 300
Washington, DC 20005
Phone: 202-783-7400
Fax: 202-783-0444
E-mail: foe@foe.org
Web: http://www.foe.org

An international environmental advocacy group with international affiliates worldwide. Topics addressed include toxic chemicals, nuclear hazards, groundwater contamination, pesticides, environmental policy development. Publishes Friends of the Earth Newsmagazine and reports.

Freshwater Society
Gray Freshwater Center
2500 Shadywood Road
Excelsior, MN 55331
Phone: 612-471-9773
E-mail: freshwater@freshwater.org
Web: http://www.freshwater.org

Public, nonprofit foundation whose mission is to pursue the sustainable use of freshwater resources through education, conferences, publications, and research. Publishes a newsletter containing information about the relationship between human health and environmental problems and contaminants.

Fund for the Replacement of Animals in Medical Experiments (FRAME)
Russell & Burch House
96-98 North Sherwood Street
Nottingham NG1 4EE, UK
Phone: 44-0115-958-4740
E-mail: frame@frame–uk.demon.co.uk.
Web: http://www.frame-uk.demon.co.uk

As noted in a FRAME publication (Fentem, J., and Balls, M, *In vitro* alternatives to toxicity testing in animals, *Chem. Ind.* **6,** 207–211, 1992), ''FRAME is working towards a future in which the integrated use of computers to model structure–activity relationships and biochemical, physiological, and toxicological processes, and *in vitro* tests using human cells will be used to assess human risk directly, without recourse to any animal testing of chemicals.'' Activities include support of research, cooperation with other organizations and publications, and publication of ATLA journal (see ATLA) and *FRAME News* (newsletter).

Genetic Toxicology Association (GTA)
David Mallon
Membership Chair
395 N. Little Tor Road
New York, NY 10956
Phone: 201-573-6391
Fax: 201-573-6046
E-mail: dave.mallon@reckitt.com
Web: http://www.ems-us.org/gta

The GTA is a tax-exempt educational and scientific organization that was founded in 1975 and incorporated in 1981 under the laws of the state of Delaware.

Its primary purpose is to promote the development of the science of genetic toxicology and to foster the exchange and dissemination of information concerning the field. Membership in the GTA is open to anyone interested in genetic toxicology. The majority of members are from the mid-Atlantic and New England regions of the United States, although members from all geographic areas are welcome. Because of the geographic concentration of the majority of its members, the GTA includes professionals from a diverse cross section of organizations: industrial, academic, governmental, and commercial. The GTA thus provides a unique and important opportunity for scientists from different types of organizations to routinely and openly exchange knowledge, ideas, views, and insights.

Global Crop Protection Federation (GCPF)
Avenue Louise 143
B 1050 Brussels, Belgium
Phone: 32-2-542-04-10
E-mail: info@gcpf.org
Web: http://www.gcpf.org

Members include American Crop Protection Association and other national associations comprising more than 950 companies producing insecticides, fungicides, and herbicides in 52 countries. Encourages cooperation among regulatory agencies, seeks to educate the public, provides a forum for exchange of toxicology and other information, acts as a liaison between member associations, etc. Publications include a newsletter and other documents.

Government Institutes
(An ABS Group Company)
4 Research Place, Suite 200
Rockville, MD 20850-3226
Phone: 301-921-2323 (publications and products); 301-921-2300 (main, general number)
Fax: 301-921-0264
E-mail: giinfo@govisnt.com
Web: http://www.govinst.com

A major publisher and distributor of environmental, health, and safety information. Publishes numerous reference, desk, and textbooks and electronic databases. Is a leading source for regulatory and compliance training related to toxicology and environmental and occupational health.

Green Chemistry Institute (GCI)
1650 Research Boulevard
Rockville, MD 20850
Phone: 301-294-2854
E-mail: breenj1@westat.com
Web: http://www.epa.gov/greenchemistry/gcinst.htm

Not-for-profit organization whose mission is to promote and foster green chemistry through information dissemination, chemical research, and conferences and symposia. Establishes industry–government partnerships with universities and national laboratories to prevent pollution using economically sustainable production technologies. GCIs newsletter is published quarterly and is available via the Web home page.

Greenpeace
1436 U Street, NW
Washington, DC 20009
Phone: 202-462-1177
Web: http://www.greenpeace.org

Leading international environmental advocacy organizations dedicated to preserving the quality of the environment through nonviolent direct action, education, and research. Air, water, soil, and nuclear pollution; toxic substances; and environmental health are among the issues addressed by Greenpeace. Publishes the Greenpeace Quarterly.

Harvard Center for Risk Analysis (HCRA)
718 Huntington Avenue
Boston, MA 02115
Phone: 617-432-4497
Fax: 617-432-0190
E-mail: epatters@sph.harvard.edu
Web: http://www.hsph.harvard.edu/organizations/hcra/hcra.html

Offers a graduate school program and publishes a newsletter and other documents, including research findings from HCRA. Newsletter contains exposure and risk assessment articles, commentaries, meetings, publications, etc.

Harvard Environmental Law Society (ELS)
Harvard Law School
Austin 201
Cambridge, MA 02138
Phone: 617-495-3125
Web: http://www.law.harvard.edu/studorgs/els

Members include Harvard law students interested in protecting the environment through legal research and educational programs. Research projects include ones on toxic wastes. Also provides advice, research, and other assistance to organizations with litigation and the drafting of legislation.

Hazardous Substance Management Research Council (HSMRC)
New Jersey Institute of Technology

138 Warren Street
Newark, NJ 07102
Phone: 201-596-3233
Web: http://www.hsmrc.njit.edu

Supported by the National Science Foundation's Industry and the (New Jersey) University Cooperative Research Consortium, this program provides research and analytical services related to hazardous and toxic substances, especially pertaining to incineration, biological and chemical treatment, and field monitoring and assessment strategies. Interests also include hazardous waste site assessment and remediation research, health effects assessment, and public policy and education. Provides short courses and training.

Hazardous Substance Research Centers (HSRC)
Dr. Dale Manty, Program Director
U.S. EPA (8703)
401 M Street SW
Washington, DC 20460
Phone: 202-564-6922
E-mail: manty.dale@epamail.epa.gov
Web: http://www.hsrc.org

A national organization that carries out an active program of basic and applied research, technology transfer, and training. Activities are conducted regionally by five multi-university centers, which focus on different aspects of hazardous substance management. Supported by the EPA, Department of Energy, Department of Defense, academia, industry and other government bodies.

Health Effects Institute (HEI)
955 Massachusetts Avenue
Cambridge, MA 02139
Phone: 617-876-6700
E-mail: facts@healtheffects.org
Web: http://healtheffects.org

The Health Effects Institute was chartered in 1980 as an independent, nonprofit corporation to provide high-quality, impartial, and relevant science on the health effects of pollutants from motor vehicles and from other sources in the environment. Supported jointly by the U.S. EPA and industry, HEI has funded 160 studies and published almost 100 research reports, producing important research findings on the health effects of a variety of pollutants, including carbon monoxide, methanol and aldehydes, nitrogen oxides, diesel exhaust, ozone, and, recently, particulate air pollution. HEI has also been called on periodically to produce special reports reviewing an entire area of scientific literature on topics such as the health effects of asbestos, diesel exhaust, and oxygenates in fuel. To accomplish its mission, HEI identifies the highest priority areas for health effects research; funds and oversees the conduct of high-quality research in these priority areas; provides intensive, independent review of HEI-supported and related research; integrates HEI's research results with those of other institutions into coherent, broader evaluations of health effects; and communicates the results of HEI research and analyses to public and private decision makers. HEI's scientific work is overseen by two independent scientific committees. The Health Research Committee works with the institute's scientific staff to develop and manage HEI's research program, and the Health Review Committee, which has no role in selecting or overseeing studies, works with the institute's scientific staff to evaluate and interpret the results of HEI studies and related research. Publications also include a newsletter.

Human Ecology Action League (HEAL)
P.O. Box 29629
Atlanta, GA 30359
Phone: 404-248-1898
E-mail: HEALatnl@aol.com

HEAL was established in 1977 by individuals and organizations interested in the study of human ecology and multiple chemical sensitivities. Collects and disseminate information on human ecology and ecological illness to persons suffering from such illness and to government agencies, scientists, and health care professionals. A goal is to raise public awareness about potential dangers from substances in the environment. Publishes various documents, including a newsletter (*Chemicals and Health*) and journal (*Human Ecologist*).

IIT Research Institute
10 W. 35th Street
Chicago, IL 69616-3799
Phone: 312-567-4859
E-mail: jfenters@iitri.com

Independent, nonprofit organization performing toxicology and other research and testing for industry and government.

INFOTERRA
Programme Activity Centre, United Nations Environment Programme
P.O. Box 30552
Nairobi, Kenya
Phone: 254-2 22-6949
E-mail: spen@cedar.univie.ac.at
Web: http://www.cedar.univie.ac.at/unep/infoterra

U.S. contact: INFOTERRA/USA
U.S. Environmental Protection Agency
MC 3404

410 M Street, SW
Washington, DC 20460
Phone: 202-260-5917
E-mail: library-infoterra@epa.gov
Web: http://www.epa.gov/earlink1/INFOTERRA/

INFOTERRA, the information exchange programme of the United Nations Environment Programme (UNEP), currently consists of 170 National Focal Points around the world. INFOTERRA strives to take a leadership role in the reliable, effective, and timely dissemination of the world's scientific and technical environmental information. The National Focal Points are usually situated in the information and documentation sections of environment ministries and national environmental protection agencies. Each National Focal Point compiles a ''Who's Who'' of environmental expertise in their country and selects the best sources for inclusion in INFOTERRA's main publication, the *International Directory of Sources*. This directory, existing in both print and electronic form, does not contain all the world's environmental information but is the means of access to more than 7000 sources of information on over 1000 environmental subjects. The sources are located in government ministries, research institutes, universities, nongovernmental and international organizations, United Nations agencies, and private consultancies.

(The) Institute for Environmental Toxicology (IET) (see Michigan State University)

Institute for in Vitro Sciences, Inc. (IIVS)
21 First Field Road, Suite 220
Gaithersburg, MD 20878
Phone: 301-947-6523
Web: http://www.iivs.org

Advancing science and animal welfare, this nonprofit organization was formed in 1997 to provide *in vitro* contract toxicity testing and to provide expertise and testing for international validation programs. Works closely with other groups active in the alternative methods area. Activities also include regulatory interactions and training on alternative methods, educational workshops and symposia, and management of *in vitro* toxicity databses. Publishes a newsletter (*Institute Up-Date*).

Institute of Food Technologists (IFT)
221 N. LaSalle Street, Suite 300
Chicago, IL 60601
Phone: 312-782-8424
E-mail: info@ift.org
Web: http://www.ift.org

Members include food industry personnel interested in toxicology and safety evaluation and other topics.

Institute for Polyacrylate Absorbents (IPA)
1100 New York Avenue, NW, Suite 1090
Washington, DC 20005
Phone: 202-414-4190

Members include manufacturers and users of polyacrylate absorbent materials. Sponsors research and disseminates information. Affiliated with the Synthetic Organic Chemical Manufacturers Association.

Institute for Risk Research (IRR)
University of Waterloo
Waterloo, ON, Canada N2L 3G1
Phone: 519-888-4567, ext. 3355
Fax: 519-725-4834
E-mail: irr@mail.eng.uwaterloo.ca
Web: http://workbench.uwaterloo.ca/irr/

The IRR was established in 1982 to conduct research on risk management and to establish a knowledge base to assist Canadian governments, public organizations, and industry in risk management decisions and policies. Research and development on measures of safety, risk management of dangerous goods, safety of blood systems, provision of membership services for risk experts in Canada, and risk publications and educational programs have all contributed to the mission: ''To promote safety for Canadians by improving the understanding of risk and risk policy decisions.''

(U.S.) Interagency Coordinating Committee on the Validation of Alternative Methods (ICCVAM) (see Special Groups)

International Academy of Legal Medicine and Social Medicine
49 A, ave. Nicolai
B-4802 Verviers, Belgium
Phone: 32-87-229821

Members include forensic pathologists and others interested in legal and social medicine. Promotes international scientific cooperation in toxicology and other fields associated with legal medicine. Publishes a newsletter and other documents.

International Academy of Oral Medicine and Toxicology (IAOMT)
1640 North Arlington Heights Road, Suite 201
Arlington Heights, IL 60004
Phone: 847-253-0240
Web: http://www.sukel.com/iaomt.htm

Members include dentists and others interested in the biocompatibility of materials used in dentistry. Publishes two newsletters.

International Academy of Toxicological Risk Assessment (IATRA) [see National Registry of Environmental Professionals (NREP)]

International Agency for Research on Cancer (IARC)
150, cours Albert Thomas
F-69372 Lyon cedex 08, France
Phone: 33-72-73-8485
Web: http://www.iarc.fr

Established in 1965 by the World Health Organization, IARC coordinates and conducts research on cancer epidemiology and carcinogenesis. IARC disseminates information through publications, courses, fellowships, and meetings. It regularly publishes *Cancer Incidence in Five Continents,* which presents the results of systematic collection of standardized data on cancer occurrence throughout the world.

International Association of Agricultural Medicine and Rural Health (IAAMRH)
Saku Central Hospital
197, Usuda, Minamisaku-gan
Nagano 384-03, Japan
Phone: 81-267-823131
Web: http://www.who.int/ina-ngo/ngo029.htm

Members include physicians and other health care professionals in 40 countries. Committees include one on toxicology, and publications include a journal.

International Association for Dental Research (IADR)
1619 Duke Street
Alexandria, VA 22314-3406
Phone: 703-548-0066
E-mail: es@iadr.com
Web: http://www.iadr.com

Members include individuals interested in areas of dental research. A scientific division of the Association on pharmacology/therapeutics/toxicology. Publishes journals, a newsletter, and other documents.

International Association of Environmental Analytical Chemistry (IAEAC)
Strengigasslizo
CH-4123 Allschwil, Switzerland
Phone: 41-61-4812789
Web: http://www.gsf.de/UNEP/swiiac.html

IAEAC encourages information exchange in the analytical chemistry of pollutants and related areas. It seeks to inform members of recent advances and new technology in the field and to increase awareness of environmental issues through publications and through a variety of interdisciplinary courses and workshops. IAEAC publishes two journals (*International Journal of Environmental Analytical Chemistry* and the *Journal of Toxicological and Environmental Chemistry*).

International Association of Environmental Mutagen Societies (IAEMS)
Michael D. Waters
National Health and Environmental Effects Research Laboratory
MD-51A
U.S. EPA
Research Triangle Park, NC 27711
E-mail: waters.mike@epamail.epa.gov
Web: http://www.iaems.nl

IAEMS is a scientific society concerned with environmental mutagens and carcinogens and their control. IAEMS develops training courses and workshops and promotes international collaboration between scientists.

International Association of Forensic Toxicologists (TIAFT)
Dr. Ilkka Ojanpera, Secretary
Department of Forensic Medicine
P.O. Box 40, FIN-00014
University of Helsinki
Finland
Phone: 358-9-1912-7487
E-mail: Ilkka.Ojanpera@helsinki.fi
Web: http://www.cbft.unipd.it/tiaft

Members include toxicologists and others interested in analytical and forensic toxicology and allied areas. Encourages research in forensic toxicology. Publications include a newsletter.

International Association of Medicine and Biology of Environment (IAMBE)
115, rue de la Pompe
F-75116 Paris, France
Phone: 33-1-4553-4504

IAMBE studies the adaptation of humans to their environment and examines the health effects resulting from this adaptation. Collects and disseminates information related to the protection of humans and their surroundings and organizes seminars and symposia.

International Association of the Soap and Detergent Industry (AIS) (Now part of AISE: See listing for Association International de la Savonnerie, de la Detergence et des Produits d'Entretien)

International Association for Therapeutic Drug Monitoring and Clinical Toxicology (IATDM-CT)
IATDM-CT, Business Office
P.O. Box 1570, 4 Cataraqui Street, Suite 310
Kingston, Ontario K7L 5C8 Canada

Phone: 613-531-8166
Fax: 613-531-0626
E-mail: iatdmct@events.kingston.net
Web: http://www.iatdmct.org

IATDM-CT, founded in 1990, represents scientists from around the world. IATDM-CT strives to develop high standards of patient care through drug monitoring and clinical toxicology techniques. Publications include the journal *Therapeutic Drug Monitoring.*

International Atomic Energy Agency (IAEA)
P.O. Box 100, Wagramerstrasse 5
A-1400 Vienna, Austria
Phone: 43-1-2060
E-mail: Official.Mail@iaea.org
Web: http://www.iaea.org/worldatom

Part of the United Nations system, IAEA encourages research and development of atomic energy for peaceful purposes. The agency establishes health and safety standards and applies safety measures in accord with the Treaty on the Nonproliferation of Nuclear Weapons.

International Commission for Protection against Environmental Mutagens and Carcinogens (ICPEMC)
David J. Brusick
Covance Laboratories
9200 Leesburg Turnpike
Vienna, VA 22182-1699
Phone: 703-893-5400

Members include scientists from academia and industry in the areas of genetics, mutagenesis, cancer, epidemiology of cancer, genetic toxicology, and other areas. Works to develop principles, guidelines and regulations, and priorities for further research and regulation and to identify substances and situations that may cause significant genotoxic harm. Publications include an annual newsletter and a journal (*Mutation Research*).

International Committee on Food Microbiology and Hygiene (ICFMH)
c/o Institute of Hygiene and Toxicology
Federal Research Center for Nutrition
Engesserstrasse 20
76131 Karlsruhe, Germany
Phone: 49-721-6625115
E-mail: wmorris@unixg.ubc.ca

Members include microbiological societies in 40 countries. Works to further the academic practice of food microbiology, especially safety and quality. Offers training, and publications include a journal (*International Journal of Food Microbiology*) and newsletter.

International Consumer Product Health and Safety Organization (ICPHSO)
P.O. Box 1785
Germantown, MD 20875-1785
Phone: 301-601-3240
Fax: 301-601-3543

Founded under the sponsorship of the Association of Food and Drug Officials (AFDO), ICPHSO's mission is to promote the health and safety of consumer products, and members are from industry, government agencies, and elsewhere. Holds an annual symposium. Publications include a newsletter.

International Fragrance Association (IFRA)
8 rue Charles-Humbert
CH-1205 Geneva, Switzerland
Phone: 41-22-3213548
Web: http://www.ifraorg.org

Includes national associations of fragrance manufacturers. Its mission is to promote safety evaluation and regulations for fragrance ingredients. IFRA issues guidelines and a code of practice for the safe use of fragrance ingredients. Publications include the code of practice notebook, information letters, and a newsletter.

International Institute for the Advancement of Medicine (IIAM)
15 East Uwchlan Ave., Suite 406
Exton, PA 19341
Phone: 800-486-4426 and 717-343-5433
Web: http://www.iiam.org

Nonprofit organization whose purpose is to facilitate the placement of nontransplantable human organs and tissues for research. Research applications include determining the most relevant animal model for human toxicity testing and other applications in toxicology, drug metabolism, and biochemistry.

International Labour Organization (ILO)
Route des Morillons 4
1211-Geneva 22, Switzerland
Phone: 41-22-799-7940
E-mail: presse@ilo.org
Web: http://www.ilo.org

Part of the United Nations system, the ILO engages in such activities as the formulation of international policies to improve working conditions, the creation of international labor standards, and training, education, and research. Of particular interest to toxicologists is the ILO-CIS International Occupational Safety and Health Information Centre. The ILO publishes extensively in the area of occupational safety and health.

International Life Sciences Institute (ILSI)
1126 16th Street, NW, Suite 300
Washington, DC 20036
Phone: 202-659-0074
Fax: 202-659-0074
E-mail: ilsi@ilsi.org
Web: http://www.ilsi.org

Nonprofit scientific research and educational foundation sponsored by various food, chemical, pharmaceutical, and other companies. Headquarters are in Washington, DC with offices (branches) around the world. Issues covered include those in toxicology, animal pathology, risk assessment, water quality, the environment, food safety, and nutrition. Offices worldwide focus on issues of regional and country-specific importance. Includes the ILSI Health and Environmental Sciences Institute focusing on environmental issues. Publishes numerous books and other documents.

International Maritime Organization (IMO)
4 Albert Embankment
London, SE1 7SR, United Kingdom
Phone: 44-171-735-7611
Web: http://www.imo.org

The main objective of IMO is to facilitate cooperation among governments on technical matters affecting international shipping in order to achieve the highest practicable standards of maritime safety and efficiency in navigation. IMO has a special responsibility for safety of life at sea and for the protection of the marine environment through prevention of pollution of the sea caused by ships and other craft.

International Programme on Chemical Safety (IPCS)
International Programme for Chemical Safety
World Health Organization (WHO)
CH-211
Geneva 27, Switzerland
Phone: 41-22-791-3588
Fax: 41-22-79-48-48
E-mail: ipcsmail@who.ch
Web: http://www.who.ch/pcs

U.S.contact: World Health Organization Regional Office for the Americas (AMRO)/Pan American Health Organization (PAHO)
525 23rd Street, NW
Washington, DC 20037
Phone: 202-861-3200
E-mail: postmaster@paho.org

The objective of WHO is ''the attainment by all peoples of the highest possible level of health.'' Health is defined in the WHO constitution as ''a state of complete physical, mental, and social well-being and not merely the absence of disease or infirmity.'' WHO's main functions include directing and coordinating international health work, assisting governments in strengthening health services, advancing work on the control of diseases, and promoting improvements in nutrition, sanitation, working conditions, and environmental hygiene. WHO is the executing agency of the IPCS. IPCS is mandated to establish the scientific basis for safe use of chemicals and to strengthen national capabilities for chemical safety. Areas of activity include the evaluation of the risk to human health from exposure to chemicals, encouragement of the use of suitable health risk evaluation methods, promotion of international cooperation with respect to chemical accidents and emergencies, promotion of training for testing and evaluating the health effects of chemicals, and regulating control of chemical hazards. Publishes various health and safety guides, environmental health criteria documents, technical documents, monographs, a newsletter, etc.

International Radiation Protection Association (IRPA)
P.O. Box 662
5600 AR Eindhoven
The Netherlands
Phone: 31-40-247-3355
E-mail: irpa.exof@sbd.tue.nl
Web: http://www.irpa-exof.nl

IRPA is the worldwide association for members of affiliated national or regional associate societies. The purpose of IRPA is ''to provide a medium whereby those engaged in radiation protection activities in all countries may communicate more readily with each other and through this process advance radiation protection in many parts of the world. This includes relevant aspects of such branches of knowledge as science, medicine, engineering, technology and law, to provide for the protection of man and his environment from the hazards caused by radiation, and thereby to facilitate the safe use of medical, scientific, and industrial radiological practices for the benefit of mankind.''

International Register of Potentially Toxic Chemicals (IRPTC)
UNEP Chemicals (IRPTC)
15, Chemin des Anémones
Case postale 356 CH-1219 Châtelaine
Geneva, Switzerland
E-mail: irptc@unep.ch
Web: http://who.unep.ch/irptc

Established by the United Nations Environment Programme in 1976, IRPTC has five main goals: to facilitate access to information on production, distribution, and adverse effects on humans of chemicals; to identify

gaps in existing knowledge on the effects of chemicals; to identify potential hazards from chemicals; to provide information about national, regional, and global policies, regulations, and recommendations on potentially toxic chemicals; and to help implement policies for the exchange of information on chemicals in international trade. IRPTC maintains an electronic database of chemicals and produces and disseminates data profiles to users.

International Society for Environmental Epidemiology (ISEE)
ISEE Secretariat
JSI Research and Training Institute
44 Farnsworth Street
Boston, MA
Phone: 617-482-9485
Fax: 617-482-0617
E-mail: carol_rougvie@jsi.com
Web: http://www.iseepi.org

The ISEE provides a forum for the discussion of problems unique to the study of health and the environment. With membership open to environmental epidemiologists and other scientists worldwide, ISEE provides a variety of forums for discussions, critical reviews, collaborations, and education on issues of environmental exposures and their human health effects. These include annual meetings, newsletters, workshops, and liaisons with academic, governmental, intergovernmental, nonprofit, and business institutions.

International Society for Environmental Toxicology and Cancer (ISETC)
Dr. George H. Scherr, Secretary
P.O. Box 134
Park Forest, IL 60466
Phone: 708-758-3242

Members include researchers and others interested in environmental toxicology and oncology. Affiliated with the European Institute of Ecology and Cancer and the World Institute of Ecology and Cancer. Publishes *Journal of Environmental Pathology, Toxicology, and Oncology*.

International Society of Exposure Analysis (ISEA)
Web: http://www.iseaweb.org

Members include toxicologists and others interested in human and environmental exposure assessment. Newsletter available on the World Wide Web home page contains exposure and risk assessment news, meetings, legislation, publications, etc. Publishes *Journal of Exposure Analysis and Environmental Epidemiology*.

International Society for Fluoride Research
Secretary, Professor Gene W. Miller
Biology Department
Utah State University
Logan, UT 84322-5305
Web: http://www.fluoride-journal.com

Interested in all phases of fluoride research, with an emphasis on the biological effects of fluoride and its physical and chemical properties. Publications include original research reports, a journal (*Fluoride*), and other documents.

International Society for the Study of Xenobiotics (ISSX)
c/o Nancy Holahan
ISSX
P.O. Box 3
Cabin John, MD 20818
Phone: 301-983-2434
Fax: 301-983-5357
E-mail: nholahan@exec.issx.org
Web: http://www.issx.org

ISSX, devoted to research on xenobiotics, exists in order to facilitate and encourage communication and acquaintance of scientists engaged in related research. The study of xenobiotics embraces, and to a large extent unites, many aspects of chemistry, biology, and related sciences. The society provides opportunities to disseminate, discuss, and publish results of research, to promote public awareness, and to promote education and training in this field.

International Society on Toxinology (IST) (also known as International Society on Toxicology)
President: Prof. Dr. Franc Gubensek
Department of Biochemistry and Molecules Biology
Jozef Stefan Institute
Jamova 39
SI-1000
Ljubljana, Slovenia
Phone: 386-61-177-3250
E-mail: franc.gubensek@ijs.si
Web: http://bio.ijs.si/ist.htm

Founded in 1961, the society includes toxicologists, pharmacologists, and others interested in the study of animal, plant, and microbial toxins and venoms. Publishes a newsletter and a journal (*Toxicon: An International Journal Devoted to the Exchange of Knowledge on the Poisons Derived from Animals, Plants, and Microorganisms*).

International Union of Pharmacology (IUPHAR)
c/o Prof. W. C. Bowman
IUPHAR Media
68 Half Moon Lane
London
UK SE24 9JE

Phone: 44-171-737-8282
Fax: 44-171-274-9687
E-mail: admin@iuphar.org
Web: http://www.iuphar.org

Includes national and international societies in pharmacology and related sciences. Its purpose is to promote cooperation and information exchange between the societies. Includes a section on toxicology. Publishes a newsletter and other documents.

International Union of Toxicology (IUTOX)
Dr. Meryl H. Karol, Secretary General
University of Pittsburgh
260 Kappa Drive
Pittsburgh, PA 15238
Phone: 412-967-6530
Fax: 412-967-6611
E-mail: mhk@vms.cis.pitt.edu
Web: http://www.toxicology.org/iutox

Members include over 30 societies around the world. Its purpose is to ''foster international scientific cooperation among national and other groups of toxicologists and promote worldwide acquisition, dissemination, and utilization of knowledge in the science of toxicology, in particular by sponsoring International Congresses on Toxicology for the benefit of all mankind.'' An annual newsletter is published, and meetings (International Congresses of Toxicology) are held every 3 years. Activities also include a Risk Assessment Summer School (RASS) for young toxicologists to broaden their knowledge and experience in chemical risk assessment (RASS Secretariat, Malmfors Consulting AB, VA Stmannagaian 48, S-113 25 Stockholm, Sweden; phone: 468-31-1990). IUTOX member societies include the following (IUTOX WWW home page includes links to all available home pages of member societies):

Argentinian Association of Toxicology
Asian Society of Toxicology (ASIATOX)
Australasian Society of Clinical and Experimental Pharmacologists and Toxicologists
Brazilian Society of Toxicology
British Toxicology Society
Chinese Society of Toxicology
Danish Society of Pharmacology and Toxicology
Deutsche Gesellschaft fur Experimentelle und Klinische Pharmakologie und Toxikologie e.V.
Egyptian Society of Toxicology
European Association of Poison Centres and Clinical Toxicologists
EUROTOX
Finnish Society of Toxicology
French Society of Clinical Toxicology
French Society of Toxicology
Hellenic Society of Toxicology
Hungarian Pharmacological Society
Irish Society of Toxicology
Israeli Society of Toxicology
Italian Society of Toxicology
Japanese Society of Clinical Toxicology
Japanese Society of Toxicology
Korean Society of Toxicology
Mexican Society of Toxicology
Netherlands Society of Toxicology
Norwegian Society of Pharmacology and Toxicology, Toxicology section
Polish Society of Toxicology
Russian Society of Toxicology
Society of Toxicologic Pathologists
Society of Toxicology of Canada
Society of Toxicology, India
Society of Toxicology, U.S.A.
Spanish Society of Toxicology
Swedish Society of Toxicology
Swiss Society of Pharmacology and Toxicology, Toxicology section
Toxicological Society of Thailand
Toxicology Society of Taiwan
Turkish Society of Toxicology

Johns Hopkins Center for Alternatives to Animal Testing (CAAT)
111 Market Place, Suite 840
Baltimore, MD 21202-6709
Phone: 410-223-1612
E-mail: altweb@jhsph.edu
Web: http://www.sph.jhu.edu/~altweb

Members include individuals and organizations interested in the development and validation of *in vitro* alternatives to the use of whole animals in toxicology. Mission includes fostering the development of scientifically acceptable *in vitro* and other alternatives for use in the development and safety evaluation of commercial and therapeutic products. Mission further includes catalyzing the validation of alternative methods and encouraging their use, where appropriate, while continuing to ensure the health of the public and to disseminate scientifically correct information about alternatives, their uses, advantages, and limitations. Also conducts education and research programs, and as recently as 1997, published two newsletters, CAATALYST with information for middle-school students and the Center for Alternatives to Animal Testing Newsletter. These newsletters contained information about the development and validation of *in vitro* alternatives to the use of whole animals in toxicology; however, since late 1997, Altweb's AltNews has replaced the printed

issues of the Center for Alternatives to Animal Testing Newsletter. CAAT also publishes other documents.

Join Hands
Phone: 800-933-8228
E-mail: info@joinhand.org
Web: http://www.joinhand.org/

A nonprofit health and safety educational alliance. Provides educational materials explaining ''the important role of biological research and product safety testing to protect people and the environment.'' Publications also include ones on alternative research methods. Works closely with other organizations, e.g., American Association for Laboratory Animal Science (AALAS).

Lawrence Berkeley National Laboratory (LBL)

(see Ernest Orlando Lawrence Berkeley National Laboratory)

Lawrence Livermore National Laboratory (LLNL)
7000 East Ave.
P.O. Box 808
Livermore, CA 94550
Web: http://www.llnl.gov/

LLNL is managed for the U.S. Department of Energy by the University of California. LLNL is a nationwide resource in industrial, environmental, and human safety and risk assessment, including contributions related to food safety and human health (http://www.llnl.gov/llnl_res/08res_health.html). The Human Genome Center (http://bbrp.llnl.gov/bbrp/genome/) at LLNL operates as a multidisciplinary team effort whose broad goal is understanding human genetic material, including genotoxic research and other research investigating the mutagenic effects of chemicals.

League of Conservation Voters
1707 L Street, NW, Ste. 750
Washington, DC 20036
Phone: 202-785-8683
Fax: 202-835-0491
E-mail: lcv@lcv.org
Web: http://www.lcv.org

The League of Conservation voters was established in 1970 to serve as a bipartisan political action advocate for the then newly formed environmental movement. Thirty years later the League works to elect environmental candidates to the U.S. Congress. It publishes the National Environmental Scorecard, a rating system for members of the Senate and the House of Representatives indicating their voting records on issues related to environmental quality and natural resources protection. It also publishes a Presidential Scorecard, and the newsletter **LCV Insider.** Provides affiliations for individual state leagues also.

Linus Pauling Institute
Oregon State University
571 Weniger Hall
Corvallis, OR 97331
Phone: 541-737-5075
Web: http://osu.orst.edu/dept/lpi

Nonprofit institute whose research activities include human toxicology. Publications include a newsletter.

Los Alamos National Laboratory (LANL)
P.O. Box 1663
Los Alamos, NM 87545
Phone: 505-667-5061
Web: http://www.lanl.gov

Toxicology and environmental health research is conducted through dedicated programs in the biological sciences (http://www.lanl.gov/external/science/subjects/bio.html), environmental sciences (http://www.lanl.gov/external/science/subjects/envir.html) (including specific programs in the Environment, Safety, & Health Division and programs in environmental and occupational/public health standards), and medical sciences (http://www.lanl.gov/external/science/subjects/med.html).

Lovelace Respiratory Research Institute (LRRI)
2425 Ridgecrest Drive, SE
Albuquerque, NM 87108
Phone: 505-845-1037
E-mail: pmarx@lucy.tli.org
Web: http://www.lrri.org

LRRI is a private biomedical research institute dedicated to the reduction of the nation's respiratory health burden. Conducts a full range of inhalation bioassays in its well-known inhalation toxicology laboratory. LRRI supports The National Environmental Respiratory Center (http://www.nercenter.org), an integrated program of information and laboratory research to improve our understanding of the relationship between complex mixtures of environmental (outdoor) air pollutants and human health.

Michigan State University, Institute for Environmental Toxicology (IET)
C-231 Holden Hall
Michigan State University
East Lansing, MI 48824-1206
Phone: 515-353-6469
Web: http://www.iet.msu.edu

Institute's focus is on environmental issues in Michigan, including coordination of activities of Michigan

State University scientists in responding to the issues. Web site includes a newsletter, with notices of meetings, job openings, scholarships, funding opportunities, and publications.

Michigan State University, Pesticide Research Center
East Lansing, MI 48824
Phone: 517-353-9430

Conducts studies on pesticides and their alternatives, including effects on animals, plants, man, and the environment.

Middle Atlantic Reproduction and Teratology Association (MARTA)
c/o Dr. Mary L. A. Giknis
100 Division Street
Summitt, NJ 07901

Dedicated to encouraging proficiency and knowledge in the fields of animal reproduction and developmental toxicology.

(U.S.) National Academy of Sciences (NAS) [also see National Research Council (NRC)]
2101 Constitution Avenue, NW
Washington, DC 20418
Phone: 202-334-2000
E-mail: www.fdbk@nas.edu
Web: http://www.nas.edu

The NAS serves in an advisory capacity to the U.S. federal government and assists in developing scientific and technical support for policy initiatives in the general sciences, technology, and medicine. Toxicology-related issues are conducted primarily through the programs in biology, chemistry, environmental issues, and health and medicine. The National Academy Press (NAP; phone: 800-624-6242; Web: http://www.nap.edu) serves as publisher for the National Science Foundation (NSF) and NRC. The NAP reading room (http://www.nap.edu/readingroom/) provides free access to selected NAP reports.

(U.S.) National Agricultural Library (NAL), Department of Agriculture
10301 Baltimore Avenue
Beltsville, MD 20705
Phone: 301-504-5755
Web: http://www.nal.usda.gov

The NAL provides comprehensive information and data services for a broad spectrum of interests related to the mission of the Department of Agriculture. The NAL supports 10 subject-specific information centers (e.g., Water Quality Information Clearinghouse), and it supports the development and maintenance of the Agricultural Online Access (AGRICOLA) bibliographic database. AGRICOLA provides access to citations to the agriculture literature. Toxicology, environmental and occupational health, risk assessment, and related subdisciplines are covered for pesticides, other agrochemicals, and other food, agricultural product, and environmental hazards.

National Animal Poison Control Center (NAPCC)
American Society for the Prevention of Cruelty to Animals (ASPCA)
National Animal Poison Control Center
1717 S. Philo Road, Suite 36
Urbana, IL 61802
Phone: 888-426-4435 or 217-337-5030
E-mail: sakhan@napcc.aspca.org
Web: http://www.napcc.aspca.org

The NAPCC was established in 1978 and is the only animal-oriented poison control center in the United States. Veterinarians provide 24-hour-a-day, 7 days-a-week telephone assistance for questions about exposures of animals to toxic chemicals, dangerous plants, and products and substances.

National Anti-Vivisection Society
53 W. Jackson, Suite 1552
Chicago, IL 60604
Phone: 800-888-NAVS
E-mail: navs@navs.org
Web: http://www.navs.org/

Among activities is compilation of statistics on usage of laboratory animals for experiments. Also underwrites alternatives to animals research. Publishes a newsletter, *National Anti-Vivisection Society Bulletin,* and other documents.

National Association of Counties (NACo)
440 1st Street, 8th Floor
Washington, DC 20001
Phone: 202-393-6226

Provides networking opportunities for elected and appointed county officials and administrators. Includes research services related to broad aspects of environmental and health concerns.

National Association of County and City Health Officials (NACCHO)
1100 17th St. 2nd Floor
Washington, DC 20036
Phone: 202-783-5550
Web: http://www.naccho.org

Stimulates and sustains services, programs, and publications that contribute to the improvement of local health initiatives. Participates in National Association

of Counties activities related to policy formulation and decision making.

National Association of Physicians for the Environment (NAPE)
6410 Rockledge Drive, Suite 412
Bethesda, MD 20817
Fax: 301-530-8910
E-mail: nape@napenet.org
Web: http://www.napenet.org

NAPE was developed to work with the national medical specialties and subspecialties, with national, state, and local medical societies, and with individual physicians to deal with the impacts of environmental pollutants on the organs, systems, and disease processes. NAPE informs physicians, patients, and the public about the impact of pollutants and the necessary personal and public health steps that should be taken to prevent, reduce, or eliminate them.

(U.S.) National Cancer Institute (NCI)
31 Center Drive
Bethesda, MD 20892–2580
Phone: 301-435-3848 or 1-800-4-CANCER (Cancer Information Service Hotline)
Web: http://www.nci.nih.gov

The NCI was established by the National Cancer Act of 1937 and broadened by the National Cancer Act of 1971. NCI is one of the National Institutes of Health. Recent changes in the function and structure of the NCI have increased its responsibilities for information dissemination (which includes the CancerNet database). The NCI serves as a focal point for research, training, and education related to the study of cancer and carcinogens, including those caused by exposure to chemicals in the ambient and workplace environments.

National Center for Environmental Health Strategies (NCEHS)
c/o Mary Lamielle
1100 Rural Avenue
Voorhees, NJ 08043
Phone: 609-429-5358

Members include persons with environmental illnesses, scientific professionals, environmentalists, and others. Interests include public awareness of health problems caused by chemical and environmental pollutants, focusing on chemical sensitivity disorders. Conducts educational programs and research, gathers and disseminates information, etc. Publications include books, a newsletter, and other documents.

(U.S.) National Center for Toxicological Research

[see (U.S.) Food and Drug Administration]

National Coalition Against the Misuse of Pesticides
701 E Street, SE, Ste. 200
Washington, DC 20003
Phone: 202-543-5450
E-mail: ncamp@ncamping.org
Web: http://www.ncamp.org

Founded in 1981, this nonprofit organization assists, individuals, organizations, and communities with information about the properties, effects, application, and proper use of pesticides and alternatives to using chemical treatments for pest control. Works to provide services and information to protect children, workers, pets, wildlife, and other living things from pesticide poisoning and exposure. Other issues covered include groundwater protection, lawn-care safety, and legislative initiatives. Newsletter: **Pesticides and You.**

National Committee for Clinical Laboratory Standards (NCCLS) [also known as the Clinical Laboratory Standards Organization (CLSO)]
940 W. Valley Road, Suite 1400
Wayne, PA 19087-1989
Phone: 610-688-0100
E-mail: exoffice@nccls.org
Web: http://www.nccls.org

Members include government agencies, professional societies, clinical laboratories, and companies interested in clinical laboratory testing, including development of national and international standards. Committees include one on Clinical Chemistry and Toxicology. Publications include a newsletter.

National Conference of Local Environmental Health Administrators (NCLEHA)
Colin Thacker
Lake County Health Dept.
3010 Grand Ave.
Waukegan, IL 60085
Phone: 847-360-6751
E-mail: cthas@aol.com

Provides environmental health professionals at the municipal (county, city, or district levels) with opportunities for the improvement in the delivery of services and increasing the scientific aspects of environmental health at the community level.

National Environmental Health Association (NEHA)
720 S. Colorado Blvd., Suite 970, S. Tower
Denver, CO 80222-1925
Phone: 303-756-9090
Web: http://www.neha.org

Members include persons working in environmental health and protection for governmental agencies, in-

dustry, academia, and elsewhere. Provides information exchange and training. Sections include general environmental health, hazardous waste/toxic substances, injury prevention and occupational health, and international environmental health. Publications include the *Journal of Environmental Health.*

National Environmental Respiratory Center

[See Lovelace Respiratory Research Institute]

(U.S.) National Eye Institute
2020 Vision Place
Bethesda, MD 20892-3655
Phone: 301-496-5248
Web: http://www.nei.nih.gov

Part of the National Institutes of Health. Conducts and funds research related to the causes, diagnosis, treatment, and prevention of diseases and disorders to the eye and vision. Research includes studies of adverse ocular reactions to drugs, medications, and other chemical and toxic threats to the eye.

National Foundation for the Chemically Hypersensitive (NFCH)
4407 Swinson Rd.
Rhodes, MI 48652
Phone: 517-697-3989

Members include individuals with chemical hypersensitivity and their families and friends, health care professionals, and others. Topics include multiple chemical sensitivity, environmental illness, food intolerance, total allergy syndrome, candida, and chronic fatigue. Conducts research and training, disseminates information, and facilitates networking. Publishes a newsletter.

National Ground Water Association (NGWA)
601 Dempsey Road
Westerville, OH 43081
Phone: 800-551-7379
Web: http://www.ngwa.org

Provides professional and technical leadership in the advancement of the groundwater industry and in the protection, promotion, and responsible development and use of ground water resources. Operates the National GroundWater Information Center and GroundWater On-Line, a database of approximately 80,000 bibiographic references to the groundwater literature.

National Institute for Chemical Studies (NICS)
2300 MacCorkle Avenue, SE
Charleston, WV 25304
Phone: 304-346-6264
Web: members.aol.com/nicsinfo

Members include representatives of the chemical industry, neighbors of chemical plants, emergency responders, and others. Serves as liaison between the chemical industry and public. Conducts health and other studies.

(U.S.) National Heart, Lung, and Blood Institute
6701 Rockledge Drive (MSC-7950)
Bethesda, MD 208920-7950
Phone: 301-435-0080, 301-496-2411, or 301-480-0867
Web: http://www.nhlbi.nih.gov

Part of The National Institutes of Health. Provides a national program for studying disorders and diseases of the heart, blood, blood vessels, and the lung, including research to improve the diagnosis, treatment, and prevention of such diseases and disorders. While the activities of this NIH program are not primarily related to toxicology research, the toxicity of environmental pollutants, chemical and biochemical agents, and therapeutic interventions (such as oxygen or drug administration in cardiovascular and pulmonary systems) are of concern and interest. Research support extends to the studies of molecular, cellular, and systematic pharmacology of cardiovascualr drugs, environmental pollutants, atmospheric gases, trace metals, airborne particulates, and blood substitutes. The Education Programs Information Center (P.O. Box 30105, Bethesda, MD 20825-0105; phone: 301-251-1222 or 301-496-4236) acquires and disseminates information and provides reference and referral services related to public health aspects of toxic and chemical exposures and their potential impacts, including high blood pressure, heart attack, asthma, and related respiratory and cardiopulmonary function.

(U.S.) National Institute of Child Health and Human Development
NICHD Clearinghouse
P.O. Box 3006
Rockville MD, 20847
Phone: 800-370-2943
E-mail: NICHDClearinghouse@iqsolutions.com
Web: http://www.nih.gov/nichd

The Development Biology, Genetics, and Teratology Branch of the National Institute of Child Health and Human Development conducts research on the genetic and teratogenic aspects of environmental factors on development.

(U.S.) National Institute of Environmental Health Sciences (NIEHS)/National Toxicology Program (NTP) (also see additional NTP information under Special Groups)
111 T. W. Alexander Drive
P.O. Box 12233
Research Triangle Park, NC 27709

Phone: 919-541-3665 (NTP: 919-541-3419)
E-mail: mcfarland@niehs.nih.gov (NIEHS) or lange@niehs.nih.gov (NTP)
Web: http://www.niehs.nih.gov

NIEHS is part of the National Institutes of Health and conducts research on environment-related diseases. NIEHS includes the NTP (http://ntp-server.niehs.nih.gov), which tests chemicals and coordinates federal research on environmental toxins. Included in its research activities are tests to assess genetic, behavioral, developmental, and immunological toxicities of chemicals. Its mission includes expanding the toxicological profiles of chemicals tested, expanding the information and knowledge base of chemicals related to their lethality, carcinogenicity, mutagenicity, and teratogenicity, and to identify specific organs or organ systems that are particularly vulnerable to toxicological action. It also maintains a candidate list of chemicals for proposed testing and possible further regulatory action. Publishes various documents including technical reports, a Biennial Report on Carcinogens, and a journal, *Environmental Health Perspectives*. NIEHS embarked on a major Community Outreach and Education Program (COEP) to address environmental health issues and problems of greatest concern to the communities in which the centers are located. NIEHS centers are encouraged to sponsor local efforts through community organizations and to collaborate with other existing outreach programs in their area, e.g., those supported by other NIH institutes, other federal agencies (NIOSH, CDC, and ATSDR) state or local agencies, or health departments. The objective of the COEP is the translation of research results into knowledge applied to public health. Appropriate activities may consist of continuing professional education, disease prevention programs, education (primary, secondary, and/or college), information dissemination, community issue programs, and public awareness seminars. NIEHS supports a comprehensive library and technical information center (http://library.niehs.nih.gov). The WWW home page of the NIEHS Library provides listings of new books, electronic journals, journals held by the library and NIEHS laboratories, reference resources, an inventory of WWW sites, information about NIEHS Library services and staff, and access to the NIEHS online catalog for books and journals, NIEHS Library WebPAC 1.2 (http://library.niehs.nih.gov/libserv/niehswebpac.htm).

(U.S.) National Institute of Neurological Disorders and Stroke
NINDS Office of Communications and Public Liason
P.O. Box 5801
Bethesda, MD 20824
Phone: 301-496-9746
Web: http://www.ninds.nih.gov/

Neurotoxicology interests include drug- and chemical-induced effects on the nervous system. Research support includes the use of toxic chemicals in the study of the biochemical and physiological mechanisms of the nervous system and the function of the brain and related neurological functions, including the localization and disposition of substances involved in neurotoxicity. Conducts and funds research related to strokes and other neurological disorders and diseases.

(U.S.) National Institute for Occupational Safety and Health (NIOSH)
Education and Information Division
Information Resources Branch
4676 Columbia Parkway
Cincinnati, OH 45226-1998
Phone: 800-356-4674
E-mail: pubstaff@niosdt1.em.cdc.gov
Web: http://www.cdc.gov/niosh/

Federal agency established by the Occupational Safety and Health Act of 1970 and is part of the Centers for Disease Control and Prevention. Responsible for conducting research and making recommendations for the prevention of work-related injuries. Produces the Registry of Toxic Effects of Chemical Substances (RTECS) database. Publishes various types of documents on specific chemicals, various workplace-related illnesses/diseases, etc. Also offers training, videotapes, and grants.

(U.S.) National Institute of Standards and Technology (NIST)
100 Bureau Drive
Gaithersburg, MD 20899–0001
Phone: 301-975-NIST
Web: http://www.nist.gov

NIST is the central resource in the United States for the development of standard procedures and measurements in the physical and applied sciences. Resources include services, information products, data, standards, quality assurance, and standard operating procedures and technical protocols for laboratory and field measurements. Environmental and toxicology-related sampling and standards development is included. Of particular interest to the area of toxicology are NIST activities related to combustion science and technologies as developed and implemented by the Fire Science Division Building and Fire Research Laboratory (Web: http://www.brfl.nist.gov) and the Fire Safety Engineering Division which operates the Fire Research Information Service.

(U.S.) National Institutes of Health (NIH) (also see other NIH listings)
Bethesda, MD 20892-0148
Phone: 301-496-2433
E-mail: NIHInfo@OD.NIH.GOV
Web: http://www.nih.gov

The NIH was established as a one-room Laboratory of Hygiene in 1887. Today, it is a major focal point for biomedical research in the United States, conducted in its own laboratories and in universities, medical schools, hospitals, and research institutions throughout the country. The NIH is one of eight health agencies of the Public Health Service, which in turn is part of the U.S. Department of Health and Human Services. There are 24 separate institutes, centers, and divisions that comprise the NIH, covering a broad spectrum of biomedical interests. Those most closely related to the topics of toxicology and environmental health include the National Cancer Institute, the National Institute of Environmental Health Sciences, and the National Library of Medicine.

National League of Cities (NLC)
1301 Pennsylvania Avenue, NW
Washington, DC 20004-1763
Phone: 202-626-3000
E-mail: pa@nlc.org
Web: http://www.nlc.org

Provides a network representing more than 18,000 municipalities in the United States. Web site provides an extensive inventory of URLs (Web site addresses) for federal, state, and local government agencies, departments, and other community programs. Access Local Government is an interactive online information system, including environmental and health-related information and resources (available by subscription for local government officials).

(U.S.) National Library Of Medicine (NLM) (also see additional information under Special Groups)
Specialized Information Services
8600 Rockville Pike
Bethesda, MD 20894
Phone: 301-496-1131
E-mail: custserv@nlm.nih.gov
Web: http://sis.nlm.nih.gov

The NLM, part of the National Institute of Health, provides extensive information and data management support and medical library and computer-based reference services for health professionals, libraries, researchers, educators, officials, managers, and administrators. The NLM maintains Index Medicus and MEDLARS, the online information system which is composed of a wide variety of biomedical, including toxicological, databases. NLM's Toxicology and Environmental Health Information Program (TEHIP) (http://sis.nlm.nih.gov/tehip.htm) was created from the Toxicology Information Program (TIP) that was established in 1967. Among the databases accessible through TEHIP's TOXNET system are the Hazardous Substances Data Bank (HSDR), the Integrated Risk Information System (IRIS), and the Toxics Release Inventory (TRI) (see Chapter 6). TEHIP also offers the ChemID Plus and TOXLINE files. Toxicology Tutor (http://sis.nlm.nih.gov/toxtutor.htm) covers basic principles of toxicology and is written at the introductory college student level. Toxicology Tutor is intended to provide a better understanding of the toxicology information contained in the NLM's chemical and toxicological databases.

(U.S.) National Oceanic and Atmospheric Administration (NOAA)
14th Street and Constitution Avenue NW, Room 6013
Washington, DC 20230
Phone: 202-482-6090
Web: http://www.noaa.gov

NOAA is a program in the U.S. Department of Commerce and provides research, services, and information to explore the Earth's oceans and atmosphere, protect coastal regions and protect marine and other resources with warnings and forecasts related to weather and climate. NOAA's toxicology and environmental health research includes efforts of the Marine Fisheries Service in the areas of biotoxins, chemical pollution, ecotoxicology. And other factors influencing the health of marine resources and seafood consumers. NOAA maintains the National Environmental Data Referral Service, which provides access to publicly available, nonbibliographic environmental data (e.g., datafiles, numeric data, monitoring data, remote sensing data, meteorologic, oceanic, and climatic data). Research and information management activities are extended to cover not only the ocean coastal zones of the U.S., including the Great Lakes. NOAA also maintains the Hazardous Materials Response and Assessment Program, providing research support and services related to hazardous materials spills, waste sites, chemical hazard assessments, and ecological response to chemical spills. NOAA's National Sea Grant Program (http://www.noaa.gov/research/seagrant.htm) provides additional information support and outreach services for researchers, educators, policymakers, and the public at large. The Sea Grant Program is facilitated at 29 colleges and universities in 30 states through a network of more than 200 marine research institutes, university

and college programs and is coordinated with individual state marine and environmental agencies.

National Paint and Coatings Association (NPCA)
1500 Rhode Island Avenue, NW
Washington, DC 20005
Phone: 202-462-6272
E-mail: npca@paint.org
Web: http://www.paint.org

Members include manufacturers of paints and chemical coatings and suppliers of raw material and equipment. Conducts research and other activities. Publishes a newsletter and other documents.

National Pest Control Association (NPCA)
8100 Oak Street
Dunn Loring, VA 22027
Phone: 703-573-8330
Web: http://www.pestworld.org

Members include firms engaged in control of insects, rodents, birds, and other pests via the use of insecticides, rodenticides, miticides, fumigants, and nonchemical methods. Provides advice and sponsors research and training. Publishes a newsletter and other documents.

National Pesticide Telecommunication Network (NPTN) (formerly the National Pesticide Information Clearinghouse)
Oregon State University
333 Weniger Hall
Corvallis, OR 97331-6502
Phone: 800-858-7378
E-mail: nptn@ace.orst.edu
Web: http://ace.orst.edu/info/nptn

An information clearinghouse for pesticide information, e.g., pesticide products, toxicology, cleanup, and disposal.

National Registry of Environmental Professionals (NREP) (absorbed the International Academy of Toxicological Risk Assessment in 1994)
P.O. Box 2099
Glenview, IL 60025-6099
Phone: 847-724-6631
Fax: 847-724-4223
E-mail: nrep@aol.com
Web: http://www.nrep.org

Members include environmental managers, scientists, and others. Offers accreditation. Activities include providing lists of qualified environmental professionals to governmental agencies, developing standards of environmental site assessment, lead-based paint training, and hazardous waste training. Publishes a newsletter and other documents. Holds annual meeting and sponsors workshops.

(U.S.) National Research Council (NRC) (also see National Academy of Sciences and additional information under Special Groups)
National Academy of Sciences
2101 Constitution Avenue, NW, TJ2114
Washington, DC 20418
Phone: 202-334-2000
E-mail: jdellamo@nas.edu
Web: http://www.nas.edu/nrc

The NRC is the principal operating agency of both the National Academy of Sciences and the National Academy of Engineering in providing services to the government, the public, and the scientific and engineering communities. It offers awards for postdoctoral scientific research at participating U.S. government research laboratories.

Natural Resources Information Council (NRIC)
Natural Resources Research Library
Utah State University
Logan, UT 84322-5260
Phone: 435-797-0114
Fax: 435-797-3798
E-mail: quinney@cc.usu.edu
Web: http://www.quinneylibrary.usu.edu/special.htm

Founded in 1991 NRIC serves as a forum for federal, state, provincial, academic, and special research librarians, information specialists, and information providers from the U.S. and Canada. The ecotoxicology, effects, and impacts to wildlife by chemicals, toxic substances, and other environmental factors are issues addressed by NRIC. NRICs discussion group NRLib-L is accessible at NRLib-L@library.lib.usu.edu.

National Safety Council (NSC)
1121 Spring Lake Drive
Itasca, IL 60143-3201
Phone: 630-285-1121
Fax: 630-285-1315
Web: http://www.nsc.org/

Promotes safety and accident prevention methods, including health and safety issues related to workplace and ambient exposures to chemicals and other hazards in the environment. Works with state and local agencies in providing training and public awareness programs. NSCs Research and Statistical Services studies safety and health issues in the workplace, home, and community settings.

(U.S.) National Science Foundation (NSF)
4201 Wilson Boulevard
Arlington, VA 22230

Phone: 703-306-1234
Web: http://www.nsf.gov

The NSF is an independent U.S. government agency responsible for promoting science and engineering, and it consists of the National Science Board of 24 part-time members and a director. Specific NSF research in toxicology is linked to support of fundamental reserch in the area of environmental endocrinology (including endocrine disrupters). This area includes research on the multilevel analysis of molecular, cellular, and genetic processes (both receptor and nonreceptor mediated) of hormone activity associated with behavioral, physiological, developmental, and ecological systems in a variety of environments. NSF also participates in the EPA/NSF partnership with the Environmental Protection Agency's Office of Research and Development National Center for Environmental Research and Quality Assurance. Research grants are under the Science to Achieve Results (STAR) program and include support in the following areas: water and watersheds, technology for a sustainable environment, and decision-making and valuation for environmental policy. The Directorate for Biological Sciences is organized along disciplinary lines into four divisions, including the Division of Environmental Biology. The Directorate for Biological Sciences supports the postdoctoral research fellowships in biosciences related to the environment. Specifically ineligible are research plans oriented toward human, animal, or plant disease or toxicology and those with clinical or other applied objectives.

(U.S.) National Technical Information Service (NTIS)
5285 Port Royal Road
Springfield, VA 22161
Phone: 703-605-6000
Web: http://www.ntis.gov

NTIS is a U.S. Department of Commerce program that provides for public sale reports of U.S. government-sponsored research, development, and engineering. Additional literature for sale includes foreign technical reports and reports prepared by local government agencies and government contractors. It sponsors the NTIS bibliographic database and a host of publication and services catalogs.

(U.S.) National Transportation Safety Board (NTSB)
490 L'Enfant Plaza East, SW
Washington, DC 20594
Phone: 202-314-6000
Web: http://www.ntsb.gov

The NTSB promotes transportation safety through independent investigations and makes recommendations for safety improvements. The Pipeline and Hazardous Materials Division investigates transportation incidents involving hazardous materials.

(U.S.) National Toxicology Program (NTP)

[see National Institute of Environmental Health Sciences]

National Wildlife Federation (NWF)
8925 Leesburg Pike
Vienna, VA 22184
Phone: 703-790-4000
Web: http://www.nwf.org

Federation of state and territorial conservation organizations. Publishes an annual directory (*Conservation Directory*) which includes comprehensive contact information for the state (and territorial for Canada) agencies dealing with environmental protection and conservation (but not for public health agencies). The *Conservation Directory* also provides information about international, national, and state environmental organizations.

Natural Resources Defense Council Inc. (NRDC)
40 W. 20th Street
New York, NY 10011-4211
Phone: 212-727-2700
E-mail: nrdcinfo@nrdc.org
Web: http://www.nrdc.org

Established in 1970 as a nonprofit organization to provide legal assistance related to the preservation and conservation of natural resources. Scope has expanded greatly and now includes issues related to toxic substances in the environment and issues related to environmental health and risk assessment. Publications include a quarterly journal (*Amicus Journal*), also available (select full-text articles) via http://www.nrdc.org/eamicus (electronic title of e-Amicus). The Web site provides a more comprehensive treatment of specific topics including those related to environmental health. See http://www.nrdc.org/nrdcpro/health for specifics and ''back up'' the URL to ''nrcdpro'' for other toxicology-related topics.

North American Mycological Association (NAMA)
Executive Secretary, Joe Miller
10 Lynne Brooke Place
Charleston, WV 25312-9521
Phone: 304-744-1654
E-mail: brightcloud@mciworld.com
Web: http://www.namyco.org

Members include mycologists, mycophagists, and others, with one committee on toxicology. Publishes a journal and newsletter.

(The) Norwegian Reference Centre for Laboratory Animal Science and Alternatives (The NORINA Database)
Laboratory Animal Unit
Norwegian School of Veterinary Medicine
P.O. Box 8146 Dep.,
N-0033 Oslo, Norway
Phone: 47-22-96-4574
E-mail: adrian.smith@veths.no
Web: http://oslovet.veths.no

The NORINA Database provides audiovisual alternatives to laboratory animals in teaching and is supported by *Laboratory Animals* (journal), the National Centre for Veterinary Contract Research and Commercial Services (VESO), Allkopi Printers (IPN), Universities Federation for Animal Welfare (UFAW), Swedish Fund for Research without Animal Experiments, the Association for Assessment and Accrediation of Laboratory Animal Care (AAALAC International), B&K Universal, and the Laboratory Animal Science Association (LASA). As of late 1998, NORINA contained information on over 3600 audiovisual aids (software, laser discs, films, etc.) that may be used as alternatives or supplements to the use of animals in student teaching. NORINA also notes meetings of possible interest and contains numerous links to other Web sites.

(U.S.) Nuclear Regulatory Commission (NRC)
One White Flint North
11555 Rockville Pike
Rockville, MD 20852-2738
Phone: 301-415-7000
Web: http://www.nrc.gov

The NRC was established in 1975 and took over from the Atomic Energy Commission responsibilities related to the regulation of commercial, industrial, academic, and medical uses of nuclear energy. Major NRC components include the Office of Nuclear Regulatory Research, the Office of Nuclear Reactor Regulation, and the Office of Nuclear Material Safety and Safeguards. NRC issues more than 22,000 licenses for facilities engaged in medical, academic, and industrial uses of nuclear materials, including radioisotopes used in a wide variety of toxicology research applications. NRC provides systematic reviews of operational data and data related to nuclear accidents and other events.

Oak Ridge Institute for Science and Education (ORISE), Oak Ridge Associated Universities (ORAU)
130 Badger Avenue
P.O. Box 117
Oak Ridge, TN 37831-0117
Phone: 423-576-3000
E-mail: smitha@orau.gov
Web: http://www.orau.org

ORISE is a consortium of 62 universities conducting research and development activities, providing education and training, and providing technical assistance to the Department of Energy, other federal agencies, and private organizations. The Materials Sciences Division conducts research and training related to occupational and environmental exposures to toxic chemicals and ionizing radiation. The Center for Epidemiologic Research examines relationships between occupational exposure to ionizing radiation and subsequent health and mortality. The Department of Energy (DOE) Health Mortality Study, which follows the health and mortality status of DOE workers, is facilitated through this program office. ORAU is also responsible for providing funding assistance for undergraduate, graduate, and postgraduate students and fellows.

Oak Ridge National Laboratory (ORNL)
P.O. Box 2008
Bethel Valley Road
Oak Ridge, TN 37831-2208
Web: http://www.ornl.gov

Oak Ridge National Laboratory (ORNL) is currently managed by Lockheed Martin Energy Research Corporation. ORNL has a rich history of toxicology research dating back to the days of its inception as one of the laboratory facilities of the Manhattan Project. Basic and applied research are conducted for toxicology, chemical and radioactive waste remediation, risk assessment, and environmental health and safety compliance. Much of the research agenda is carried out by programs in the Life Sciences and Environmental Technologies Directorate. The Life Sciences Division conducts research to advance the understanding of biological systems and their relationships with human health and the environment in six research areas: assessment technology, biochemistry and biophysics, computational biosciences, environmental technology, mammalian genetics and development, toxicology and risk analysis. The Health and Environmental Risk Analysis (HERA) Section conducts research related to information management, analysis, and applications in the areas of toxicology, health and environmental risk assessments, cost/benefit analysis, strategic planning and prioritization, and environmental regulations.

Oak Ridge National Laboratory, Toxicology Information Response Center (TIRC)
1060 Commerce Park, MS-6480
P. O. Box 2008
Oak Ridge, TN 37831-6480
Phone: 423-576-1746

Web: http://www.ornl.gov/TechResources/tirc/hmepg.html

TIRC was organized to serve as an international repository of toxicology information, and it is sponsored by the National Library of Medicine (NLM) to assist in the NLM Toxicology and Environmental Health Information Program. TIRC provides direct access to the world's scientific and technical databases on a cost-recovery basis for scientists, researchers, policy- and decision makers, educators, and the public at-large. TIRC is staffed by ORNL's Toxicology and Risk Assessment (TARA) section.

(U.S.) Occupational Safety and Health Administration (OSHA)
200 Constitution Avenue, NW
Washington, DC 20210
Phone: 202-693-1999
Web: http://www.osha.gov

The mission of the OSHA is to save lives, prevent injuries, and protect the health of personnel in their workplace environments. OSHA develops and promulgates occupational safety and health standards, develops and issues regulations and guidelines, conducts inspections and investigations, and issues citations and imposes penalties for noncompliance with regard to health and safety standards. OSHA sponsors nationally recognized testing laboratories, including blood-lead laboratories (http://osh-aslc.gov/OCIS/toc_bloodlead.html). It also sponsors the development of the virtual OSHA CD-ROM (http://www.osha–slc.gov/OCIS/CD–ROM.html), a virtual library of information and resources related to the OSHA mission. OSHA also facilitates outreach education through their network of OSHA Training Institute Education Centers (http:// www.osha-slc.gov/Training_toc/ted_out.html).

Organization for Economic Cooperation and Development (OECD)
2, rue André-Pascal
75775 Paris Cedex 16, France
Phone: 33-1-45-24-8200
E-mail: extrel@oecd.org
Web: http://www.oecd.org

U.S. contact: OECD Washington Center
2001 L Street NW, Suite 650
Washington, DC 20036-4922
Phone: 202-785-6323
Web: http://www.oecdwash.org

The OECD promotes economic welfare in member countries. In the area of environmental health and safety, projects include the Chemicals Programme, the Chemical Accidents Programme, BioTrack Online (Harmonization of Regulatory Oversight in Biotechnology), and the Pesticides Programme.

Pacific Northwest National Laboratory (PNL)
P.O. Box 999
Richland, WA 99352
Phone: 509-375-2121
Web: http://www.pnl.gov

Battelle Memorial Institute manages and operates the federal government's Hanford Laboratories in Washington state. The research facility, separated from Hanford site operations, is called the PNL. Much of PNL's toxicology research is found in the Environmental Molecular Sciences Laboratory (http://www.emsl.pnl.gov:2080) which focuses on the following areas of basic and applied research: the use of natural and engineered techniques to remediate and restore contaminated soils and groundwater, the processes and techniques used to extract and destroy chemical wastes and to separate and safely store radioactive wastes, the development of a new generation of industrial processes that minimize or eliminate the use of toxic materials and the production of hazardous waste products, and the impact of toxic contaminants on the health of humans and the ecosystem. PNL also supports additional broad-based research and development activities in the Health Sciences (http://www.pnl.gov/health), including activities related to toxicology and environmental health.

People for the Ethical Treatment of Animals (PETA)
501 Front Street
Norfolk, VA 23510
Phone: 757-622-PETA
Web: http://www.peta-online.org/

See Web site for information on German and European Web sites and offices. With over 600,000 members, PETA is the largest animal rights organization in the world. Dedicated to establishing and protecting the rights of all animals, with the principle that ''animals are not ours to eat, wear, experiment on, or use for entertainment.''

Pesticide Action Network North America (PANNA)
49 Powell Street, Suite 500
San Francisco, CA 94102
Phone: 415-981-1771
E-mail: panna@panna.org
Web: http://www.igc.apc.org/panna

For 17 years, PANNA has campaigned to replace pesticide use with ecologically sound alternatives. As one of five regional centers worldwide, PANNA links individuals, researchers, farmers, opinion leaders, busi-

nesses, and public interest organizations in Canada, Mexico, and the United States with over 400 consumer, labor, health, environment, and agriculture groups in more than 60 countries. This network includes over 130 affiliated groups in North America.

Pesticide Education Center (PEC)
P.O. Box 420870
San Francisco, CA 94142
Phone: 415-391-8511
Fax: 415-391-9159
E-mail: pec@igc.apc.org
Web: http://www.igc.org/pesticides

PEC is a nonprofit organization founded in 1988 to educate workers and the public about the hazards of pesticides to human health and the environment. PEC provides critical information on health effects and safer alternative pest control methods to the public. Their mission is to educate consumers to make more informed choices to protect themselves, their families, their pets, their neighbors, and the environment from toxic pesticides.

Pharmaceutical Research and Manufacturers of America (PhRMA)
1100 Fifteenth Street NW
Washington, DC 20005
Phone: 202-835-3400
Web: http://phrma.org

The Pharmaceutical Research and Manufacturers of America is a group of about 100 companies with a primary commitment to pharmaceutical research. Formerly known as the Pharmaceutical Manufacturers Association (PMA).

Physicians for Social Responsibility (PSR)
Environment and Health Program
1101 Fourteenth Street, NW, Suite 700
Washington, DC 20005
Phone: 202-898-0150
E-mail: snewsome@psr.org
Web: http://www.psr.org/enviro.htm

Recipient of the 1989 Nobel Peace Prize for its advocacy by physicians for the prevention of nuclear war, PSR is an organization of more than 20,000 health professionals and supporters promoting the end to the means of mass destruction, violence, and environmental degradation. Environmental issues undertaken by PSR include persistent organic pollutants, medical waste incineration and dioxin, climate change and human health, and children's environmental health.

Polyisocyanurate Insulation Manufacturers Association (PIMA)
1001 Pennsylvania Avenue, NW
Washington, DC 20004
Phone: 202-624-2709
E-mail: pima@pima.org
Web: http://www.pima.org/

Formerly known as The ''Roof Insulation Council.'' Members include companies and individuals involved in the manufacture of polyisocyanurate insulation. Addresses various issues including toxicity of insulation.

Public Interest Research Groups (PIRGs)
218 D Street, SE
Washington, DC 20003-1900
Phone: 202-546-9707
Fax: 202-546-2461
Web: http://www.pirg.org

The state PIRGs have worked on Superfund issues for over a decade. They issue reports (beginning in 1985) that explore Superfund pollution, problems, and politics. Other environmental issues the PIRGs work on include energy, toxics, right-to-know, and clean air. PIRGs have helped to enact laws that clean up the atmosphere and have used lawsuites to stop illegal water pollution. Their environmental pages (http://www.pirg.org/enviro) feature extensive fact sheets, reports, and action alerts. Individual state PIRGs also provide a vast array of information resources, such as the New York Public Information Research Group's (NYPIRG's) acclaimed report, ''Getting the Lead Out'' NYPIRG's Handbook for Lead Poisoning Prevention, 3rd. ed. 1995 (NYPRIG, 9 Murray Street, 3rd Floor, New York, NY 10007; phone: 212-349-6460; e-mail: nypirg@nypirg.org: Web: http://www.nypirg.org)

Rachel Carson Council (RCC)
8940 Jones Mill Road
Chevy Chase, MD 20815
Phone: 301-652-1877
E-mail: rccouncil@aol.com
Web: http://members.aol.com/rccouncil/ourpage/rcc_page.htm

A clearinghouse and library with information at both scientific and layperson levels on pesticide-related issues. Rachel Carson Council develops its knowledge from literature searches and conversations with experts. It then provides answers to the public and also produces various publications clarifying pesticide dangers and bringing alternative pest controls to the public's attention.

Radiation Effects Research Foundation (RERF)
Hiroshima Laboratory
5-2 Hijiyama Park, Minami-ku
Hiroshima City, 732-0815 Japan
Phone: 81-82-261-3131 (from outside Japan) or 082-261-3131 (from inside Japan)

Web: http://www.rerf.or.jp/eigo/experhp/rerfhome.htm

Formerly the Atomic Bomb Casualty Commission. Conducts research and studies, for peaceful purposes, on various aspects of the effects of radiation on man with a view toward contributing to the maintenance of the health and welfare of atomic bomb survivors and to the enhancement of the health of all mankind.

Rare-Earth Information Center (RIC)
R. William McCallum, Director
Center for Rare Earths and Magnetics
116 Wilhelm Hall
Iowa State University
Ames, IA 50011
Phone: 515-294-4736
E-mail: RIC@ameslab.gov

Members include corporate sponsors. The purpose is to collect, store, evaluate, and disseminate information about rare-earth elements (a group of 17 elements with unique electric and magnetic properties), including the toxicity of the rare-earth elements and compounds. The Center publishes two newsletters—RIC News and RIC Insight.

Registry of Comparative Pathology (RCP)
c/o Armed Forces Institute of Pathology
Washington, DC 20306-0001
Phone: 202-782-2440
E-mail: oneill@afip.osd.mil
Web: http://www.afip.org/rcp/

Operated by the Universities Associated for Research and Education in Pathology. Members include biomedical scientists and others interested in biomedical research, particularly the comparative pathology of animals and animal models of disease. Publishes a handbook, newsletter, and other documents.

Reproductive Toxicology Center (RTC)
Columbia Hospital for Women Medical Center
2440 M Street, NW, Suite 217
Washington, DC 20037-1404
Phone: 202-293-5137
E-mail: reprotox@reprotox.org
Web: http://reprotox.org

Developed the REPROTOX information system, which provides current assessments on the potentially harmful effects of environmental exposure to chemicals & physical agents on human pregnancy, reproduction, and development. Available online and on diskettes.

Research Institute for Fragrance Materials (RIFM)
Two University Plaza, Suite 406
Hackensack, NJ 07601
Phone: 201-488-5527
E-mail: help@rifm.org
Web: http://rifm.org/data/start.cfm

The RIFM is an independent nonprofit scientific organization. Included among RIFM's efforts is the development of over 1300 peer-reviewed ''fragrance monographs'' published in *Food and Chemical Toxicology* and separately as updated sets in a RIFM compendium. Also, RIFM distributes ''draft'' monographs assembled from toxicology and other information in RIFM's online database (available via an Internet WWW home page available to members). RIFM also conducts research on fragrance materials, with progress reported via ''information bulletins.'' RIFM's work leads to recommendations on the safe use of fragrance materials worldwide issued by the International Fragrance Association (IFRA).

Resolve
1255 23rd Street, NW
Washington, DC 20037
Phone: 202-944-2300
Fax: 202-338-1264
E-mail: outreach@resolv.org
Web: http://www.resolv.org

Resolve was established in 1977 as one of the first national environmental dispute resolution organizations. Resolve has greatly expanded mediation and consensus building services to individuals, organizations, and communities. Services include mediation of negotiated rulemaking, facilitation of workshops and public–private collaboratives, and conflict assessments for convening negations. Resolve maintains a section devoted to toxics and chemicals in the environment, which deals primarily with Superfund and related risk assessments to facilitate discussions and dialogs among stakeholders. Publishes the newsletter, Resolve.

Resources for the Future, Center for Risk Management (RFF)
1616 P Street, NW
Washington, DC 20036
Phone: 202-328-5060
E-mail: info@rff.org
Web: http://www.rff.org

RFF is a nonprofit and nonpartisan think tank that carries out a broad program of fundamental research, policy analysis, and outreach related to the management of risks to public health and the environment. Funded by U.S. EPA, U.S. DOE, and various foundations, corporations, and institutes. Publishes a newsletter and other documents.

Risk Assessment & Policy Association (RAPA)
Secretariat
Carol Ruh, Assistant Secretary-Treasurer
RAPA
Franklin Pierce Law Center
2 White Street
Concord, NH 03301
Phone: 603-228-1541
Web: http://www.fplc.edu/tfield/rapa.htm

Goals are to promote multidisciplinary research on the theory and practice of risk assessment and management, to foster intellectual exchange among researchers, risk assessors, and policymakers, to encourage public involvement in risk assessment and management, to examine the use of risk assessment in legislative, regulatory, and other policy deliberations, and to study the use of risk analysis in decision making. Home page provides access to issues of *Risk: Health, Safety & Environment* (official journal of RAPA).

Royal Society of Chemistry (RSC)
Burlington House
Piccadilly
London W1V 0BN, UK
Phone: 44-171-4378656
E-mail: Langers@rsc.org
Web: http://www.rsc.org

Members include chemists and others in most countries of the world. Subcommittees include one on toxicology. Numerous publications include journals and a newsletter.

Science and Environmental Health Network (SEHN)
RR 1
Box 73
Cleveland, ND 58434-9801
Phone: 701-763-6286
E-mail: 75114.1164@compuserve.com

A coalition of 42 environmental groups functioning as a hub of scientific networking in community and national environmental and public health protection efforts. Included among SEHN's organizations are Alliance for Justice, American Lung Association, Arizona Toxics Project, Citizen Action, Commission for Racial Justice, United Church of Christ, Downwinders at Risk, Ecology Center of Ann Arbor, Environmental Health Network, Environmental Law Institute, Environmental Defense Fund, Labor/Community Strategy Center, Mothers and Others for a Livable Planet, National Wildlife Federation, Natural Resources Defense Council, OMB Watch, Physicians for Social Responsibility, Southeast Network for Economic and Environmental Justice, the Wilderness Society, U.S. Public Interest Research Group, and Working Group on Right to Know. Holds bimonthly forums. Publications include a newsletter and a *Science and the Media* handbook.

Scientists Center for Animal Welfare
7833 Walker Drive, Suite 340
Greenbelt, MD 20770
Phone: 301-345-3500
Fax: 301-345-3503
E-mail: info@scaw.com
Web: http://www.scaw.com

Nonprofit educational organization promoting the welfare of animals used in research, testing, and teaching.

Sierra Club
85 2nd Street, 2nd Floor
San Francisco, CA 94105-3459
Phone: 415-977-5500
Web: http://www.sierraclub.org

Founded in 1892 as one of America's first natural resources advice groups, the Sierra Club today embraces a wide variety of issues that advocate the responsible use of the Earth's resources and ecosystems and to protect the quality of the environment. Provides extensive education and outreach campaigns at national and international levels. Its 65 chapters and nearly 400 affiliated groups in North America provide public information on a wide variety of environmental and natural resources topics, including those related to toxicology and environmental health.

Silicones Environmental Health and Safety Council (SEHSC) (formerly the Silicones Health Council)
1767 Business Center Drive, Suite 302
Reston, VA 20190
Phone: 703-438-3943
E-mail: wsmock@sehsc.org

Members include manufacturers of organosilicones. Coordinates health and environmental programs, and disseminates information.

Soap and Detergent Association (SDA)
475 Park Avenue S.
New York, NY 10016
Phone: 212-725-1262
Fax: 212-213-0685
Web: http://www.sdahq.org

Representing North American manufacturers of household, industrial, and institutional cleaning products, their ingredients, and finished packaging. Activities include toxicology and regulatory issues. Publications include a newsletter and other documents.

Soap and Detergent Industry Association (SDIA)
315 Clair Road
Haywards Heath
West Sussex RH16 3DP
Phone: 44-0-1444-450884144153
E-mail: info@sdia.org.uk
Web: http://www.sdia.org.uk

Members include manufacturers of soaps and detergents in the United Kingdom. Activities include toxicology and regulatory issues. Publications include a newsletter.

Society for Chemical Hazard Communications
Lori Chaplin, Administrator
P.O. Box 1392
Annandale, VA 22003-9392
Phone: 703-658-9246
Fax: 703-658-9247
E-mail: SCHCLori@aol.com
Web: http://www.schc.org

A nonprofit organization with a mission to promote the improvement of the business of hazard communication for chemicals. Sponsors events, courses, and related activities related to Material Safety Data Sheets (MSDSs).

Society of Environmental Journalists (SEJ)
P.O. Box 27280
Philadelphia, PA 19118
Phone: 215-836-9970
E-mail: sej@aol.com
Web: http://www.sej.org

Members include journalists, educators, and students. Its mission is to advance public understanding of environmental issues by improving the quality, accuracy, and visibility of environmental reporting. Publishes a newsletter *SEJournal*, and a biweekly ''TipSheet.''

Society of Environmental Toxicology and Chemistry (SETAC)
1010 N. 12th Avenue
Pensacola, FL 32501-3367
Phone: 850-496-1500
E-mail: setac@setac.org
Web: http://www.setac.org

Members include professionals in the fields of chemistry, toxicology, biology, ecology, etc. promoting the use of multidisciplinary approaches to examine the impacts of chemicals and technology on the environment. Publishes a newsletter and other documents including a journal (*Environmental Toxicology and Chemistry*). SETAC also has offices in Europe (e-mail: setac@ping.be) and Asia/Pacific (e-mail: graeme.batley@syd.dcet.csiro.au).

Society of Forensic Toxicologists (SOFT)
SOFT Administrative Office
P.O. Box 5543
Mesa, AZ 85211-5543
Phone: 602-839-9106
Web: http://www.soft-tox.org

Composed of practicing forensic toxicologists. Holds annual meetings. Publications include a newsletter.

Society for *in Vitro* Biology (SIVB) (formerly the Tissue Culture Association)
9315 Largo Drive West, Suite 255
Largo, MD 20774
Phone: 301-324-5054
E-mail: sivb@sivb.org
Web: http://www.sivb.org

Members are interested in the collection and dissemination of information about the maintenance and experimental use of tissue cells *in vitro* and in the development and evaluation of procedures using tissue cells. Publications include a journal (*In Vitro Cellular and Developmental Biology*—separate animal and plant editions, and *Methods in Cell Science* [formerly Journal of Tissue Culture Methods]) and a newsletter (*In Vitro Report*).

Society for Risk Analysis (SRA)
1313 Dolley Madison Blvd., Suite 402
McLean, VA 22101-3926
Phone: 703-790-1745
E-mail: sra@burkinc.com
Web: http://www.sra.org

Members include risk analysis professionals from varied areas, including human and environmental risk assessment. Scope includes risk assessment, risk characterization, risk communication, risk management, and policy relating to risk. SRA has local and regional chapters in various parts of the United States and international chapters representing Europe and Japan.

Society of Toxicologic Pathologists (STP)
19 Mantua Road
Mount Royal, NJ 08061
Phone: 609-423-3610
E-mail: stphq@talley.com
Web: http://www.toxpath.org

Members include toxicologic pathologists, veterinarians, physicians, and dentists interested in the pathological changes produced by pharmacological, chemical, and environmental agents. Principal aim is the advancement of pathology as it pertains to changes elicited by pharmacologic, chemical, and environmental agents and factors that modify these responses. Publi-

cations include a newsletter and a journal (*Toxicologic Pathology*).

Society of Toxicology (SOT)
1767 Business Center Drive, Suite 302
Reston, VA 22090
Phone: 703-438-3115
E-mail: sothq@toxicology.org
Web: http://www.toxicology.org

Members include toxicologists and others in industry, academia, government, and elsewhere interested in toxicology and risk assessment. SOT has regional chapters in various parts of the United States and also has several specialty sections, e.g., inhalation toxicology and risk assessment. Publishes a newsletter and two journals [*Toxicology and Applied Pharmacology* and *Toxicological Sciences* (formerly *Fundamental and Applied Toxicology*)]. SOT established the Toxicology Education Foundation (TEF) in 1990; TEF's mission is to provide educational programs to enhance public understanding of toxicology, with a focus on programs in the K-12 grades (particularly the middle-school grade levels) and lay public health and science areas.

Special Libraries Association
1700 18th Street, NW
Washington, DC 20009-2514
Phone: 202-234-4700
E-mail: sla@sla.org
Web: http://www.sla.org

The Special Libraries Association is an international professional association of information resource experts. Its Environment and Resource Management Division http://www.sla.org/membership/divisions/erm.html was created in 1989. The Toxicology Round Table is a biannual series of toxicology-related presentations at the SLA Annual Meeting. The ERMD Newsletter is published quarterly. Other SLA divisions also have interests in the areas of toxicology and environmental health.

State and Territorial Air Pollution Program Administrators (STAPPA)
444 N. Capitol Street, NW, Suite 307
Washington, DC 20001
Phone: 202-624-7864
Web: http://www.4cleanair.org

Encourages communication among federal, state, and local regulatory agencies. Issues covered include air toxic control and other aspects of implementing the Clean Air Act. Works closely and shares offices with the Association of Local Air Pollution Control Officials.

States Network of Biomedical Research and Education Organizations (OSERA)
P.O. Box 14424
Columbus, OH 43214-0424
Phone: 614-784-1961
E-mail: director@osera.org

Coalition of various state organizations for biomedical and product safety research committed to public education on the use of animals in research and safety testing until valid alternatives are developed.

Styrene Information and Research Center (SIRC)
1300 Wilson Boulevard, Suite 1200
Arlington, VA 22209
Phone: 202-721-4100
Web: http://www.styrene.org

Members include styrene manufacturers and users. Activities include dissemination of health, safety, and regulatory information to public, workers, and others and performing research. Publications include a newsletter and other documents.

Synthetic Amorphous Silica and Silicates Industry Association (SASSI)
c/o R. K. Lee
One PPG Place
Pittsburgh, PA 15272
Phone: 412-434-2604

Members include manufacturers and other firms involved with synthetic amorphous silica and silicates. Disseminates health and safety information.

Synthetic Organic Chemical Manufacturers Association (SOCMA)
1850 M Street, NW, Suite 700
Washington, DC 20036
Phone: 202-721-4100
Web: http://www.socma.org

The association for the batch and custom chemical industry. Members include manufacturers of synthetic organic chemicals, which are made from coal, natural gas, crude petroleum, and certain natural substances. There are committees on government affairs, hazardous waste, occupational safety and health, and toxic substances. Publications include a monthly newsletter (*The Chemical Bond*).

(U.S.) Tennessee Valley Authority (TVA), Environmental Research Center
TVA Reservation
P.O. Box 1010
Muscle Shoals, AL 35661-1010
Phone: 256-386-2601
Web: http://www.tva.gov/orgs/erc.htm

Supports TVA's responsibilities for protecting the air, water, and land of the Tennessee Valley. Activities include atmospheric modeling, chemical testing, etc.

Teratology Society
1767 Business Center Drive, Suite 302
Reston, Virginia 20190-5332
Phone: 703-438-3104
Fax: 703-438-3113
E-mail: tshq@teratology.org
Web: http://teratology.org

The Teratology Society is a multidisciplinary scientific society whose members study the causes and biological processes leading to abnormal development and birth defects at the fundamental and clinical level and appropriate measures for prevention.

Toxicology Education Foundation

(see Society of Toxicology)

Toxicology Excellence for Risk Assessment (TERA)
4303 Hamilton Avenue
Cincinnati, OH 45223
Phone: 513-542-7475
Web: http://www.tera.org

This nonprofit organization maintains the International Toxicity Estimates for Risk (ITER) database, summarizing toxicity values for use in performing health risk assessments. Values are from government agencies (e.g., U.S. EPA and Health Canada), public organizations (e.g., World Health Organization), and health groups around the world. TERA is also expanding ITER via the conduct of peer reviews of chemical toxicity assessments from independent groups. Also, Verifiable Estimates for Risk Assessment (VERA) is a project of TERA that provides risk values for use in environmental or pollution prevention decisions. Under the VERA project, TERA scientists develop risk estimates for interested parties based on the most appropriate toxicity data and latest methods from United States federal agencies or other recognized organizations. Other TERA activities include improving the underlying methods for reducing uncertainty in human health risk assessment through research and publication of theoretical papers, and education through lectures, training, courses and scientific support so that better risk-based decisions are made.

Toxicological History Society (THiS)
John H. Trestrail, III
5757 Hall Street, SE
Grand Rapids, MI 49546-3845
Phone: 616-774-5329

Members include individuals interested in the researching and documentation of the history of poisons and antidotes and the impact of toxicology on events in world history. Publishes a newsletter, has compiled a bibliography, and has a speakers' bureau.

Toxicology Forum (TF)
1575 Eye Street, NW, Suite 325
Washington, DC 20005-1105
Phone: 202-659-0030
E-mail: toxforum@clark.net
Web: http://www.clark.net/pub/toxforum

European Office
91 A High Street
Oxford, OX1 4RJ
United Kingdom
Phone: 44-1865-249900
E-mail: toxforum@compuserve.com

An international nonprofit organization devoted entirely to the organization of open dialogues among the various segments of society concerned with problems in toxicology. Members include corporations and individuals interested in toxicology. Seeks to facilitate communication among scientific decision makers and aid in the development of safety assessments and regulations.

Toxicology Information Resources Center (TIRC)

[see Oak Ridge National Laboratory, Toxicology Information Resources Center (TIRC)]

Tufts Center for Animals and Public Policy
Tufts University School of Veterinary Medicine
200 Westboro Road
North Grafton, MA 01536
Phone: 508-839-7991
Web: http://www.tufts.edu/vet/cfa/aboutcfa.html

Activities include support, coordination, and funding of programs dealing with ethical, legal, scientific, and social issues concerning domestic and farm animals and wildlife. Includes interest in animal research ethics. Publications include two newsletters.

Tulane University and Xavier University Center for Bioenvironmental Research (CBR)
1430 Tulane Ave. SL-3
New Orleans, LA 70112
Phone: 504-585-6910
E-mail: CBR@mailhost.tcs.tulane.edu
Web: http://www.tmc.tulane.edu/cbr/

Purpose is ''to prevent disease and enhance health in humans and ecosystems through partnerships in research and learning, providing solutions to environmental problems of the future.'' Research efforts include environmental astrobiology, women's health,

ecosystems, biomonitoring/bioremediation, and environmental endocrinology.

United Nations (UN)
Public Inquiries Unit
Department of Public Information
New York, NY 10017
Phone: 212-963-4475 and 212-963-9246
Web: http://www.un.org

The charter of the UN states its four main objectives; to maintain international peace and security; to develop friendly relations among nations based on respect for the principle of equal rights and self-determination of peoples; to achieve international cooperation in solving international problems of an economic, social, cultural, or humanitarian character and in promoting and encouraging respect for human rights and for fundamental freedoms for all without distinction as to race, sex, language, or religion, and to be a center for harmonizing the actions of nations in the attainment of these common ends. Organizations which are part of the UN system, and which are relevant to toxicology research, have been listed separately, including FAO, IAEA, and ILO (also see United Nations Environment Programme).

United Nations Environment Programme (UNEP)
Chief, Information and Public Affairs
UNEP—P.W. Box 30522
Nairobi, Kenya
Phone: 254-2-62-1234/3292
Fax: 254-2-62-3927/3692
E-mail: ipainfo@unep.org
Web: http://www.unep.org

An outgrowth of the 1972 Stockholm Conference on the Human Environment, UNEP provides an integrative mechanism for various intergovernmental, nongovernmental, national, and regional bodies to collaborate to discuss environmental concerns. Among the subjects within its domain are sustainable management, biosafety, cleaner production, transfer of green technologies, and chemical databanks such as the International Register of Potentially Toxic Chemicals (http://irptc.unep.ch/irptc), the Inter-Organization Programme for Sound Management of Chemicals, and Infoterra (a global network for environmental information exchange and scientific and technical query response services).

United States Federal Agencies

[see Department of Agriculture, Environmental Protection Agency, etc.]

United States National Institutes of Health

[see National Institute for Occupational Safety and Health, National Institute of Environmental Health Sciences, etc.]

Universities Associated for Research and Education in Pathology (UAREP)
9650 Rockville Pike
Bethesda, MD 20814-3993
Phone: 301-571-1880

Members are from university pathology departments. Provides core material for teaching and researching of pathology, with an emphasis on toxicology and chemical carcinogens. Operates the **Registry of Comparative Pathology.**

University of Washington

[see Counseling and Advice on Reproductive Exposures]

Wildlife Disease Association
P.O. Box 1897
Lawrence, KS 66044-8897

International nonprofit group founded in 1951 as a means of scientists and researchers to advance the knowledge and understanding of diseases in free-living and captive wild animals. Topics addressed include toxic exposures and physiological diseases caused by environmental factors natural and man-made.

World Federation of Associations of Clinical Toxicology Centers and Poison Control Centers
Secretary-General: Jacques Descotes
Centre Anti-Poisons
Hopital Edouard Herriot
5 pl d'Arsonval
69003 Lyon
France
Phone: 33-78-54-80-22

Members include national and international toxicology organizations, associations of poison control centers, and national poison control centers. Main purposes includes assisting developing countries in toxicology education and training and collecting and disseminating information. It also maintains a liaison with the World Health Organization, compiles statistics, and organizes working groups. Publishes a quarterly bulletin, two journals, and other documents.

World Health Organization

[see International Programme on Chemical Safety (IPCS)]

World Resources Institute (WRI)
1709 New York Avenue, NW
Washington, DC 20006
Phone: 202-638-6300
Fax: 202-638-0036
E-mail: nkete@wri.org
Web: http://www.wri.org

WRI was founded in 1982 as an environmental policy research center. WRI provides coverage of many environmental topics, including those related to toxic substances and environmental health.

World Wildlife Fund (WWF)
1250 24th Street, NW
Washington, DC 20037
Phone: 202-293-4800
Web: http://www.wwf.org

The black-and-white panda logo of the WWF is an internationally recognized symbol for the protection of natural resources and the environment. WWF was founded in 1961 and now has a membership of more than 1.2 million, making it the largest U.S. organization working worldwide to protect wildlife. WWF has an international research and policy campaign directed to chemical contamination of the environment and has spear-headed an international effort to address the issues related to endocrine disrupters.

Worldwatch Institute
1776 Massachusetts Avenue, NW
Washington, DC 20036-1904
Phone: 202-452-1999
800-555-2028 (publications)
E-mail: worldwatch@worldwatch.org
Web: http://www.worldwatch.org

This nonprofit publicity organization was created in 1974 and provides a critical link between the scientific and technical aspects of the environment to the economic and sociopolitical support systems. Worldwatch bridges the complexities of environmental information by critical analyses of the science underlying the issues in the context of economic and policy making. Its annual book, *State of the World,* is one of the most widely translated and circulated books published in the world. Its series of Environmental Alerts provide detailed analysis on single issues. Worldwatch cover toxicology, environmental health, and chemical contamination directly and indirectly.

SPECIAL GROUPS

Within some of the organizations listed previously, or separate from them, are a variety of groups functioning as ad hoc or standing committees or that serve in a coordinating, collaborative, advisory, or other special capacity. There are far too many to itemize fully; the following are among the foremost:

Committee on Environment and Natural Resources (CENR)
National Science and Technology Council (NSTC)
Office of Science and Technology Policy
1600 Pennsylvania Avenue, NW
Washington, DC 20502
Phone: 202-482-5181
E-mail: information@ostp.eop.gov
Web: http://www.nnic.noaa.gov/CENR

One of nine standing committees of the White House's National Science and Technology Council (NSTC), CENR works to coordinate historically decentralized research programs to address environmental issues in an integrated manner across agencies. Includes subcommittees on environmental technology, risk assessment, air quality, toxic substances/hazardous and solid waste, etc.

Committee for the National Institute for the Environment (CNIE)
1725 K Street, NW, Suite 212
Washington, DC 20006-1401
Phone: 202-530-5810
Fax: 202-628-4311
E-mail: cnie@cnie.org
Web: http://www.cnie.org

CNIE's mission is to improve the scientific basis for making decisions on environmental issues through the successful operation of a National Institute for the Environment (NIE). Its National Library for the Environment (see Web address) provides free online access to understandable and unbiased information on a wide range of environmental issues.

Department of Health and Human Services Environmental Health Policy Committee (EHPC)

The EHPC was established to coordinate policy development for environmental health activities related to the mission of the U.S. Public Health Service and its agencies. It serves as the primary focal point within the Department of Health and Human Services for promoting the exchange of environmental health information and for providing review, advice, and consensus facilitation where necessary on environmental health research, exposure assessments, risk assessment, and risk management procedures. It is chaired by the assistant secretary for health and composed of representatives of the Agency for Toxic Substances and Disease Registry, Centers for Disease Control and Prevention, Food and Drug Administration, Indian Health

Service, National Institutes of Health, and Office of the Chief Counsel, Public Health Service. Liaison membership has also been extended to the Environmental Protection Agency, the Department of Agriculture, the Department of Energy, and the Department of Labor. EHPC's subcommittees are in the areas of (i) a public health approach to children and the environment, (ii) emerging issues, (iii) risk communication and education, (iv) environmental justice, and (v) data needs. Contact:

Dalton Paxman, PhD
Senior Health Sciences Advisor
U.S. Department of Health and Human Services
Office of the Secretary
Office of Public Health and Science
Office of Disease Prevention and Health Promotion
200 Independence Avenue, SW, Room 738-G
Washington, DC 20201
Phone: 202-205-5829
Fax: 202-205-9478
E-mail: dpaxman@osophs.dhhs.gov
Web: http://web.health.gov/environment

Environmental Protection Agency Science Advisory Board (SAB)

Established in 1978, the SAB is a public advisory group providing extramural scientific information and advice to the administrator and other officials of the EPA. The SAB is structured to provide balanced, expert assessment of scientific matters relating to problems facing the agency. Members of and consultants to the board constitute a distinguished body of scientists, engineers, and economists who are recognized, nongovernmental experts in their respective fields. These individuals are drawn from academia, industry, and environmental communities throughout the United States and, in some cases, other countries. The board functions as a technical peer-review panel, conducting its business in public view and benefiting from public input during its deliberations. Among the SAB's major committees are the Clean Air Scientific Advisory Committee, Environmental Processes and Effects Committee, Environmental Engineering Committee, Environmental Health Committee, Integrated Human Exposure Committee, Research Strategies Advisory Committee, Drinking Water Committee, Council on Clean Air Compliance Analysis, Environmental Economics Advisory Committee, Integrated Risk Project. The Executive Committee serves as a ''board of directors'' for the SAB. To find out more about the SAB, contact:

Dr. Donald Barnes
Staff Director
Science Advisory Board
Environmental Protection Agency
401 M Street, SW
Washington, DC 20460
Phone: 202-26-8414
Fax: 202-260-7118
ListServ: LISTSERV/UNIXMAIL.RTPNC.EPA.GOV
Web: http://www.epa.gov/docs/science1

Interagency Coordinating Committee on the Validation of Alternative Methods (ICCVAM)

Coordinates issues throughout the federal government that relate to the development, validation, acceptance, and harmonization of toxicological test methods. It focuses on test method issues that are common to multiple agencies without impinging on considerations unique to individual programs and agencies. The committee seeks to promote toxicological test methods that (i) enhance agencies' abilities to assess risks and make decisions, and, (ii) where feasible and practical, reduce animal use, refine animal procedures to make them less stressful, or replace animals in toxicological tests. Its report, Validation and Regulatory Acceptance of Toxicological Test Methods (NIH Publication No. 97-3981), was published in 1997. For more information, contact:

Dr. William S. Stokes (ICCVAM Co-Chair)
Associate Director for Animal and Alternative Resources
Environmental Toxicology Program
National Institute of Environmental Health Sciences
P.O. Box 12233, MD WC-05
Research Triangle Park, NC 27709
Phone: 919-541-7997
Fax: 919-541-0947
E-mail: stokes@niehs.nih.gov

National Cancer Institute Chemical Selection Working Group (CSWG)

CSWG is an interagency group that evalutates, selects, and prioritizes candidate chemicals for carcinogenicity and other toxicity studies by the National Toxicology Program. The CSWG includes representatives from the CPSC, DOD/U.S. Army, DOE, EPA, FDA, NCI, NICHD, NIEHS, NLM, OSHA, USDA, and VA. Contact:

Dr. Victor A. Fung (Chair)
CPCB/DCB/NCI
6011 Executive Blvd., Suite 551
Bethesda, MD 20892-7670
Phone: 301-496-1625
Fax: 301-496-1040
E-mail: vf6n@nih.gov

National Institutes of Health Toxicology Study Sections

The original Toxicology Study Section was established within NIH's Division of Research Grants (DRG) in 1958. Over time, the number of study sections grew and the disciplines of toxicology and alcohol were merged so that there are currently three Alcohol/Toxicology Study Sections (known as ALTX 1, ALTX 3, and ALTX 4) within what is now known as NIH's Center for Scientific Review (CSR). These study sections review applications for research and training in the subjects of toxicology and alcohol for NIEHS, NIAAA, NHLBI, and some other NIH institutes. Two scientific review administrators (SRAs) share responsibilities for these four sections. The following are the major areas of interest of these study sections: ALTX 1, biotransformation and pharmacokinetics; ALTX 3, neuropathology, neurophysiology, neuropharmacology/toxicology, neuroendocrinology, behavioral genetics, teratology, neuroimaging, and neuroimmunotoxicology; ALTX 4, molecular, cellular, physiologic, and pharmacologic mechanisms of toxicant actions on distinct organ systems. Contact:

Dr. Gopal C. Sharma
Scientific Review Administrator
Center for Scientific Review, Room 4112
National Institutes of Health
6701 Rockledge Drive, MSC 7816
Bethesda, MD 20892-7816
Phone: 301-435-1783
Fax: 301-480-2644
E-mail: sharmag@csr.nih.gov

National Library of Medicine Toxicology and Environmental Health Information Program (TEHIP)

TEHIP was originally established in 1967 as the Toxicology Information Program to create automated toxicology data banks and provide toxicology information and data services. The major program with the National Library of Medicine's Division of Specialized information Services, TEHIP's scope has broadened to include environmental and occupational health. It now provides selected core information resources and services, facilitates access to national and international information resources, and strengthens the information infrastructure of toxicology and environmental health. Databases sponsored by TEHIP are described elsewhere in this book. Among the important committees falling under the auspices of TEHIP is the Hazardous Substances Data Bank Scientific Review Panel (SRP), a committee of experts drawn from the major subject disciplines within the data bank's scope that ensures the scientific accuracy and quality of the file. Contact:

Toxicology and Environmental Health Information Program
Division of Specialized Information Services
National Library of Medicine
8600 Rockville Pike
Bethesda, MD 20894
Phone: 301-496-1131
Fax: 301-480-3537
E-mail: tehip@teh.nlm.nih.gov
Web: http://sis.nlm.nih.gov/tehip.htm

National Research Council Board on Environmental Studies and Toxicology (BEST)

The Board on Environmental Studies and Toxicology is the National Research Council's focal point for studies of environmental pollution problems affecting human health and societal conflicts involving ecological resources. BEST addresses questions involving air and water pollution; solid and hazardous waste; toxicology; epidemiology; risk assessment; applied ecology; biotic resources; and environmental engineering, economics, law, and policy. Its mission is to provide independent expert assistance to the federal government and advice to the nation on matters of science and technology affecting public policy on important environmental problems and conflicts. It typically achieves this goal through the use of study committees composed of expert volunteers from acadmic and other institutions. BEST's oversight is shared by the National Research Council's Commission on Life Sciences and Commission on Geosciences, Environment, and Resources. BEST's three major programs are Human Toxicology and Risk Assessment (supporting the Committee on Toxicology, which has produced approximately 700 reports for military and civilian agencies since 1947), Applied Ecology and Biotic Resources, and Environmental Engineering and Physical Sciences. Among the many important documents prepared by BEST are *Science and Judgment in Risk Assessment*, *Animals as Sentinels of Environmental Health Hazards*, *Monitoring Human Tissues for Toxic Substances*, *Carcinogens and Anticarcinogens in the Human Diet*, and a series on biological markers. Most of BEST's reports are available from the National Academy Press. Contact:

Dr. James J. Reisa, Director
Board on Environmental Studies and Toxicology
National Research Council
Room HA354
2101 Constitution Avenue NW
Washington, DC 20418
Phone: 202-334-3060

Fax: 202-334-2752
E-mail: JREISA@nas.edu
Web: http://www4.nas.edu/cls/besthome.nsf

National Toxicology Program (NTP)

The NTP coordinates toxicology research and testing activities within the Department of Health and Human Services in order to provide information about potentially toxic chemicals to regulatory and research agencies and the public and to strengthen the science base in toxicology. A world leader in designing, conducting, and interpreting animal assays for toxicity, NTP consists of relevant toxicology activities of the National Institute of Environmental Health Sciences (NIH/NIEHS), the Centers for Disease Control and Prevention's National Institute for Occupational Safety and Health (CDC/NIOSH), and the Food and Drug Administration's National Center for Toxicological Research (FDA/NCTR). Primary scientific oversight is provided by the NTP Board of Scientific Counselors and its Technical Reports Review Subcommittee. Among the many important documents prepared by NTP are the *Biennial Report on Carcinogens*, containing a list of all substances which either are known to be human carcinogens or may reasonably be anticipated to be human carcinogens and to which a significant number of persons residing in the United States are exposed. Also invaluable are the *NTP Annual Plan* and the companion *Review of Current DHHS, DOE, and EPA Research Related to Toxicology*. NTP also issues many technical reports on its toxicology studies and short-term toxicity studies, as well as a management status report. To find out more about the National Toxicology Program, contact:

Dr. Larry Hart
NIEHS
P.O. Box 12233
Research Triangle Park, NC 27709
Phone: 919-541-3971
Fax: 919-541-0295
E-mail: hart@niehs.nih.gov
Web: http://ntp-server.niehs.nih.gov

Toxic Substances Control Act (TSCA) Interagency Testing Committee (ITC)

The TSCA ITC is an independent advisory committee to the EPA Administrator that was created in 1976 under section 4(e) of the Toxic Substances Control Act (TSCA). Sixteen U.S. government organizations are ITC members. The members nominate industrial chemicals to the ITC when their organizations need data that can be obtained through the ITC. Such data include unpublished production volume, use, exposure, monitoring, environmental fate, and ecological and health effects data. The ITC coordinates data needs for the nominated chemicals with those of other member organizations and determines if these chemicals should be (i) added to the Priority Testing List and recommended or designated for testing, (ii) deferred for testing and not added to the list, or (iii) removed from the list. By coordinating federal data needs and establishing partnerships with manufacturers, importers, processors, and users, the ITC provides an infrastructure to obtain information on industrial chemicals. Contact:

John Walker, PhD, MPH
Director, TSCA Interagency Testing Committee
U.W. EPA (7401)
401 M Street, SW
Washington, DC 20460
Phone: 202-260-1820
Fax: 202-260-7895
E-mail: walker.johnd@epamail.epa.gov

Toxicology Information Roundtable (TIR)

The TIR is an annual meeting of persons involved in information management in the areas of toxicology and environmental health and safety. It serves as an informal forum for information exchange among people with mutual concerns. No formal records are kept, nor is any documentation about the group or meetings available. The group is a mix of industry and government, information users, and producers, managers, and front-line staff. Attendance at the TIR is by invitation only to keep the group small enough for useful interactions, but there are no restrictions on who can be invited. The first TIR was hosted at the National Library of Medicine (NLM) in 1973; since then NLM representatives have participated in the annual meetings. Previous roundtables have been hosted by Dow, DuPont, Monsanto, Exxon, CIIT, Oak Ridge National Laboratory, ICI, FMC, Searle, Eli Lilly, Merck, and Chemical Abstracts Service. Typically, representatives from approximately 30–40 companies and government agencies will participate. The TIR operates without a staff, officers, or headquarters. For more general information about its activities, contact:

Associate Director
Division of Specialized Information Services
Toxicology and Environmental Health Information Program
National Library of Medicine
8600 Rockville Pike
Bethesda, MD 20894
Phone: 301-496-1131

United States Congress

United States Senate Committee on Environment and Public Works
410 Dirksen Senate Office Building
Washington, DC 20510-6175
Phone: 202-224-6176
E-mail: EPW-Web
Web: http://www.senate.gov/~epw/

Within the jurisdiction of this committee are environmental policy, research, and development; air, water, and noise pollution; construction and maintenance of highways; environmental aspects of Outer Continental Shelf lands; environmental effects of toxic substances other than pesticides; fisheries and wildlife; flood control and improvements of rivers and harbors; nonmilitary environmental regulation and control of nuclear energy; ocean dumping; public buildings and grounds; public works, bridges, and dams; regional economic development; solid waste disposal and recycling; and water resources. The following subcommittees would be of interest to the toxicology community:

Clean Air, Wetlands, Private Property, and Nuclear Safety Subcommittee

Fisheries, Wildlife, and Drinking Water Subcommittee

Superfund, Waste Control, and Risk Assessment Subcommittee

United States House Committee on Commerce
2125 Rayburn House Office Building
Washington, DC 20515
Phone: 202-225-2027
E-mail: Commerce@mail.house.gov
Web: http://www.house.gov/commerce

Subcommittee on Finance and Hazardous Materials

The jurisdiction of this subcommittee of interest to toxicologists includes solid waste, hazardous waste, and toxic substances, including Superfund and RCRA (excluding mining, oil, gas, and coal combustion wastes) and noise pollution control.

Subcommittee on Health and the Environment

The jurisdiction of this subcommittee includes public health and quarantine, hospital construction, mental health and research, biomedical programs and health protection in general, food and drugs, drug abuse, the Clean Air Act, and environmental protection in general, including the Safe Drinking Water Act.

This Page Intentionally Left Blank

CHAPTER

16

Education

SOCIETY OF TOXICOLOGY (SOT) AND SOCIETY OF ENVIRONMENTAL TOXICOLOGY AND CHEMISTRY (SETAC)

The very idea of being in a canoe in the waters off the New Jersey Turnpike was viscerally thrilling but this thrill was counterbalanced by a gnawing consideration of the toxicity of the environment.

(Robert Sullivan, *The Meadowlands: Wilderness Adventures at the Edge of a City*)

INTRODUCTION

This chapter consists of two directories of graduate programs in toxicology, which have recently been compiled by the Society of Toxicology (SOT) and the Society of Environmental Toxicology and Chemistry (SETAC). Specific faculty listings and financial aid information, included in the full SETAC listing, have been removed for this chapter. The directories in their entireties are available at the SOT (http://www.toxicology.org) and SETAC (http://www.setac.org) Web sites. Users are encouraged to visit the sites periodically for complete and up-to-the-minute versions.

The listings in this chapter are an excellent first step in researching graduate study in toxicology. Many commercial resource guides can also be used to locate schools offering programs at various levels, in such areas as toxicology and environmental health. Among these guides are:

Barron's Education Series (Barron's, Hauppauge, New York)
Lovejoy's Education Guides (Macmillan, New York)
Peterson's Graduate Program Guides (Peterson's, Princeton, New Jersey) (also available online through DIALOG and other vendors)
American Universities and Colleges (de Gruyter, New York)
World List of Universities and Other Institutions of Higher Education (Macmillan, London)

The World Wide Web is yet another resource for information about schools. One useful general site is http://www.gradschools.com. Below are other interesting sites with brief toxicology tutorials for nonprofessionals.

Health and Environment for the Lay Person
http://www.sciences.com/layperson
From Sciences International

Introduction to Applied Toxicology
http://www.bio.hw.ac.uk/edintox/page1.htm
From the Edinburgh Centre for Toxicology

Toxicology Education Study Unit
http://www.uoguelph.ca/cntc/educat/guide
From the Canadian Network of Toxicology Centres

Toxicology for the Citizen
http://www.iet.msu.edu/local/citizen.htm
From Michigan State University's Institute for Environmental Toxicology

Toxicology Problem Set
http://www.biology.arizona.edu/chh/problem_sets/toxicology/toxicology.html
From the University of Arizona's Southwest Environmental Health Sciences Center

Toxicology Tutor
http://sis.nlm.nih.gov/toxtutor.htm
From the National Library of Medicine's Toxicology and Environmental Health Information Program

Continuing education programs are provided by many of the groups listed in Chapter 15 of this book. Courses may be presented at their annual meetings and at other times or venues. These organizations are also making increasing efforts to present simplified concepts in toxicology and the broader area of environmental sciences to students at the secondary level and even to primary school students. Rutgers University, for instance, has developed ''TOXRAP'' instructional materials for grades K–9 (http://eohsi.rutgers.edu/rc/toxrap.html).

Other Web sites to consider:

The **British Society of Toxicology** provides information on continuing professional development and educational courses available in the UK at http://www.bts.org/register/education.html.

The **Chemical Industry Institute of Toxicology** offers training in toxicology to scientists at every career level and offers stipends and benefits (http://ciit.org/EDUCATION/edprog.html).

The **National Institute for Environmental Health Sciences** funds a variety of training programs (www.niehs.nih.gov/dert/programs/training/home.htm).

Extensive training opportunities are offered under the auspices of the **National Environmental Health Association** (http://www.neha.org).

RESOURCE GUIDE TO CAREERS IN TOXICOLOGY (PREPARED BY THE SOT)

Brown University
Program title: Pathobiology: Environmental Pathology
Degrees offered: Ph.D., M.D./Ph.D.

School of Medicine
Biomedical Center
Providence, RI 02912
Phone: 401-863-3119
Fax: 401-863-9008
Web: http://biomed.brown.edu/Biology-Programs/Pathobiology/themes.html

Program Strengths: Fiber Toxicology; Reproductive Toxicology; Metal Toxicology; Carcinogenesis; Signal Transduction; Stress and Immune Function

Chemical Industry Institute of Toxicology (CIIT)
Program title: Toxicology Training

6 Davis Drive
Research Triangle Park, NC 27709-2137
Phone: 919-558-1331
Fax: 919-558-1300
Web: http://www.ciit.org/EDUCATION/edprog.html

Program Strengths: Carcinogenesis; Endocrine, Developmental, and Reproductive Toxicology; Respiratory Toxicology; Neurotoxicology; Risk Assessment; Inhalation

Clemson University
Program title: Clemson Institute of Environmental Toxicology
Degrees offered: Ph.D., M.S.

Department of Environmental Toxicology
P.O. Box 709, 509 Westinghouse Road
Pendleton, SC 29670
Phone: 864-646-2961
Fax: 864-646-2260
Web: http://depts.clemson.edu/entox/

Program Strengths: Biochemical and Molecular Toxicology; Immunotoxicology; Aquatic Toxicology; Environmental Chemistry; Ecotoxicology; Ecological Risk Assessment and Risk Mitigation

Colorado State University
Program title: Environmental Toxicology
Degrees offered: M.S., Ph.D.

Department of Environmental Health
Environmental Health Building
Fort Collins, CO 80523-1676
Phone: 970-491-7038
Fax: 970-491-2940
Web: http://www.cvmbs.colostate.edu/cvmbs/ehtemp.html

Program Strengths: Physiologically Based Pharmacokinetic/Pharmacodynamic Modeling; Quantitative Toxicology and Risk Assessment; Analytical Toxicology; Toxicology of Chemical Mixtures; Biochemical Toxicology; Cellular and Molecular Toxicology

Duke University
Program title: Integrated Toxicology
Degree offered: Ph.D.
Medical Center and School of the Environment

Psychiatry Department
244 Sands-Research Drive (Box 3572)
Durham, NC 27710
Phone: 919-684-6989
Fax: 919-684-8894
Web: http://www.pharmacology.mc.duke.edu/itp.html

Program Strengths: Neurotoxicology; Developmental Toxicology; Oxidative Stress; Ecotoxicology/Aquatic Toxicology; Molecular Toxicology/Mechanisms

Florida A&M University
Program title: Environmental Toxicology Graduate Program
Degree offered: Ph.D.

College of Pharmacy
College of Pharmacy and Pharmaceutical Sciences
Tallahassee, FL 32307
Phone: 850-599-3871
Fax: 850-599-3351

Program Strengths: Metals Toxicology; Pesticide Toxicology; Neurotoxicology; Carcinogenesis

Indiana University
Program title: Division of Toxicology
Degrees offered: M.S., Ph.D., postdoctoral

Pharmacology and Toxicology Department
635 Barnhill Dr., Medical Science Building MS 1021
Indianapolis, IN 46202
Phone: 317-274-7824
Fax: 317-274-7787
Web: http://www.iupui.edu/~iutox/toxl.html

Program Strengths: Environmental Toxicology; Chemical Carcinogenesis; Forensic Toxicology; Hepatic Toxicology and Carcinogenicity; *In Vitro* Toxicology

Iowa State University
Program title: Interdepartmental Toxicology
Degrees offered: M.S., Ph.D.

Interdepartmental Toxicology
2102 Molecular Biology
Ames, IA 50011-3260
Phone: 515-294-3396
Fax: 515-294-6669
Web: http://molebio.iastate.edu/~L_Wild/toxhome.htm

Program Strengths: Aquatic Toxicology; Veterinary Toxicology; Agrichemicals and Mycotoxins; Insecticide Toxicology; Food Toxicology; Environmental Toxicology

Johns Hopkins University, School of Hygiene and Public Health
Program title: Toxicological Sciences
Degrees offered: M.H.S., Sc.M., Ph.D.

Environmental Health Sciences, Division of Toxicological Sciences
615 North Wolfe Street, Room 7032
Baltimore, MD 21205
Phone: 410-955-2913
Fax: 410-955-0116
Web: http://www.jhsph.edu/ehs

Program Strengths: Molecular Toxicology; Carcinogenesis; Neurotoxicology

Massachusetts Institute of Technology
Program title: Graduate Program in Toxicology
Degrees offered: Ph.D., S.M. in certain cases

Division of Bioengineering and Environmental Health
77 Massachusetts Ave., Room 56-651
Cambridge, MA 02139-4307
Phone: 617-253-1712
Fax: 617-258-8676
Web: http://web.mit.edu/beh/

Program Strengths: Cell Kinetics and Cancer; Extracellular Matrix and Cell Function; Bacterial Pathogenesis; Cancer Pharmacology; Carcinogenesis and Mutagenesis; DNA Repair and Recombination

Michigan State University
Program title: Multidisciplinary Graduate Program in Environmental Toxicology
Degree offered: Ph.D.

Institute for Environmental Toxicology
C231 Holden Hall
East Lansing, MI 48824-1206
Phone: 517-353-6469
Fax: 517-355-4603
Web: http://www.iet.msu.edu

Program Strengths: Biochemical Toxicology; Food Toxicology; Neurotoxicology; Carcinogensis; Lung Toxicology; Immunotoxicology

Mississippi State University
Program title: Environmental Toxicology Graduate Program
Degrees offered: M.S., Ph.D.

Center for Environmental Health Sciences/CVM
College of Veterinary Medicine, Box 9825
Mississippi State, MS 39762-9825
Phone: 662-325-1255
Fax: 662-325-1031
Web: http://www.cvm.msstate.edu/~cehs/

Program Strengths: Neurotoxicology; Biochemical Toxicology; Pesticide Toxicology; Pesticide Exposure Assessment; Neurochemistry; Endocrine Disruption

New York University
Program title: Environmental Toxicology Program
Degrees offered: M.S., Ph.D.

New York University School of Medicine
57 Old Forge Road
Tuxedo, NY 10987
Phone: 914-351-5480
Fax: 914-351-5472

Program Strengths: Respiratory Toxicology; Genetic and Molecular Toxicology; Aquatic Toxicology; Environmental Carcinogenesis

Northeast Louisiana University
Program title: Division of Toxicology
Degrees offered: B.S., M.S., Ph.D.

College of Pharmacy and Health Sciences
700 University Avenue
Monroe, LA 71209-0470
Phone: 318-342-1695
Fax: 318-342-3286
Web: http://www.nlu.edu/pharmacy/toxicology

Program Strengths: Neurotoxicology; Hepatotoxicology; Immunotoxicology; Aquatic Toxicology; Regulatory Toxicology; Pulmonary Toxicology

Northeastern University
Program title: Pharmaceutical Sciences/Toxicology
Degrees offered: B.S., M.S., Ph.D.

Pharmaceutical Sciences/Bouve College of Health Sciences
312 Mugar Hall, 360 Huntington Avenue
Boston, MA 02115
Phone: 617-373-3214
Fax: 617-373-8886
Web: http://www.pharmsci.neu.edu/Toxicology/Intro.html

Program Strengths: Respiratory Toxicology; Solvents; Extrahepatic Xenobiotic Metabolism

Oregon State University
Program title: Toxicology
Degrees offered: M.S., Ph.D.

Environmental and Molecular Toxicology
Agricultural and Life Sciences Bldg., Room 1007
Corvallis, OR 97331-7301
Phone: 541-737-3791
Fax: 541-737-0497
Web: http://www.ehsc.orst.edu/emt

Program Strengths: Xenobiotic Metabolism; Immunotoxicology; Environmental Toxicology; Genetic Toxicology; Carcinogenesis

Purdue University
Program title: Toxicology
Degrees offered: M.S., Ph.D.

School of Health Sciences
1338 Civil Engineering Building
West Lafayette, IN 47907-1338
Phone: 765-494-1419
Fax: 765-496-1377
Web: http://www.purdue.edu/HSCI

Program Strengths: Industrial Toxicology; Chemical Toxicology; Solvent Toxicology; Xenobiotic Metabolism

Rutgers, The State University of New Jersey
Program title: Joint Graduate Program in Toxicology
Degrees offered: M.S., Ph.D.

Department of Pharmacology and Toxicology/College of Pharmacy
EOHSI, 170 Frelinghuysen Rd.
Piscataway, NJ 08854-8020
Phone: 732-445-3720
Fax: 732-445-0119
Web: http://eohsi.rutgers.edu

Program Strengths: Biochemical Toxicology/ Carcinogenesis; Cellular and Molecular Toxicology; Neurotoxicology; Environmental Toxicology

University at Albany
Program title: Toxicology
Degrees offered: Ph.D., M.S.

Environmental Health and Toxicology
Wadsworth Center, C-236
Albany, NY 12201
Phone: 518-473-7553
Fax: 518-473-8520
Web: http://www.wadsworth.org/EHT/

Program Strengths: Biochemical Toxicology; Neurotoxicology; Immunotoxicology; *In Vitro* Toxicology; Molecular Epidemiology; Biomarkers

University of Alabama at Birmingham
Program title: Environmental Health/Toxicology
Degrees offered: M.S.P.H., Ph.D.

Environmental Health Sciences
1665 University Blvd., Ryals Building 317
Birmingham, AL 35294-0022
Phone: 205-934-8488
Fax: 205-975-6341
Web: http://www.uab.edu

Program Strengths: Genetic Susceptibility; Endocrine Disruptors; DNA Damage and Repair; Exposure Assessment

University of Alabama at Birmingham
Program title: Graduate Training Program in Toxicology
Degree offered: Ph.D.

Pharmacology and Toxicology
1670 University Blvd.
Birmingham, AL 35294-0019
Phone: 205-934-7139

Fax: 205-934-8240
Web: http://www.uab.edu/pharmtox

Program Strengths: Biochemical Toxicology; Environmental/Aquatic Toxicology; Clinical Pharmacology and Toxicology; Cancer Causation and Chemoprevention; Molecular and Cellular Toxicology; Reproductive/Developmental Toxicology

University of Arizona
Program title: Graduate Program in Pharmacology and Toxicology (Interdisciplinary)
Degrees offered: M.S., Ph.D.

College of Pharmacy
AHSC 5103, P.O. Box 245050
Tucson, AZ 85724-5050
Phone: 520-626-7218
Fax: 520-626-2204
Web: http://grad.admin.arizona.edu/idps/ptox/ptox.html

Program Strengths: Molecular and Cellular Toxicology; Carcinogenesis/Cancer Chemotherapy; Immunopharmacology/Toxicology; Biotransformation Toxicokinetics; *In Vitro* Toxicology; Environmental Toxicology

University of California, Davis
Program title: Graduate Training in Pharmacology and Toxicology
Degrees offered: M.S., Ph.D.

Pharmacology and Toxicology Graduate Group
One Shields Ave.
Davis, CA 95616
Phone: 530-752-4516
Fax: 530-752-3394
Web: http://www.envtox.ucdavis.edu/ptx

Program Strengths: Mechanistic Toxicology; Reproductive Toxicology; Inhalation (Lung) Toxicology; Ecotoxicology and Environmental Toxicology; Neurotoxicology; Agricultural Chemicals

University of California, Irvine
Program title: Environmental Toxicology
Degrees offered: M.S., Ph.D.

Department of Community and Environmental Medicine/College of Medicine
370 Medical Surge II
Irvine, CA 92697
Phone: 949-824-8642
Fax: 949-824-2793
Web: http://www.ucihs.uci.edu/envtox

Program Strengths: Inhalation Toxicology; Biochemical Neurotoxicology; Chemical Carcinogenesis; Chemical Pathology

University of California, Riverside
Program title: Environmental Toxicology Graduate Program
Degrees offered: M.S., Ph.D.

College of Natural and Agricultural Sciences
5429 Boyce Hall
Riverside, CA 92521
Phone: 909-787-4164
Fax: 909-787-3087
Web: http://cnas.ucr.edu/~etox/home.html

Program Strengths: Biochemical and Molecular; Carcinogenesis/Mutagenesis; Air Pollution; Risk Assessment; Bioremediation; Fate and Transport

University of Cincinnati, Department of Environmental Health, College of Medicine
Program title: Molecular Toxicology Graduate Program
Degrees offered: M.S., Ph.D.

Environmental Health/College of Medicine
P.O. Box 670056
Cincinnati, OH 45267-0056
Phone: 513-558-5704
Fax: 513-558-1756
Web: http://www.med.uc.edu/envhealth

Program Strengths: Genetic Determinants of Individual Susceptibility; Mutagenesis; Carcinogenesis; Signal Transduction; Transcriptional Activation; Pulmonary Toxicology; Risk Assessment; Integrate Physiology

University of Connecticut
Program title: Interdepartmental Toxicology Program
Degrees offered: M.S., Ph.D.

Pharmaceutical Sciences
372 Fairfield Road, U-92
Storrs, CT 06269-2092
Phone: 860-486-4265
Fax: 860-486-4998
Web: http://pharmacy.uconn.edu/departments_programs/Tox/default.htm

Program Strengths: Cellular/Molecular/Biochemical Toxicology; Lung, Liver and Kidney Toxicology; Immune and Nervous Systems Toxicology; Chemical Carcinogenesis; Environmental Biomarkers; Analytical Toxicology

University of Florida
Program title: Interdisciplinary Toxicology
Degree offered: Ph.D.

Center for Environmental and Human Toxicology
Box 110885
Gainesville, FL 32611-0885

Phone: 352-392-4700
Fax: 352-392-4707
Web: http://www.floridatox.org

Program Strengths: Xenobiotic Metabolism and Bioavailability; Reproductive and Developmental Toxicity; Hepatic and Renal Toxicity; Signal Transduction in Toxicity; Environmental Toxicity; Risk Assessment

University of Georgia
Program title: Interdisciplinary Graduate Program in Toxicology
Degrees offered: M.S., Ph.D.

Pharmaceutical and Biomedical Sciences, College of Pharmacy
D.W. Brook Drive
Athens, GA 30602-2352
Phone: 706-542-5403
Fax: 706-542-3398
Web: http://www.rx.uga.edu/main/home/toxi/toxi.html

Program Strengths: Environmental Health/Industrial Hygiene; Ecotoxicology and Wildlife Toxicology; Neurotoxicology; Toxicokinetics/ Risk Assessment; Radioecology; Molecular Toxicology

University of Illinois at Urbana-Champaign
Program title: Interdisciplinary Environmental Toxicology Program
Degrees offered: M.S., Ph.D.

Department of Veterinary Biosciences
2001 S. Lincoln Avenue
Urbana, IL 61802
Phone: 217-333-2506
Fax: 217-244-1652
Web: http://www.environ.uiuc.edu/et/default.htm

Program Strengths: Toxicologic Pathology; Endocrine Disruptors; Ecological Toxicology; Chemoprotection; Genetic Toxicology; Developmental Toxicology

University of Kansas Medical Center
Degree offered: Ph.D.

Department of Pharmacology, Toxicology and Therapeutics
3901 Rainbow Boulevard
Kansas City, KS 66160-7417
Phone: 913-588-7140
Fax: 913-588-7501

Program Strengths: Biochemical and Molecular Mechanisms; Endocrine Mechanisms; Disposition of Xenobiotics; Altered Gene Expression and Susceptibility to Toxicants; Organic and Inorganic Toxicants

University of Kentucky
Program title: Graduate Center for Toxicology
Degrees offered: M.S., Ph.D.

Graduate School
306 Health Sciences Research Building
Lexington, KY 40536-0305
Phone: 606-257-3760
Fax: 606-323-1059
Web: http://www.mc.uky.edu/toxicology/

Program Strengths: Chemical Carcinogenesis and DNA Repair; Metabolism, Transport, Toxicokinetics; Gene Regulation, Apoptosis, Oxidative Stress; Immunological Toxicology; Halogenated and Aromatic Hydrocarbons (PCBs, Dioxins, PAHs); Metals

University of Louisville
Program title: Pharmacology and Toxicology
Degrees offered: M.S., Ph.D.

Department of Medicine
Health Science Center
Louisville, KY 40292
Phone: 502-852-5141
Fax: 502-852-7868
Web: http://www.louisville.edu/medschool/pharmacology

Program Strengths: Molecular Pharmacogenetics; Biomarkers; Biochemical Toxicology; DNA Damage and Repair; Neuropharmacology and Toxicology; Biomolecular Analysis

University of Maryland
Program title: Program in Toxicology
Degrees offered: M.S., Ph.D.

100 N. Greene Street, Rm. 416
Baltimore, MD 21201
Phone: 410-706-8196
Fax: 410-706-6203

Program Strengths: Aquatic Toxicology; Neurotoxicology; Reproductive Toxicology; Cell Injury and Carcinogenesis; Molecular Epidemiology; Forensic Toxicology

University of Michigan
Program title: Toxicology Program
Degrees offered: M.P.H., M.S., Ph.D.

Environmental Health Sciences/School of Public Health
1420 Washington Heights
Ann Arbor, MI 48109-2029
Phone: 734-764-5410
Fax: 734-647-9770

Web: http://www.sph.umich.edu/eih/programs/tox.htm

Program Strengths: Developmental Toxicology; Neurotoxicology; Reproductive Toxicology

University of Nebraska
Program title: University of Nebraska Center for Environmental Toxicology
Degrees offered: M.S., Ph.D., tentative Jan. 2000

986895 Nebraska Medical Center
Omaha, NE 68198-6805
Phone: 402-559-8924
Fax: 402-559-8068
Web: http://www.unmc.edu/Eppley/ToxCenter

Program Strengths: Alcohol Toxicity; Biochemical and Molecular Toxicology; Carcinogenesis; Ecological/Environmental; Food Toxicology; Respiratory Biology and Inhalation Toxicology

University of New Mexico
Program title: Toxicology Program
Degrees offered: M.S., Ph.D.

College of Pharmacy
2502 Marble NE
Albuquerque, NM 87131
Phone: 505-272-0583
Fax: 505-272-6749
Web: http://hsc.unm.edu/pharmacy/tox.html

Program Strengths: Carcinogenesis and Signal Transduction; Developmental Toxicology; Immunotoxicology; Inhalation/Pulmonary Toxicology; Molecular Toxicology; Xenobiotic Metabolism

University of North Carolina at Chapel Hill
Program title: Curriculum in Toxicology
Degree offered: Ph.D.

CB 7270, 509 M.E. Jones Building
Chapel Hill, NC 27599
Phone: 919-966-4685
Fax: 919-966-6357
Web: http://www.med.unc.edu/toxicology/

Program Strengths: Biochemical/Molecular; Carcinogenesis and Mutagenesis; Hepatic; Neurotoxicology; Pulmonary; Risk Assessment

University of Oklahoma Health Sciences Center
Program title: Interdisciplinary Toxicology Program
Degrees offered: Ph.D., Postdoctoral Fellowship

Center for Toxicology/College of Pharmacy
1110 North Stonewall, CPB 232
Oklahoma City, OK 73117
Phone: 405-271-6593
Fax: 405-271-7477
Web: http://www.cpb.uokhsc.edu/tox

Program Strengths: Neurotoxicology; Metabolism; Free Radicals; Exposure Assessment; Solvents; Inhalation

University of Rochester School of Medicine and Dentistry
Program title: Molecular Toxicology and Environmental Medicine
Degree offered: Ph.D.

Department of Evnironmental Medicine
575 Elmwood Avenue, Box EHSC
Rochester, NY 14642
Phone: 716-275-6702
Fax: 716-256-2591
Web: http://www.envmed.rochester.edu/toxweb/welcome.html

Program Strengths: Neurotoxicology; Pulmonary Toxicology; Immunotoxicology and Carcinogenesis; Molecular Modifiers of Toxicology; Osteotoxicology

University of Texas at Austin
Program title: The Graduate Program in Toxicology
Degrees offered: M.S., Ph.D.

College of Pharmacy
200 University Avenue
Austin, TX 78712
Phone: 512-471-5096
Fax: 512-471-5002
Web: http://www.utexas.edu/pharmacy/divisions/pharmtox/

Program Strengths: Molecular Toxicology; Neurotoxicology; Apoptosis; Signal Transduction; Carcinogenesis

University of Texas Houston Health Science Center
Program title: Program in Toxicology
Degrees offered: M.S., Ph.D.

Graduate School of Biomedical Sciences
P.O. Box 20334
Houston, TX 77225
Phone: 713-500-9236
Fax: 713-500-9249
Web: http://www.uth.tmc.edu/schools/gsbs/toxicology/

Program Strengths: Molecular Mechanisms of Cell Death; Chemical Carcinogenesis; Respiratory Tract/ Immune Toxicology; Endocrine/ Reproductive/ Renal; Metabolism/ Chemotherapeutics; Air Toxics/ Environmental Toxicology

University of Texas Medical Branch, The
Program title: Interdisciplinary Curriculum in Toxicology

Graduate School of Biomedical Sciences
Department of Pathology
Galveston, TX 77555-0609
Phone: 409-772-3650
Fax: 409-747-1763
Web: http://www.utmb.edu/gsbs/toxweb.html

Program Strengths: Molecular/Structural Biology; Genetic Biomonitoring; DNA Repair; Pulmonary Toxicology; Oxidative Stress; Pathophysiology

University of the Sciences in Philadelphia
Program title: Pharmacology and Toxicology
Degrees offered: M.S., Ph.D.

Pharmaceutical Sciences
600 S. 43rd St.
Philadelphia, PA 19104
Phone: 215-596-8937
Fax: 215-596-8764
Web: http://www.usip.edu/graduate/pharmtox.html

Program Strengths: Broad Theoretical Training; Drug and Xenobiotic Metabolism; Mechanisms of Renal Toxicity; Oxidative Stress and Free Radicals; Tissue Culture and *In Vitro* Techniques

University of Utah
Program title: Pharmacology and Toxicology
Degree offered: Ph.D.

Department of Pharmacology and Toxicology
30 S 2000 E, Rm 201
Salt Lake City, UT 84112
Phone: 801-581-6287
Fax: 801-585-5111
Web: http://lysine.pharm.utah.edu/phtx/phtxhome.html

Program Strengths: Analytical Toxicology; Anticancer Natural Products; Bioactivation and Inactivation; Enzyme Regulation; Epilepsy Drug Development; Toxicity of Drugs of Abuse

University of Wisconsin, Madison
Program title: Environmental Toxicology Graduate Program
Degrees offered: M.S., Ph.D.

Environmental Toxicology Center
550 Babcock Drive, B157 Steenbock Library
Madison, WI 53706
Phone: 608-263-4580
Fax: 608-262-5245
Web: http://www.wisc.edu/etc/

Program Strengths: Mechanisms of Toxicity at the Molecular Level; Developmental Toxicology; Suppression of the Immune System; Damage to Ecosystems; Environmental Fate of Pollutants; Remediation and Risk Assessment

Vanderbilt University
Program title: Graduate Study and Postdoctoral Training in Toxicology and Carcinogenesis
Degree offered: Ph.D.

Biochemistry, Cell Biology, Chemistry, Medicine, Pathology, and Pharmacology
Center in Molecular Toxicology, Room 638 MRB I
Nashville, TN 37232-0146
Phone: 615-322-2261
Fax: 615-322-3141
Web: http://www.toxicology.mc.vanderbilt.edu

Program Strengths: DNA Damage and Carcinogenesis; Enzymology; Oxidative Damage; Neurotoxicology; Gene Regulation; Analytical Chemistry

Virginia–Maryland Regional College of Veterinary Medicine
Program title: Toxicology
Degrees offered: M.S., Ph.D.

1 Duck Pond Drive
Blacksburg, VA 24061
Phone: 540-231-4992
Fax: 540-231-7367
Web: http://milieu.grads.vt.edu
Web: http://education.vetmed.vt.edu/Education/Program/graduate/handbook/VM.S.handbook.html

Program Strengths: Neurotoxicology; Immunotoxicology; Toxicologic Pathology; Pesticide Toxicology; Free Radical Toxicology

Wayne State University
Program title: Graduate Program in Molecular and Cellular Toxicology
Degree offered: Ph.D.

Institute of Chemical Toxicology
2727 Second Avenue
Detroit, MI 48201
Phone: 313-577-0100
Fax: 313-577-0082
Web: http://www.wayne.edu/ict

Program Strengths: Gene Expression and Regulation by Environmental Chemicals; Transgenic/Gene Knockout Animal Models; Toxic Events and Call Signaling and Function; Mechanisms of Metals Toxicology; DNA Damage and Repair; Molecular Genetics

GRADUATE PROGRAMS IN ENVIRONMENTAL CHEMISTRY, ENVIRONMENTAL ENGINEERING, AND ENVIRONMENTAL TOXICOLOGY (PREPARED BY THE SETAC)

Alabama

Auburn University
Department of Agronomy and Soils
Soil Sciences and Plant Sciences
Degrees offered: M.S., Ph.D.
Titles of Degrees: M.S. in Plant Sciences, Ph.D. in Sciences, M.S. in Soil Sciences, Ph.D. in Soil Sciences

J. T. Touchton
Professor
Agronomy and Soils Department
202 Funchers Hall
Auburn University, AL 36849-5412
Phone: 334-844-3952
Fax: 334-844-3945

Areas of Specialization: Water Movement through Soils; Animal Waste Management; Ecology and Microbiology; Pesticide Movement and Degradation

University of Alabama at Birmingham
Environmental Toxicology Program
Degrees offered: M.S., Ph.D.
Titles of Degrees: M.S. in Public Health, Ph.D. in Public Health

Cherie Hunt
Program Coordinator
U.A.B. School of Public Health
317C Ryals Building
Birmingham, AL 35294-0022
Phone: 205-934-8488
Fax: 205-975-6341

Areas of Specialization: Dermal Toxicology; Reproductive Toxicology; Genetic Toxicology; Risk Assessment

Alaska

University of Alaska, Fairbanks
Program in Environmental Chemistry
Degrees offered: M.S., Ph.D.
Title of degree: Ph.D. in Environmental Chemistry

Lawrence K. Duffy
Program Coordinator
Department of Chemistry and Biochemistry
University of Alaska, Fairbanks
Fairbanks, AK 99775
Phone: 907-474-7525
Fax: 907-474-5101
Web: http://www.uaf.edu/chem

Areas of Specialization: Atmospheric Chemistry; Wildlife Toxicology; Human Toxicology; NO_2 and Sulfur Chemistry

Arizona

University of Arizona
Department of Pharmacology and Toxicology
Degrees offered: M.S., Ph.D.
Titles of Degrees: M.S. in Pharmacology and Toxicology, Ph.D. in Pharmacology and Toxicology

Edward D. French
Associate Professor and Chairman
Department of Pharmacology and Toxicology
The University of Arizona
AHSC 5103
Tucson, AZ 85724-5050
Phone: 520-626-7218
Fax: 520-626-2204
Web: http://grad.admin.arizona.edu/idps/ptox/ptox.html

Areas of Specialization: Environmental Toxicology; Metal Toxicology; *In Vitro* Toxicology; Biotransformation

Arkansas

Arkansas State University
Department of Biological Sciences
Degrees offered: M.S., Ph.D.
Titles of Degrees: M.S. in Biology, Ph.D. in Environmental Sciences

Lynita Cooksey
Chairman
Department of Biological Sciences
Arkansas State University
State University, AR 72467
Phone: 870-972-3082
Fax: 870-972-2638

Areas of Specialization: Ecotoxicology; Reproductive Toxicology; Agroecosystems; Biomarkers

California

University of California, Riverside
Environmental Toxicology Graduate Program
Degrees offered: M.S., Ph.D.
Titles of Degrees: M.S. in Environmental Toxicology, Ph.D. in Environmental Toxicology

Sarjeet S. Gill
Chair
University of California, Riverside
Environmental Toxicology
5429 Boyce Hall
Riverside, CA 92521
Phone: 909-787-4164
Fax: 909-787-3087
Web: http://cnas/vcr/edu/~etox/home.html

Areas of Specialization: Molecular/Cellular Toxicology; Air Pollution; Fate, Transport and Degradation of Toxicants; Environmental/Chemical Engineering

Colorado

Colorado State University
Department of Environmental Health
Environmental Health
Degrees offered: M.S., Ph.D.
Title of Degree: Environmental Health with specialization in Environmental Toxicology

Joyce Calder-Emanuel
Administrative Assistant
Department of Environmental Health
Colorado State University
Fort Collins, CO 80523-1676
Phone: 970-491-0294
Fax: 970-491-2940
Web: http://www.cvmbs.colostate.edu/cvmbs/environhealth/

Areas of Specialization: Wildlife Toxicology; Aquatic Toxicology; Residue Analysis; Molecular Toxicology

District of Columbia

The American University
Department of Chemistry and Department of Biology
Degree offered: M.S.
Title of Degree: M.S. in Toxicology

Nina M. Roscher
Professor and Chair
The American University
Department of Chemistry
4400 Massachusetts Ave., NW
Washington, DC 20016-8014
Phone: 202-885-1750
Fax: 202-885-1752
Web: http://www.american.edu/academic.depts/cas/chem

Areas of Specialization: Environmental Fate; Aquatic Toxicology; Environmental Mutagens

Florida

FAMU—Florida State University
College of Engineering
Chemical–Environmental Engineering
Degrees offered: M.S., Ph.D.
Titles of Degrees: M.S. in Chemical Engineering, Ph.D. in Chemical Engineering

Bruce R. Locke
Graduate Chair
Department of Chemical Engineering
FAMU—FSU College of Engineering
2525 Pottsdamer Street
Tallahassee, FL 32310-6046
Phone: 850-487-6151
Fax: 850-487-6150
Web: http://www.eng.fsu.edu/cheme

Areas of Specialization: Chemical–Environmental Engineering

Georgia

Georgia Institute of Technology
School of Biology
Degrees offered: M.S., Ph.D.
Titles of Degrees: Masters in Biology, Ph.D. in Biology

Terry Snell
Professor
School of Biology
Georgia Institute of Technology
Atlanta, GA 30332
Phone: 404-894-8906
Fax: 404-894-0519
Web: http://www.gatech.edu/biology

Areas of Specialization: Aquatic Toxicology; Soil Toxicology

Mercer University
Department of Biomedical and Environmental Engineering
Degrees offered: M.E.
Title of Degree: Master of Engineering in Environmental Engineering

Dr. Richard Miness
Director, Environmental Engineering
1400 Coleman Ave.
Macon, GA 31208
Phone: 912-752-2144

Idaho

Idaho State University
Environmental Engineering
Degrees offered: M.S., Ph.D.

Titles of Degrees: M.S. in Environmental Engineering/ College of Engineering, Ph.D. in Engineering and Applied Sciences

Solomon W. Leung
Associate Professor
College of Engineering
P.O. Box 8060
Idaho State University
Pocatello, ID 83204
Phone: 208-236-2524
Fax: 208-236-4538
Web: http://www.stuffle1.isu.edu/engrg/environ.html

Areas of Specialization: Physical/Chemical Treatment; Air Pollutant Transport; Modeling; Risk Assessment

Idaho State University
Hazardous Waste Management Program
Interdisciplinary
Degree offered: M.S.
Title of Degree: M.S. in Hazardous Waste Management

Dr. Edwin W. House
Dean of Research/Director
Campus Box 8130
Idaho State University
Pocatello, ID 83209
Phone: 208-236-3134
Fax: 208-236-4529
Web: http://www.isu.edu/departments/offrsch/home.html

Areas of Specialization: Bioremediation; Environmental Geology; Project Management; Health Physics

Illinois

Illinois Institute of Technology
Department of Chemical and Environmental Engineering
Degrees offered: M.S., Ph.D.
Titles of Degrees: M.S. in Environmental Engineering, Master of Environmental Engineering, Ph.D. in Environmental Engineering

Associate Chairman
Environmental Engineering Program
Illinois Institute of Technology
10 West 33rd Street, PN 127
Chicago, IL 60616
Phone: 312-567-3040
Fax: 312-567-8874
Web: http://www.chee.iit.edu

Areas of Specialization: Air Pollution Engineering; Chemical Engineering; Hazardous Waste Engineering; Water and Wastewater Engineering

Northwestern University
Environmental Health Engineering
Degrees offered: M.S., Ph.D.
Titles of Degrees: M.S. in Environmental Engineering, Ph.D. in Environmental Engineering

Bruce E. Rittman
Professor
Department of Civil Engineering
Northwestern University
2145 Sheridan Road
Evanston, IL 60208-3109
Phone: 847-491-8790
Fax: 847-491-4011
Web: http://www.civil.nwu.edu/ehe

Areas of Specialization: Environmental Biotechnology; Environmental Chemistry; Biogeochemistry; Bioremediation

Indiana

Indiana University
School of Public and Environmental Affairs
Degree offered: MSES
Title of Degree: M.S. in Environmental Science

Coordinator of Student Recruitment
Indiana University
School of Public and Environmental Affairs
SPEA 260
Bloomington, IN 47405
Phone: 812-285-2840
Fax: 812-855-7802
Web: http://www.indiana.edu/speaweb

Areas of Specialization: Applied Ecology: Environmental Chemistry; Hazardous Materials Management; Water Resources

Iowa

University of Northern Iowa
Environmental Science and Technology
Degree offered: M.S.
Title of Degree: M.S. in Environmental Science or Environmental Technology

Edward Brown
Director, Environmental Program
University of Northern Iowa
2234 McCollum
Cedar Falls, IA 50614-0421

Phone: 319-273-2645
Fax: 319-273-5815
Web: http://www.uni.edu/envprogs

Areas of Specialization: Hydrogeology; Applied Biochemistry; Applied and Environmental Microbiology; Sustainable Technology

Kansas

Kansas State University
Department of Agronomy
Environmental Soil Science
Degrees offered: M.S., Ph.D.
Titles of Degrees: M.S. in Agronomy, Ph.D. in Agronomy

Charles W. Rice
Professor of Soil Microbiology
Department of Agronomy
Throckmorton Hall
Kansas State University
Manhattan, KS 66506
Phone: 785-532-7217
Fax: 785-532-6094
Web: http://www.ksu.edu/agronomy

Areas of Specialization: Water Quality; Bioremediation of Contaminated Soil; Soil-Ecological Impacts of Global Climate Change; Environmental Fate of Agricultural Chemicals

Kansas State University
Comparative Toxicology
Degrees offered: M.S., Ph.D.
Titles of Degrees: M.S. in Toxicology, Ph.D. in Toxicology

Frederick W. Oehme
Professor/Director
Comparative Toxicology Laboratories
Kansas State University
Manhattan, KS 66506-5606
Phone: 785-532-4334
Fax: 785-532-4481

Areas of Specialization: Clinical Toxicology; Environmental Toxicology; Biochemical Toxicology; Diagnostic Toxicology

University of Kansas
Graduate Program in Environmental Engineering and Science
Degrees offered: M.S., Ph.D.
Titles of Degrees: M.S. in Environmental Engineering or Environmental Science, Ph.D. in Environmental Engineering or Environmental Science

Stephen J. Randtke
Professor
Civil and Environmental Engineering Department
University of Kansas
Lawrence, KS 66045
Phone: 913-864-3731
Web: http://www.civil-env.ce.ukans.edu

Areas of Specialization: Water Quality and Treatment; Bioremediation; Air Quality and Air Pollution Control; Wastewater Treatment; Solid and Hazardous Waste Management

Wichita State University
Interdisciplinary Program in Environmental Science
Degree offered: M.S.
Title of Degree: M.S. in Environmental Science

Dr. Michael Lydy
Assistant Professor
Wichita State University
Department of Environmental Science
Campus Box 26
Wichita, KS 67260-0026
Phone: 316-689-3111
Fax: 316-978-3772

Areas of Specialization: Environmental Toxicology; Environmental Chemistry; Environmental Geology

Kentucky

University of Kentucky
Graduate Center for Toxicology
Degrees offered: M.S., Ph.D.
Titles of Degrees: M.S. in Toxicology, Ph.D. in Toxicology

Dr. Mary Vore
Director and Professor
University of Kentucky
Graduate Center for Toxicology
306 Health Sciences Research Building
Lexington, KY 40536-0305
Phone: 606-257-3760
Fax: 606-323-1059
Web: http://www.mc.uky.edu/toxicology

Areas of Specialization: Chemical Carcinogenesis; Drug Metabolism and Disposition; Gene Regulation; Neurotoxicology

Louisiana

Louisiana State University
Department of Civil and Environmental Engineering
Degrees offered: M.S., Ph.D.

Titles of Degrees: M.S. in Civil Engineering, Ph.D. in Civil Engineering

John Pardue
Assistant Professor
Louisiana State University
Department of Civil and Environmental Engineering
3508 CEBA
Baton Rouge, LA 70803
Phone: 504-388-8661
Fax: 504-388-8652
Web: http://www.ce.lsu.edu

Areas of Specialization: Hazardous Waste; Wastewater Treatment; Modeling; Aquaculture

McNeese State University
Department of Biology and Environmental Science; Graduate Environmental Science Program
Degree offered: M.S.
Title of Degree: M.S. in Environmental Science

Mary Gay Haegler
Associate Professor
Department of Biology and Environmental Science
McNeese State University
P.O. Box 92000
Lake Charles, LA 70609
Phone: 318-475-5656
Fax: 318-475-5677
Web: http://www.mcneese.edu/colleges/cos/bioensc/enscgrad

Areas of Specialization: Aquatic Toxicology; Aquatic Pollution; Air Pollution; Industrial Hygiene/Risk Assessment

Northeast Louisiana University
Division of Toxicology
Aquatic Toxicology
Degrees offered: M.S., Ph.D.
Title of Degree: Pharmacy

Kevin N. Baer
Assistant Professor
Northeast Louisiana University
Division of Toxicology
700 University Avenue
Monroe, LA 71209-0400
Phone: 318-342-1698
Fax: 318-342-3286
Web: http://198.79.220.3/pharmacy

Area of Specialization: Aquatic Toxicology

Tulane University School of Medicine
Department of Pharmacology/Division of Toxicology
Degrees offered: M.S., Ph.D.
Title of Degree: Ph.D. in Toxicology/Pharmacology

William J. George
Professor
Tulane University School of Medicine
Department of Pharmacology
1430 Tulane Avenue
New Orleans, LA 70112
Phone: 504-588-5444
Fax: 504-588-5283
Web: http://www.tmc.tulane.edu/departments/pharmacology/info

Areas of Specialization: Environmental Toxicology; Occupational Toxicology; Mechanistic Toxicology; Aquatic Toxicology

University of Southwestern Louisiana
Department of Biology
Degrees offered: M.S., Ph.D.
Titles of Degrees: M.S. in Biology, Ph.D. in Environmental and Evolutionary Biology

Karl H. Hasenstein
Graduate Coordinator
Department of Biology
University of Southwestern Louisiana
P.O. Box 42451
Lafayette, LA 70504
Phone: 318-482-6750
Fax: 318-482-5834
Web: http://www.usl.edu/departments/biol

Area of Specialization: Aquatic Ecotoxicology

Maryland

Johns Hopkins University
Department of Geography and Environmental Engineering
Environmental Engineering and Chemistry
Degrees offered: M.S., Ph.D.
Titles of Degrees: M.S. in Environmental Chemistry, Ph.D. in Environmental Engineering and Chemistry

Ms. Carmelita King
Program Coordinator
Department of Geography and Environmental Engineering
The Johns Hopkins University
313 Ames Hall, 3400 North Charles Street
Baltimore, MD 21218-2686
Phone: 410-516-5533
Fax: 410-516-8996
Web: http://www.jhu.edu/~dogee/

Areas of Specialization: Aquatic Chemistry; Environmental Fate; Environmental Colloid Chemistry; Environmental Engineering

University of Maryland–Univers. College
Environmental Management
Degree offered: M.S.
Title of Degree: M.S. in Environmental Management

Robert G. Beauchamp
Associate Director
University of Maryland–Univers. College
Graduate School of Management and Technology
University Boulevard at Adelphi Road
College Park, MD 20742
Phone: 301-985-7200
Fax: 301-985-4611
Web: http://www.umuc.edu

Areas of Specialization: Land and Water Resource Management; Air Quality Management; Waste Management

Massachusetts

University of Massachusetts, Amherst
Environmental Engineering—Graduate Program
Degrees offered: M.S., Ph.D.
Titles of Degrees: M.S. in Environmental Engineering (ABET), M.S. in Civil Engineering, Ph.D. in Civil Engineering

Michael S. Switzenbaum
Professor and Program Coordinator
Department of Civil and Environmental Engineering
University of Massachusetts
P.O. Box 35205
Amherst, MA 01003-5205
Phone: 413-545-5393
Fax: 413-545-2202

Areas of Specialization: Water and Wastewater Treatment; Water Resources Engineering; Environmental Chemistry and Microbiology; Hazardous Waste Management

Michigan

Michigan State University
Multidisciplinary Program in Environmental Toxicology
Degrees offered: M.S., Ph.D.
Titles of Degrees: M.S. in Home Department with Specialization in Environmental Toxicology, Ph.D. in Home Department with Specialization in Environmental Toxicology

Lawrence J. Fischer
Director
Institute for Environmental Toxicology
C231 Holden Hall
Michigan State University
East Lansing, MI 48824
Phone: 517-353-6469
Fax: 517-355-4603
Web: http://www.iet.msu.edu

Areas of Specialization: Biochemical Toxicology; Food Toxicology; Aquatic and Wildlife Toxicology; Analytical Toxicology

Michigan Technological University
Civil and Environmental Engineering
Degrees offered: M.S., Ph.D.
Titles of Degrees: M.S. in Civil Engineering, Ph.D. in Engineering (Environmental)

James Mihelcic
Associate Professor
Michigan Technological University
1400 Townsend Drive
Hoaghton, MI 49931
Phone: 906-487-2324
Fax: 906-487-3292
Web: http://www.cee.mtu.edu

Areas of Specialization: Environmental Chemistry; Waste Treatment; Environmental Fate; Pollution Prevention

University of Michigan–College of Engineering
Environmental and Water Resources Engineering Program
Degrees offered: M.S., Ph.D.
Titles of Degrees: M.S. in Environmental Engineering or Civil Engineering, Hydraulics and Hydrology, Ph.D. in Environmental Engineering or Civil Engineering, Hydraulics and Hydrology

Steven J. Wright
Professor
University of Michigan
116 EWRE Bldg.
1351 Beal Avenue
Ann Arbor, MI 48109-2125
Phone: 734-764-9406
Fax: 734-763-2275
Web: http://www.engin.umich.edu/dept/cee

Areas of Specialization: Environmental Chemistry and Microbiology; Surface and Groundwater Hydrology; Hydraulics and Fluid Mechanics; Water Quality Engineering

University of Michigan
Department of Environmental and Industrial Health
Degrees offered: M.S., Ph.D.

Titles of Degrees: M.S. in Toxicology, M.S. in Industrial Health, M.S. in Environmental Health Sciences, M.S. in Nutritional Science, Ph.D. in Toxicology, Ph.D. in Industrial Health, Ph.D. in Environment Health Sciences

Khalid N. Mancy
Professor and Chair
Environmental and Industrial Health
School of Public Health
University of Michigan
109 South Observatory
Ann Arbor, MI 48109-2029
Phone: 734-764-3188
Fax: 734-936-7283
Web: http://www.sph.umich.edu/eih

Areas of Specialization: Environmental Health; Toxicology; Occupational Health; Human Nutrition

Mississippi

Jackson State University
Department of Environmental Science
Degree offered: M.S.
Title of Degree: M.S. in Environmental Science/Biology Department

Dr. Charles Rhyne
Director
Department of Biology
Jackson State University
Jackson, MS 39217
Phone: 601-968-7062
Fax: 601-974-5853

Areas of Specialization: Bio/Phyto Remediation; Vermicomposting; Aquatic Photochemistry; Microbial Ecotoxicology

Mississippi State University
Interdisciplinary Program in Environmental Toxicology
Degrees offered: M.S., Ph.D.
Titles of Degrees: M.S. in Veterinary Medical Sciences, Ph.D. in Environmental Toxicology

Dr. Janice Chambers
Professor
Mississippi State University
College of Veterinary Medicine
Box 9825
Mississippi State, MS
39762-9825
Phone: 601-325-1255
Fax: 601-325-1031

Areas of Specialization: Aquatic Toxicology; Biochemical Toxicology; Immunotoxicology; Neurotoxicology

New Jersey

Rutgers University
Graduate Program in Environmental Sciences
Environmental Sciences
Degrees offered: M.S., Ph.D.
Titles of Degrees: M.S., Ph.D. in Environmental Sciences

Dr. Alan Appleby
Graduate Program Director
Department of Environmental Sciences
Rutgers University–Cook College
14 College Farm Road
New Brunswick, NJ 08901-8551
Phone: 732-932-9081
Fax: 732-932-8644

Areas of Specialization: Pollution Prevention and Remediation; Aquatic and Soil Science; Radiation Science; Exposure Assessment

New York

Cornell University
Graduate Program in Environmental Toxicology
Degrees offered: M.S., Ph.D.
Titles of Degrees: M.S. in Environmental Toxicology, Ph.D. in Environmental Toxicology

Andrew Yen
Professor, Veterinary Path.
Environmental Toxicology Graduate Faculty Representative
T4-017B VRT
Cornell University
Ithaca, NY 14853
Phone: 607-253-3354
Fax: 607-253-3317
Web: http://www.cfe.cornell.edu/icet

Areas of Specialization: Cellular and Molecular Toxicology; Ecotoxicology and Environmental Chemistry; Nutritional and Food Toxicology; Bioremediation

Manhattan College
Program in Environmental Engineering
Degrees offered: M.S., M.E.
Titles of Degrees: M.S. in Environmental Engineering, Master of Engineering in Environmental Engineering

James A. Mueller
Chair, Environmental Engineering Department

Manhattan College
Manhattan College Parkway
Riverdale, NY 10471
Phone: 718-862-7276
Fax: 718-862-8018

Areas of Specialization: Water and Air Quality Modeling; Environmental Chemistry; Bioprocess Engineering; Hazardous Waste Management

University of Rochester
Degree offered: Ph.D.
Title of Degree: Ph.D. in Toxicology

Thomas A. Gasiewicz
Professor
University of Rochester
Department of Environmental Medicine
Box EHSC
Rochester, NY 14642
Phone: 716-275-7723
Fax: 716-256-2591
Web: http://www.envmed.rochester.edu

Areas of Specialization: Cellular and Molecular Toxicology; Pulmonary Toxicology; Reproductive and Developmental Toxicology; Neurotoxicology

North Carolina

Duke University
Nicholas School of the Environment
Environmental Sciences
Degrees offered: Ph.D., M.E.M.
Titles of Degrees: Ph.D. in Environmental Sciences, M.E.M. in Environmental Toxicology, Chemistry and Risk Assessment

Richard T. Di Giulio
Associate Professor
Nicholas School of the Environment
Duke University
Durham, NC 27708-0328
Phone: 919-613-8024
Fax: 919-684-8741

Areas of Specialization: Ecotoxicology; Molecular and Biochemical Toxicology; Environmental Chemistry; Ecological Risk Assessment

North Carolina State University
Department of Toxicology; Environmental Option
Degrees offered: M.S., Ph.D., M/Tox
Titles of Degrees: M.S. in Toxicology, Ph.D. in Toxicology

Gerald A. LeBlanc
Director of Graduate Programs
Department of Toxicology
Box 7633
North Carolina State University
Raleigh, NC 27695-7633
Phone: 919-515-7404
Fax: 919-515-7169

Areas of Specialization: Aquatic Toxicology; Wildlife Toxicology; Environmental Fate; Analytical Chemistry

University of North Carolina, Wilmington
Department of Chemistry
Chemistry
Degree offered: M.S.
Title of Degree: M.S. in Chemistry

Graduate Coordinator
University of North Carolina, Wilmington
Chemistry
601 South College Road
Wilmington, NC 28403-3297
Phone: 910-962-3450
Fax: 910-962-3013

Areas of Specialization: Atmospheric Chemistry; Biochemistry; Marine Chemistry; Toxicology

Ohio

Cleveland State University
Environmental Sciences
Degree offered: M.S.
Title of Degree: M.S. in Environmental Science

Robert Wei
Associate Professor
Cleveland State University
Chemistry Department
Cleveland, OH 44115
Phone: 216-687-2421
Fax: 216-687-9298
Web: http://www.cestp.csuohio.edu/datactr/datactr.htm

Areas of Specialization: Environmental Chemistry; Environmental Geology; Ecology; Environmental Planning

The Ohio State University
Department of Civil and Environmental Engineering
Degrees offered: M.S., Ph.D.
Titles of Degrees: M.S. in Civil Environmental Engineering, Ph.D. in Civil and Environmental Engineering

Earl Whitlatch
Associate Professor
Department of Civil and Environment Engineering

Ohio State University
2070 Neil Avenue
Columbus, OH 43210
Phone: 614-292-8155
Fax: 614-292-3780

Areas of Specialization: Water and Wastewater Treatment; Environmental Systems Analysis; Water Quality Modeling; Hazardous Waste Treatment

Wright State University
Environmental Science
Degree offered: M.S.
Title of Degree: M.S. in Biology, Chemistry, or Geology with Environmental Science Core

G. Allen Burton, Jr.
Director and Professor
Institute for Environmental Quality
Wright State University
3640 Colonel Glenn Highway
Dayton, OH 45435
Phone: 937-775-2201
Fax: 937-775-4997
Web: http://www.wright.edu/academics/ieq

Areas of Specialization: Aquatic Toxicology; Avian Immunotoxicology; Natural Product Toxins; Environmental Chemistry; Environ. Hydrogeology

Pennsylvania

Drexel University
School of Environmental Science, Engineering and Policy
Environmental Science and Environmental Engineering
Degrees offered: M.S., Ph.D.
Titles of Degrees: M.S. in Environmental Engineering or Environmental Science, Ph.D. in Environmental Engineering or Environmental Science

Kimberly Smith
Assistant to the Director
Drexel University
3141 Chestnut Street
Abbotts Building, Room 303
Philadelphia, PA 19104
Phone: 215-895-2272
Fax: 215-895-2267
Web: http://www.coas.drexel.edu/environ

Areas of Specialization: Water and Wastewater Treatment; Environmental Chemistry; Environmental Biotechnology; Subsurface Contaminant Hydrology

University of Pittsburgh
Department of Civil and Environmental Engineering
Environmental Engineering
Degrees offered: M.S., Ph.D.
Titles of Degrees: M.S. in Civil and Environmental Engineering, Ph.D. in Civil and Environmental Engineering

Frederick G. Pohland
Professor and Weidlein Chair
Department of Civil and Environmental Engineering
University of Pittsburgh
1140 Bendedum Hall
Pittsburgh, PA 15261
Phone: 412-624-1880
Fax: 412-624-0135
Web: http://www.engrng.pitt.edu

Areas of Specialization: Environmental Sciences; Environmental Assessment and Remediation; Water and Wastewater Treatment; Solid and Hazardous

South Carolina

Medical University of South Carolina
Master of Science in Environmental Studies
Degree offered: M.S.
Title of Degree: M.S. in Environmental Studies

Dodie Weise
Administrative Assistant
Medical University of South Carolina
Environmental Studies Program
Room 1151, Rutledge Tower
Charleston, SC 29425-2502
Phone: 843-876-1144
Fax: 843-876-1146
Web: http://www.cofc.edu/~environ/main.htm

Areas of Specialization: Policy; Risk Assessment; Science

University of South Carolina
Department of Environmental Health Sciences
Public Health
Degrees offered: M.S., Ph.D., MHP
Titles of Degrees: M.S. in Public Health, Master in Public Health, Ph.D. in Health with a Major in Environmental Health Sciences

Dr. Edward O. Oswald
Graduate Director
Department of Environmental Health Sciences
University of South Carolina
U.S.C. School of Public Health
Columbia, SC 29208
Phone: 803-777-6994

Fax: 803-777-3391
Web: http://www.enhs.sc.edu/

Areas of Specialization: Aquatic Toxicology; Biochemical Toxicology; Public Health–Toxicology

South Dakota

South Dakota State University
Department of Chemistry and Biochemistry
Degrees offered: M.S., Ph.D.
Titles of Degrees: M.S. in Chemistry, Ph.D. in Chemistry

James Rice
Professor of Chemistry
South Dakota State University
Chemistry Department
Box 2202
Brookings, SD 57007-0896
Phone: 605-688-4252
Fax: 604-688-6364
Web: http://www.sdstate.edu/~wchm/http/index.html

Areas of Specialization: Environmental Geochemistry; Environmental Surface Science; Contaminant Fate; Pesticide Analysis

South Dakota State University
Department of Environmental Toxicology
Degrees offered: M.S., Ph.D.
Titles of Degrees: M.S. in Chemistry, Ph.D. in Chemistry

Don Evenson
Professor of Chemistry
Department of Chemistry/Biochemistry
South Dakota State University
Box 2202
Brookings, SD 57027-0896
Phone: 605-688-5475
Fax: 605-688-6295
Web: http://www.sdstate.edu/~wchm/http/index.html

Areas of Specialization: Reproductive Toxicology; Flow Cytometry

Tennessee

Tennessee Technological University
Civil and Environmental Engineering
Degrees offered: M.S., Ph.D.
Titles of Degrees: M.S. in Civil Engineering, Ph.D. in Engineering

William P. Bonner
Chairperson
Department of Civil and Environmental Engineering
Tennessee Technological University
Cookeville, TN 38505
Phone: 931-372-3454
Fax: 931-372-6352

Area of Specialization: Environmental Engineering

University of Memphis
Graduate Program in Biology
Degrees offered: M.S., Ph.D.
Titles of Degrees: M.S. in Biology, Ph.D. in Biology

Kurt J. Maier
Assistant Professor
Department of Biology
University of Memphis
Memphis, TN 38152-0001
Phone: 901-678-2327
Fax: 901-678-4457

Areas of Specialization: Aquatic Toxicology; Ecotoxicology; Mutagenesis; Microbial Toxicology

University of Tennessee
Department of Chemistry
Degrees offered: M.S., Ph.D.
Titles of Degrees: M.S. in Chemistry, Ph.D. in Chemistry

Michael J. Sepaniak
Department Head
Department of Chemistry
University of Tennessee
552 Buehler Hall
Knoxville, TN 37996-1600
Phone: 423-974-3141
Fax: 423-974-3454
Web: http://www.chem.utk.edu

Areas of Specialization: Environmental Analysis; Remediation Chemistry; Atmospheric Chemistry

Texas

Texas A&M University
Intercollegiate Faculty of Toxicology
Degrees offered: M.S., Ph.D.
Titles of Degrees: M.S. in Toxicology, Ph.D. in Toxicology

Chair
Texas A&M University
Faculty of Toxicology
Mail Stop 4461
College Station, TX 77843-4461

Phone: 409-845-5529
Fax: 409-862-4929
Web: http://www.cvm.tamu.edu/tox

Areas of Specialization: Molecular/Cellular Toxicology; Veterinary, Environmental and Food Toxicology; Developmental/Reproductive Toxicology; Behavioral and Neurotoxicology

University of Houston, Clear Lake
Program in Environmental Science
Degree offered: M.S.
Title of Degree: Masters in Environmental Science

Cynthia L. Howard
Associate Professor
Biological and Environmental Sciences
School of Natural and Applied Sciences
University of Houston, Clear Lake
2700 Bay Area Blvd.
Houston, TX 77058
Phone: 281-283-3745
Fax: 281-283-3707
Web: http://www.cl.uh.edu

Areas of Specialization: Environmental Biology; Environmental Chemistry; Environmental Geology; Industrial Hygiene and Safety

William Marsh Rice University
Department of Environmental Science and Engineering
Environmental Science and Engineering
Degrees offered: M.S., Ph.D., MES, MEE

P. B. Bedient
Chair and Professor
6100 Main Street
MS 317
Houston, TX 77005-1892
Phone: 713-527-4953
Fax: 713-285-5203
Web: http://www.ruf.rice.edu/~envi/

Areas of Specialization: Surface Hydrology; Biochemical Engineering; Environmental Chemistry; Environmental Microbiologies

Virginia

George Mason University
Environmental Science and Public Policy
Degrees offered: M.S., Ph.D.
Titles of Degrees: M.S. in Biology with a specialization in Environmental Science and Public Policy, Ph.D. in Environmental Science and Public Policy

Claudia Hamblin-Katnik
Assistant Director
George Mason University
MSN: 3E1
4400 University Drive
Fairfax, VA 22030
Phone: 703-993-3187
Fax: 703-993-1046
Web: http://www.gmu.edu

Areas of Specialization: Aquatic; Wildlife; Bioremediation; Wetland

Virginia Polytechnic Institute and State University
Department of Civil and Environmental Engineering
Degrees offered: M.S., Ph.D.
Titles of Degrees: M.S. in Environmental Engineering, Environmental Science and Engineering, and Civil Engineering, Ph.D. in Civil Engineering, Ph.D. in Environmental Science and Engineering

John T. Novak
Chairman of Environmental Engineering
Department of Civil Engineering
VPI and SU
Blacksburg, VA 24061
Phone: 540-231-6132
Fax: 540-231-7916
Web: http://www.ce.vt.edu/enviro/enveng.html

Areas of Specialization: Water/Wastewater Treatment; Environmental Toxicology; Environmental Modeling; Industrial and Hazarous Waste Management

Old Dominion University
Department of Chemistry
Degrees offered: M.S., Ph.D.
Titles of Degrees: M.S. in Chemistry, Ph.D. in Oceanography

John R. Donat
Associate Professor
Department of Chemistry and Biochemistry
Old Dominion University
Norfolk, VA 23529-0126
Phone: 757-683-4098
Fax: 757-683-4628
Web: http://www.odu.edu/~chem

Areas of Specialization: Aquatic Trace Metal Biogeochemistry; Aquatic Organic Photochemistry; Atmospheric Chemistry; Pollution Monitoring/Remediation

College of William and Mary
Department of Environmental Science
Marine Science
Degrees offered: M.S., Ph.D.

Titles of Degrees: M.S. in Marine Science, Ph.D. in Marine Science, Ph.D. in Environmental Toxicology

Morris H. Roberts, Jr.
Professor and Chair
College of William and Mary
Virginia Institute of Marine Science
P.O. Box 1346
Gloucester Point, VA 23062
Phone: 804-684-7260
Fax: 804-684-7186
Web: http://www.vims.edu/env/

Areas of Specialization: Aquatic Toxicology; Ecotoxicology; Environmental Chemistry; Risk Assessment

Washington

Western Washington University
Huxley College of Environmental Studies
Degree offered: M.S.
Title of Degree: Masters in Environmental Science

John T. (Jack) Hardy
Professor and Director
Huxley College of Environmental Studies
MS 9181
Western Washington University
Bellingham, WA 98225-9181
Phone: 360-650-6108
Fax: 360-650-7284

Areas of Specialization: Aquatic Toxicology; Environmental Chemistry; Risk Assessment; Regional, Global and Terrestrial Ecosystems

West Virginia

West Virginia University
Department of Pharmacology and Toxicology
Degrees offered: M.S., Ph.D.
Titles of Degrees: M.S. in Pharmacology and Toxicology; Ph.D. in Pharmacology and Toxicology

Charles R. Craig, Professor
Director of Graduate Studies
Department of Pharmacology and Toxicology
West Virginia University
Robert C. Byrd Health Sciences Center
P.O. Box 9223
Morgantown, WV 26506-9223
Phone: 304-293-5795
Fax: 304-293-6854
Web: http://www.hsc.wvu.edu/som/pcol_tox/pcoltox.htm

Areas of Specialization: Pulmonary Toxicology; Hepatic Toxicology; Renal Toxicology; Inflammation

Wisconsin

University of Wisconsin, La Crosse
Department of Biology and Microbiology
Degree offered: M.S.
Title of Degree: M.S. in Biology

Mark B. Sandheinrich
Graduate Program Director
University of Wisconsin, La Crosse
Department of Biology and Microbiology
River Studies Center
La Crosse, WI 54601
Phone: 608-785-8261
Fax: 608-785-6959

Areas of Specialization: Aquatic Toxicology; Aquatic Ecology; Limnology; Aquatic Science

Wyoming

University of Wyoming
Department of Zoology and Physiology
Degrees offered: M.S., Ph.D.
Titles of Degrees: M.S. in Zoology and Physiology, M.S. in Neuroscience, M.S. in Pathobiology, Ph.D. in Zoology and Physiology, Ph.D. in Neuroscience

Joseph S. Meyer
Assistant Professor
Department of Zoology and Physiology
University of Wyoming
Laramie, WY 82071
Phone: 307-766-2017
Fax: 307-766-5625
Web: http://www.uwyo.edu/a&s/zoology/zohmpage.htm

Areas of Specialization: Aquatic and Terrestrial Toxicology; Environmental Fate of Chemicals; Physiology; Microbiology

British Columbia

University of British Columbia
Division of Pharmacology and Toxicology, Faculty of Pharmaceutical Sciences
Degrees offered: M.S., Ph.D.
Titles of Degrees: M.S. in Toxicology, Ph.D. in Toxicology

G. D. Bellward
Associate Dean
Graduate Studies and Res.
Faculty of Pharmaceutical Sciences
The University of British Columbia
2146 East Mall

Vancouver, B.C. V6T 1Z3 CANADA
Phone: 604-822-4103
Fax: 604-822-3035
Web: http://www.pharm.ubc.ca

Areas of Specialization: Molecular Mechanisms; Toxicokinetics; Metabolism; Analytical Chemistry

Ontario

Trent University
Watershed Ecosystems Graduate Program
Toxicology and Ecology
Degrees offered: M.S., Ph.D.
Titles of Degrees: M.S. in Watershed Ecosystems, Ph.D. in Watershed Ecosystems

J. M. Buttle
Professor
Watershed Ecosystems Graduate Program
Trent University
1600 West Bank Drive
Peterborough, ON K9J 7B8
Canada
Phone: 705-748-1475
Fax: 705-748-1026
Web: http://www.trentu.ca

Areas of Specialization: Aquatic Toxicology; Ecological Processes; Physical Environmental Processes; Chemical Environmental Processes

University of Waterloo
Department of Biology
Degrees offered: M.S., Ph.D.
Titles of Degrees: M.S. in Biology, Ph.D. in Biology

Marion Brown
Graduate Secretary
University of Waterloo
Department of Biology
Waterloo, ON N2L 3G1
Canada
Phone: 519-888-4567
Fax: 519-746-0614
Web: http://www.uwaterloo.ca

Areas of Specialization: Environmental Toxicology; Limnology; Environmental Chemistry; Environmental Biology

Saskatchewan

University of Saskatchewan
Toxicology Graduate Program
Degrees offered: M.S., Ph.D., PGD
Titles of Degrees: M.S. in Toxicology, Ph.D. in Toxicology, PGD in Toxicology

Coordinator, Academic Programs
Toxicology Center
University of Saskatchewan
44 Campus Drive
Saskatoon, SK S7N 5B3
Canada
Phone: 306-966-7441
Fax: 306-966-1664
Web: http://www.usask.ca/toxicology

Areas of Specialization: Environmental/Ecological; Clinical/Veterinary and Wildlife; Analytical/Forensic; Clinical/Human

This Page Intentionally Left Blank

CHAPTER

17

Grants and Other Funding Opportunities

FREDERICK W. STOSS AND PHILIP WEXLER

Toxic waste, poison air, beach goo, eroded roads draw nations together, whereas magnanimous platitude and sweet semblance ease each nation back into its comfort or despair

(A. R. Ammons, *Garbage*)[1]

Competition for research funds has always been a problem for researchers investigating various aspects of toxicology and environmental health. The availability of funds required to support staff, equipment, and supplies for laboratory, clinical, and field research is unpredictable from year to year and is subject to a wide variety of influences, some of which unfortunately have very little to do with science. Funding priorities of federally sponsored programs may shift dramatically and suddenly. In addition, the increased costs of conducting research and the increased numbers of, applicants for decreasing or limited amounts of funding intensify the overall competitiveness of the process of securing support and funding toxicology research.

Schools of public health, medical research universities, government agencies, and nonprofit and for-profit research and testing laboratories are all vying for limited funding, which obviously limits the extent of research which can be conducted.

However, new analytical procedures, growing regulatory compliance factors, and other legal issues are increasing the demand for sound toxicology research. Toxicologists need to become adept at considering creative research funding mechanisms.

There are more than 70,000 chemicals in commerce, the overwhelming majority of which have not been characterized toxicologically. Inadequate monitoring, testing, and evaluation of these chemicals poses potentially serious societal problems.

Federal, state and local governments, industries and businesses, academic institutions, philanthropic trusts and foundations, professional societies and associations, and the public need to work cooperatively to expand toxicological testing and monitoring programs for new and existing chemicals, especially for those chemicals and hazardous agents to which the public is significantly exposed. To adequately fund this research, comprehensive and coordinated funding programs and creative funding strategies need to be implemented to maximize the effectiveness of toxicology research dollars.

Many colleges and most research universities have administrative offices or departments devoted to sponsored programs services [e.g., State University of New York (SUNY) at Buffalo Sponsored Programs Administration at http://wings.buffalo.edu/spa]. These offices serve as liaisons between grant-making groups (and other funding sources) and those faculty and staff seeking and preparing grants. These program offices typically provide comprehensive links useful for applying for grants, including institution-specific requirements and guidelines and other grants-related resources. They may provide an overview of the many items

[1] From GARBAGE by A. R. Ammons. Copyright © 1993 by A. R. Ammons. Reprinted by permission of W. W. Norton & Company, Inc.

and documentation required to complete grant and contract applications, including links to Internet resources.

Libraries of many colleges, universities, and larger nonprofit groups typically provide access to resources and services to assist in the identification of grants and grant sources, grant-making guides, library–specific resources, and compilations of Internet resources. For example, *Grants: A Guide to Selected Resources* is a print and online guide (http://ublib.buffalo.edu/libraries/units/lml/Collections/docs/grants.html) prepared by librarians in the Lockwood Memorial Library at the SUNY at Buffalo. This guide lists selected resources for identifying grant and other funding support, including reference books owned by the University Libraries, other university and western New York resources, and links to grant resources on the Internet.

In addition to this SUNY at Buffalo library resource is a Web site, Biology—Grants and Grant-Making (http://ublib.buffalo.edu/libraries/units/sel/bio/grants.html), which is maintained by the author. Nearly all the Internet resources listed in this chapter are found in this compilation. It is best to check your institution's library or the public library to find additional resources related to grants and grant making.

In addition to the specific resources provided here, the reader is encouraged to consult individual organizations and agencies listed elsewhere in this book. Newsletters are other potential sources for information on the availability of research funding and grants.

REFERENCE BOOKS

Annual Register of Grant Support
National Register Publishing Co., Wilmette, IL

Provides grant programs of government agencies, public and private foundations, corporations, community trusts, unions, professional societies and associations, and educational and special interest groups.

Catalog of Federal Domestic Assistance
U.S. Government Printing Office, Washington, DC

A comprehensive compendium of federal government assistance programs administered by more than 50 agencies, including those providing support for toxicology research.

Corporate 500: The Directory of Corporate Philanthropy
Public Management Institute, San Francisco, CA

Lists private corporations that have given $500,000 or more in grants.

Corporate Foundation Profiles
The Foundation Center, New York, NY

More than 3000 programs on human health and biomedicine are profiled.

Directory of Grants in the Physical Sciences
Oryx Press, Phoenix, AZ

More than 1500 funding programs for undergraduate, graduate, and postgraduate study are found. Includes descriptions of individual programs, requirements, eligibility, and restrictions.

Directory of Research Grants
Oryx Press, Phoenix, AZ

Lists research funding in all areas of study, including the life, physical, and medical sciences.

Environmental Grant-Making Foundations, 1999, 6th Edition
Resources for Global Sustainability, Cary, NC

The most comprehensive directory of nongovernmental grant resources covering the environment. More than 800 foundations and trusts are inventoried. Each entry is provided a point of contact, requirements and deadlines for submission of preliminary communications and grant applications, size of grants, funding history, sample projects funded, eligibility requirements, and restrictions. Solid wastes (124) (numbers represent the number of entries for that category in the 1999 edition of the directory) and toxic wastes (139) are among the environmental issues covered. An environmental topics and activities index includes entries for environmental health (66); environmental information (5); environmental justice (42); health hazards/risks (5); health: maternal and child (5); herbicides (5); pesticides (25); pesticides: education (4); pesticides: environmental hazards (10); pesticides: health hazards (2); toxic/hazardous substances (77); toxic/hazardous substances: lead (13); toxic/hazardous substances: military (9); toxic/hazardous substances: source reduction (15); toxic/hazardous waste (26); toxic/hazardous wastes: brownfields (18); toxic/hazardous waste: cleanup (15); toxic/hazardous waste: disposal (8); toxic/hazardous wastes: household (2); toxic/hazardous wastes: incineration (2); toxic/hazardous wastes: source/use reduction (11); and toxic substances (183). Available as a searchable CD-ROM database for Windows 95 and above.

Foundation 1000
The Foundation Center, New York, NY

Profiles of the 1000 largest U.S. foundations.

The Foundation Center's Guide to Proposal Writing
The Foundation Center, New York, NY

Provides an overview of grant writing, including the six steps for successfully writing grants. Appendices include practical aids, including a bibliography, a sample proposal, and other useful resources.

Foundation Grants Index
The Foundation Center, New York, NY

Provides a listing of grants of $5000 and greater. A useful tool to examine the types of funding support available for specific grant funding areas.

Grants Register
St. James Press, Chicago, IL

A guide for students (graduate and postdoctoral) and professionals seeking support for training and education. Provides lists of scholarships, grants, travel grants, scientific exchange programs, grants-in-aid, funds to attend conferences and seminars, prizes, and honoraria.

Grant Seekers Guide
Moyer Bell, Mt. Kisco, NY

Provides funding sources for small, nonprofit organizations and centers, especally those involved in community activism and social change. Includes chapter on grant making and preparation of proposals.

Grants for Information Technology
The Foundation Center, New York, NY 1998/1999

With increased attention to data and information management, data archives, communication, and new technologies such as the Internet, World Wide Web, and CD-ROMs. This book provides information on nearly 2,500 grants made by 385 foundations mostly in 1996 and 1997 covering a broad spectrum of information technologies.

Guide to Grants, Fellowships, and Scholarships in International Forestry and Natural Resources
U.S. Department of Agriculture, U.S. Forest Service, Washington, DC, 1995 (1997 revised edition available only on the World Wide Web: www.fs.fed.us/people/gf/gf00.htm)

Detailed profiles of nearly 80 individual private and public agencies, organizations, or foundations that support research in areas related to forestry and natural resources (many of the groups listed also support various toxicology, ecotoxicology, and environmental health issues). Includes sections for funds available to minorities and women. The last chapter provides an inventory of Internet resources: home pages of commercial, federal agencies, nonprofit organizations and universities (grant assistance or sponsored programs offices), and selected online guides for locating grants, fellowships, and scholarships. Includes a 12-page bibliography of print resources. The 1997 Web version does not provide the inventory of university sites. However, additional sites have been added for undergraduate and graduate financial aid resources.

A Guide to NIH Grant Programs
Oxford University Press, New York, NY, 1992

The National Institutes of Health (NIH) is perhaps the single largest source of federal government support for activities associated with the topics of toxicology, environmental health, environmental medicine and allied disciplines. In fiscal year 1991 over 80% of the NIH budget of over $8 billion was allocated to support extramural grants and contracts. The authors of this guide report that each year about 40,000 biomedical and behavioral researchers apply to the U.S. Public Health Service for support of their research and that a vast majority of those applications directed to the NIH (for example, the National Institute of Environmental Health Sciences Superfund Basic Research Program in 1995 funded 142 separate research projects within 18 programs encompassing 29 universities and institutions around the United States). The process of applying for NIH funds is complex and includes a rigorous peer-review system, and numerous quality controls to ensure the funding of research. Knowledge of the NIH process for reviewing grants is essential when applying for NIH grants. This book was written to organize and highlight significant information about NIH grants and programs and to generally assist scientists working in biomedical research to gain a better understanding of the process of finding and obtaining grant support from NIH.

International Encyclopedia of Foundations
Gale Research Corporation, Detroit, MI

International foundations and grant-making organizations worldwide are profiled.

National Directory of Corporate Giving
The Center, New York, NY

Provides profiles of more than 1500 corporations and companies contributing to nonprofit, nongovernmental organizations. Public, academic, and special libraries can be particularly helpful in locating print resources related to grant funding (and information related to scholarships, fellowships, and other sources of private and public funding). Obvious Library of

Congress subject headings are Fund Raising and Grants-in-Aid, and related subject headings include Federal Aid to Research, Research Grants, Scholarships, Research Grants, and Student Aid. In addition to these terms being used as primary indexing terms, they are more effectively used as secondary indexing terms, such as Toxicology-Research Grants or Toxicology-Scholarships, Fellowships.

ONLINE SEARCHABLE DATABASES

Foundation Directory
The Foundation Center, New York, NY

Provides descriptions of more than 34,500 grant-making foundations.

Foundation Grants Index
The Foundation Center, New York, NY

Provides a listing of more than 300,000 grants awarded to nonprofit organizations by private foundations and trusts in the United States.

Grants
Oryx Press, Phoenix, AZ

Provides descriptions of grants available from federal, state, and local agencies, commercial organizations, trade and professional associations, and private foundations and trusts. This is the online equivalent of the merged editions of *Directory of Research Grants, Directory of Biomedical and Health Care Grants, Directory of Grants in the Physical Sciences,* and *Directory of Grants in the Humanities.*

Grants Database
CD-ROM database of resources on grants and grant making.

Note: The previous four databases are available from DIALOG/Knight-Ridder Information, Inc. See the ''Database Vendor'' section of Chapter 6.

TOXLINE
National Library of Medicine, Bethesda, MD (see the ''Database Vendor'' section of Chapter 6).

Toxicology Research Projects are covered in NLM's TOXLINE database through the CRISP subfile. CRISP contains information on research projects and programs supported by the Department of Health and Human Services. The CRISP TOXLINE subfile emphasizes that portion of CRISP related to toxicology. Information is obtained from the NIH Office of Extramural Research's Computer Retrieval of Information on Scientific Projects (CRISP) system database.

SELECTED INTERNET RESOURCES

Alexander Hollaender Distinguished Postdoctoral Fellowship Program
http://www.orau.gov/orise/edu/postgrad/alexh.htm

This site describes the U.S. Department of Energy's prestigious postdoctoral award for research opportunities in energy-related life, biomedical and environmental sciences.

American Fund for Alternatives to Animal Research—Grants
http://www.ortge.ufl.edu/fyi/v23n05/fyi017.html

Information on grants in the biological sciences to replace or reduce the use of animals in biomedical research.

Biomedical Grant Information
http://scilib.ucsd.edu/bml/grants.htm

This site is compiled by the Biomedical Library at the University of California at San Diego for the biomedical research community.

Catalog of Federal Domestic Assistance
http://www.gsa.gov/fdac

The Catalog of Federal Domestic Assistance, produced by the General Services Administration, is a government-wide compendium of federal programs, projects, services, and activities which provide assistance or benefits to the American public. It contains financial and non financial assistance programs administered by departments and establishments of the federal government. Entries from the Catalog of Federal Domestic Assistance include Agriculture, Environmental Quality, and Science and Technology (which includes the following subcategories: Biotechnology, Biological Sciences, Science and Education, Environmental Research, and Pesticides Control).

Centers for Disease Control (CDC)
http://www.cdc.gov/funding.htm

Site providing information on funding opportunities at the CDC.

Community of Science (COS)
http://www.cos.com

Online inventory of research funding in the United States and Canada. The Community of Science World Wide Web server contains information about scientific expertise, funded scientific research, and funding opportunities for research. The COS philosophy is to pro-

vide working researchers with valuable information tools. Supports the Funding Opportunities Topic Index, an interactive inventory of funded research projects, which includes many topics related to environmental and drug toxicology, environmental and occupational medicine, environmental health, and related topics.

Computer Retrieval of Information on Scientific Projects (CRISP)
www–commons.cit.nih.gov/crisp

A weekly update of this service provides information on research supported by the U.S. Public Health Service.

(U.S.) Department of Energy Office of Science
http://www.er.doe.gov/production/grants/grants.html

This is the DOE Office of Science's ''Grants and Contracts Web Site,'' providing information on applying for an Energy Research Grant.

(U.S.) DHHS Grantsmanship
http://www.hhs.gov/progorg/grantsnet

The U.S. Department of Health and Human Services has assembled a vast repository of resources for its grants programs (e.g., NIH, NIEHS, and CDC). These documents comprise a core collection of useful resources for locating grants information, applying for funding, and preparation of proposals.

EPA Grants
http://www.epa.gov/epahome/grants.htm

The U.S. Environmental Protection Agency's official grants page, providing access to all relevant information concerning the agency's grants and procurements, including the EPA Grant Programs as listed in the Federal Domestic Assistance Catalog, STAR Grants and Cooperative Agreements from the EPA's National Center for Environmental Research and Quality Assurance (NCERQA), and NCERQA's Resident Research Associate Program for postdoctoral and senior research awards. EPA Grants and Fellowship Information (http://www.epa.gov/epahome/scifund.htm) provides additional access to research funding opportunities in specific EPA program areas.

Federal Information Exchange (FEDIX)
http://web.fie.com

Provides detailed and comprehensive coverage of federal agency programs and opportunities for funding research. Includes Opportunity Alert, an e-mail service announcing new funding opportunities in specified areas of interest.

FinAid
http://www.finaid.org

To date, the most comprehensive source for all types of information about grants, fellowships, and scholarships.

Foundation Center
http://fdncenter.org

Provides links to Internet resources from foundations and trusts. Points of contact and profiles of sources of foundations, trusts, and corporate giving. Provides extensive resources through its Grantmaker Information site.

Fundraising Online-IGC
http://www.igc.org/fundraising

IGC has been providing Internet access to nonprofit groups for a long time, and on this site they pull together some good advice about online fund-raising and on line resources for fund-raising. Updated periodically.

Grants Net
http://www.os.dhhs.gov/progorg/grantsnet

A resource for finding information about the Department of Health and Humans Service and other federal grants, includes key contacts for federal grantmaking agencies.

International Foundation for Ethical Research—Preproposals
http://www.ortge.ufl.edu/fyi/v22n20/fyi022.html

Grants for valid alternatives to the use of live animals in research, testing, and teaching.

MedWeb
http://www.emory.edu/medweb/

An inventory of resources broadly related to biomedical research, including electronic publications, general grants and funding sources, guidelines and guides, institutes and agencies issuing grants, lists of Internet resources, National Library of Medicine Extramural Grants and Contracts Program, and public health.

National Academy of Science Fellowships
http://www4.nas.edu/osep/fo.nsf

Information related to NAS predoctoral, dissertation, and postdoctoral fellowship programs.

National Institutes of Health—Office of External Research
http://www.nih.gov/grants/oer.htm

An inventory of grant and contract opportunities, guidelines, and other relevant information. Includes links to the comprehensive listing of funding programs from the NIH.

National Oceanic and Atmospheric Administration Grants
http://www.rdc.noaa.gov/~grants

The NOAA Grants home page provides links to appropriate sites, including the Grants Management Administration with links to specific NOAA research program areas.

National Science Foundation Biological Sciences Directorate
http://www.nsf.gov/home/grants.htm

This page provides access to all NSF programs and projects related to the biological sciences and includes relevant information and resources for grants and funding. Specifies requirements, program areas, and deadlines for NSF-sponsored research grants and other funding opportunities. NSF also maintains a Grant Proposal Guide as an online resource. Alphabetical listing of NSF programs is also available.

NIEHS Grants and Contracts
http://www.niehs.nih.gov/external/grant.htm

NLM Extramural Programs (Grants and Other Assistance Mechanisms)
http://www.nlm.nih.gov/ep

The Extramural Programs (EP) of the National Library of Medicine (NLM) funds projects in areas defined by NLM as important to its mission. Grants are available to investigate the management and utilization of biomedical information, such as representation of medical knowledge in computers; organization and retrieval issues for image databases; enhancement of human intellectual capacities through virtual reality, dynamic modeling, artificial intelligence, and machine learning; medical decision making; linguistic analyses of medical languages and nomenclatures; investigations of topics relevant to health information or library science; and biotechnology informatics issues. These areas are applicable to data, information, and library management related to toxicology and environmental or occupational health issues and concerns.

NonProfit Gateway
http://www.nonprofit.gov

NonProfit Gateway was created for nonprofit groups to access federal information, including grants and other financial information. Grants-related information is available on topics such as loans and grants, federal register notices (and other toxicology issues such as community right-to-know, pollution prevention, and partnerships). The Web site is the result of a year-long partnership between federal agencies and departments and hundreds of nonprofit groups. The Nonprofit Resources section provides links to department and agency-specific management and policy resources, such as grants, nonfinancial, laws, regulations, volunteer opportunities partnering, and budgets. The NonProfit Gateway provides a convenient hypertext link from a tabular matrix to specific grant-providing offices of Cabinet Departments, Federal Agencies, and Search Notices of Funding Availability.

Oak Ridge Associated Universities/Oak Ridge Institute for Science and Education
http://www.orau.org/ and www.orau.gov/orise/Educ.html

ORAU programs include Junior Faculty Enhancement Awards to help faculty members enhance their research during the early stages of their careers. The Oak Ridge Institute for Science and Education (ORISE) was established by the U.S. Department of Energy to undertake national and international programs in education, training, health, and the environment. The ORISE Resource Guide is available in Adobe PDF format (728K) and provides a comprehensive listing of ORISE's educational opportunities for precollege and college faculty as well as postdoctoral, doctoral, graduate, undergraduate, and precollege students.

RAMS
http://www.rams–fie.com/

Provides access to assorted grants and funding opportunities.

Scholarship and Fellowship Databases
http://www.finaid.org/finaid/awards.html

This page provides links to a variety of general scholarship and fellowship databases. The term scholarship refers to awards intended primarily for undergraduate students. The term fellowship refers to awards intended primarily for graduate and postgraduate students.

Smithsonian Opportunities for Research
http://www.si.edu/youandsi/studies/ofg/fellapp.htm

Grants site for the Smithsonian Institution, providing guidelines and assistance for grants and fellowships.

Society of Toxicology—Awards
http://www.toxicology.org

Lists SOT awards and fellowships and links to the Sponsored Awards & Student Awards page at www.toxicology.org/spon.html, including the Burroughs Wellcome Fund Award in toxicology (www.bwfund.org).

ELECTRONIC JOURNALS AND NEWSLETTERS

The Chronicle of Higher Education
http://www.chronicle.merit.edu/index.html

Includes Events and Deadlines in Academe which lists deadlines for fellowships, grants, etc. from the Chronicle of Higher Education.

Commerce Business Daily (via Community of Science)
http://cbd.cos.com/

Provides a daily listing of notices of actions and activities of the U.S. federal government and requests for proposals and contract awards.

Federal Register
http://gpo.lib.purdue.edu/

Official record of the U.S. government, in a searchable format, updated daily, and free of charge from GPO Access.

Funding News
gopher://gopher.igc.apc.org:7003/00/mny/about

Contains grant announcements, advice on obtaining public and private funding, and a searchable database.

NIH—Guide to Grants and Contracts Database
http://www.med.nyu.edu/nihguide.html

Provided by New York University, the NIH-guide is distributed weekly via e-mail to sites that require information about NIH's activities, including grants and other funding information.

NSF Bulletin
http://www.nsf.gov/home/ebulletin

News about NSF programs and target and deadline dates for submission of proposals.

Philanthropy News Network Online
http://www.pj.org/

Provides news about the nonprofit sector. Supports a free e-mail newsletter, *Philanthropy Journal Alert*.

Philanthropy News Digest
http://fdncenter.org/pnd/current/index.html

This weekly news service of the Foundation Center abstracts philanthropy-related articles and features stories in the national media.

WEB SITES AND/OR E-MAIL ADDRESSES

The following inventory is a list of e-mail and URLs of selected foundations cited as funding toxicology and environmental health research, projects, and programs. These resources were compiled from the 1998 edition of *Environmental Grantmaking Foundations*, Appendix F and Appendix G.

A Territory Resource
cpencke@aol.com, aliceito@aol.com
http://www.atrfoundation.org

The Abelard Foundation West
ccounsel@igc.apc.org

The Abell Foundation, Inc.
TAQF@charm.net, abell@abel.org

The Acorn Foundation
ccounsel@igc.apc.org

Alaska Conservation Foundation
acfinfo@akcf.org

The Jennifer Altman Foundation
altman123@aol.com
http://www.jaf.org

American Conservation Foundation
74111.3156@compuserve.com

Ameritech Foundation
http://www.ameritech.com

Angelica Foundation
angelicasb@aol.com

ARCO Foundation
http://www.arco.com/Corporate/reports/foundation

AT&T Foundation
attfound/attmail.com
http://www.att.com/foundation

Mary Reynolds Babcock Foundation
info@mrbf.org

The Bauman Foundation
baumanp@rtk.net

Beldon Fund
beldon@igc.apc.org

Boeing–McDonnell Foundation
http://www.boeing.com

The Boston Globe Foundation
http://www.bostonglobe.com

The Brainerd Foundation
infor@Brainerd.org
http://www.Brainerd.org

Kathleen Price Bryan Family Fund
kpbffund@interpath.com

The Bullit Foundation
info@bullit.org
http://www.bullit.org

C. S. Fund
kathy@csfund.org

Chesapeake Bay Trust
http://www2.ari.net/home/cbt

Conservation, Food & Health Foundation, Inc.
grantman@igc.apc.org

Jessie B. Cox Charitable Trust
grantman@igc.apc.org
http://www.agmconnect.org/cox.html

The Mary A. Crocker Trust
mact95@aol.com

The Nathan Cummings Foundation
info@cummings.nef.org
http://www.ncf.org

Geraldine R. Dodge Foundation, Inc.
infor@grdodge.org
http://www.grdodge.org

The Educational Foundation of America
efa@efaw.org

Exxon Corporation
http://www.exxon.com

FACT Services Company, Inc.
fact@igc.apc.org

Ford Foundation
office-secretary@fordfound.org
http://www.fordfound.org

Friends of the Environment Foundation
http://www.fef.ca

Funding Exchange
http://www.fex.org

Gap. Inc. Community Fund
http://www.gap.com/company

The Wallace Alexander Gerbode Foundation, Inc.
http://www.fndcenter.org/grantmaker/gerbode

The German Marshall Fund of the United States
info@gmfus.org
http://www.gmfus.org

Give to the Earth Foundation
arinkenb@aveda.com
http://www.gtte.org

Global Environment Project Institute
http://www.enviro-info.org

Global Grants Fund
greengrants@igc.org

The Goldman Environmental Foundation
http://www.goldmanprize.org/goldman

The Greenville Foundation
greenville-brochure@gain.org

The George Gund Foundation
http://www.gundfdn.org

Howard Heinz Endowment
amlozer@heinz.org
http://www.heinz.org

The William and Flora Hewlett Foundation
info@hewlett.org
http://www.hewlett.org

The James Irvine Foundation
info@irvine.org

Island Foundation
jrussell2@capecod.net

W. Alton Jones Foundation, Inc.
earth@wajones.org
http://www.wajones.org

The Joyce Foundation
info@joyce fdn.org

W. K. Kellog Foundation
http://www.wkkf.com

The Henry P. Kendall Foundation
tedkendall@aol.com

Kongsgaard–Goldman Foundation
KGFound@aol.com

Laidlaw Foundation
laidlaw@web.apc.org

The Max and Anna Levinson Foundation
levinson@igc.apc.org

The John D. and Catherine T. MacArthur Foundation
4answers@macfdn.org
http://www.macfdn.org

Marin Community Foundation
mcf@midas.org
http://www.midas.org/npo/mcf/mcf.html

MARPAT Foundation, Inc.
jkoven@aol.com

Massachusetts Environmental Trust
robbin.peach@state.ma.us
http://www.agmconnect.org/maenvtr1.html

The McKnight Foundation
info@mckfdn.org

The Medical Foundation for the Study of the Environment and the Human Body
bglitten@aol.com

Joyce Mertz-Gilmore Foundation
jmgf@gmjf.org
http://www.jmgf.org

The Charles A. and Anne Morrow Lindbergh Foundation
lindfdtn@mtn.org
http://www.mtn.org/lindfdtn/

Charles Stewart Mott Foundation
inforcenter@mott.org
http://www.mott.org

The National Environmental Education and Training Foundation, Inc.
yum@neetf.org

The Needmore Fund
needmorkp@aol.com

New England Grassroots Environment Fund
cfisher@plainfield.bypass.com

Norman Foundation
http://www.normanfdn.org

Northwest Fund for the Environment
nwfund@wolfenet.com
http://www.wolfenet.com/~nwfund

Jessie Smith Noyes Foundation
noiyse@igc.org
http://www.noyes.org

Ottinger Foundation
ottinger@funder.org
http://www.funder.org/ottinger

Patagonia, Inc.
jil_zilligen@patagonia.com

James C. Penny Foundation
103173.1720@compuserve.com

The Pew Charitable Trusts
http://www.pewtrusts.com

Z. Smith Reynolds Foundation, Inc.
internet/info@zsr.org
http://www.zsr.org

Rockefeller Family Fund, Inc.
mmccarthy@rffund.org
http://www.rffund.org

The Rockefeller Foundation
http://www.rockfound.org

The Rockfall Foundation
vrr@rockfallfoundation.org

Rose Foundation for Communities in the Environment
rosefdn@aol.com

The San Diego Foundation
info@sdf.org
http://www.sdfoundation.org

The San Francisco Foundation
jpr@sff.org

Seventh Generation Fund
7genfund@humboldt1.com

The Sonoma County Community Foundation
http://www.sonoma.org

Surdna Foundation, Inc.
request@surdna.org

The Robert and Patricia Switzer Foundation
jb@nhcf.org
http://www.switzernetwork.org

Texaco Foundation
contributions@texaco.com (inquiries only)

Threshold Foundation
threshold@igc.apc.org

Tides Foundation
tides@igc.apc.org

Tortuga Foundation
pmaurath@msn.org

Trust for Mutual Understanding
tmu@igc.apc.org

Turner Foundation, Inc.
turnerfi@mindspring.com
http://www.turnerfoundation.org

Unitarian Universalist Veatch Program at Shelter Rock
veatech@igc.apc.org

Lawson Valentine Foundation
vdoyle@compuserve.com

Wallace Global Fund, Inc.
mdann@wgforg or tkroll@wgf.org

Wilburforce Foundation
http://www.wilburforce.org

WMX Environmental Grants Program
http://www.wmx.com

Working Assets
ccorell@wafs.com
http://www.wald.com

Margaret Cullinan Wray Charitable Lead Annuity Trust
wraytodd@wt.org

Reference

[1] Stein, Edith C. (1992). *The Environmental Source Book: A Comprehensive, Up-to-Date Guide to the Environmental Movement*. Lyons & Burford, New York.

ENDNOTE

Also consider some of the resources discussed in Chapter 18 as potential funding sources, particularly in areas related to animal alternatives.

Good summaries of grant-supported research in environmental and related scientific disciplines are available at the Web site of the National Science and Technology Council's Committee on Environment and Natural Resources [http://www.nnic.noaa.gov/CENR/]. The following, for example, describes funding opportunities from the Environmental Protection Agency (EPA).

To fulfill its statutory mandates to protect the environment and human health, EPA promulgates Federal regulations; sets national standards; issues permits to conduct certain activities; licenses and registers products; inspects for compliance; enforces regulations where necessary; and monitors results. To do these things effectively and efficiently, more scientific information is needed in a number of areas. The functions of the Office of Research and Development (ORD) are to conduct or sponsor research in areas important to EPA and provide technical support to the Agency.

Types of Environment and Natural Resources Research Supported

The current areas of emphasis for research and development are:

Safe Drinking Water
High Priority Air Pollutants
Emerging Issues
Ecological Risk Assessment
Human Health Risk Assessment
Pollution Prevention and New Technologies

More details on these topics can be found in ORD's Strategic Plan and in individual Research Plans as they become available. The ORD Strategic Plan can be found on EPA's Internet homepage at http://www.epa.gov.

STAR Research Funding Opportunities

In areas of research in which EPA does not have in-house expertise, a large part of that research is sought outside EPA. These extramural research needs are competitively funded through the STAR program. The program is part of EPA's commitment to include the best scientists from this country's universities, colleges, and other research institutions in its research program. The STAR program, now in its fourth funding year, is soliciting Requests for Applications (RFAs) in 23 areas.

The STAR program has four components:

(1) Focused RFAs are targeted at specific research topics defined by the ORD Strategic Plan and address the science needs of the EPA program offices and regions. This component supports investigator-initiated research by universities and other not-for-profit research institutions that complements the expertise in ORD laboratories. A portion of the program is conducted jointly with other Federal and non-Federal research partners.

(2) The Exploratory Research Grants Program provides support for investigator-initiated research in broad areas, such as environmental chemistry, environmental physics, and health and ecological effects of pollution, that are not covered by the RFAs.

(3) The Graduate Fellowship Program supports masters and doctoral students in environmental sciences and engineering to ensure the availability of the expertise needed to address environmental concerns in the future. This program is announced nationally and provides broad opportunities to apply. Applicants are judged by external peer reviewers and are selected based on their past record and future potential.

(4) The Environmental Research Centers Program involves competitive awards for complex, long-term collaborative research using multidisciplinary approaches on issues of broad concern to EPA.

This Page Intentionally Left Blank

CHAPTER

18

Toxicology Testing Methods and Laboratories

P. J. (BERT) HAKKINEN

Our Adonais has drunk poison—oh!
What deaf and viperous murderer could crown
Life's early cup with such a draught of woe?

(Percy Bysshe Shelley, *Adonais*)

There are many sources of information regarding toxicology testing methods, including *in vitro* alternatives to the use of whole animals. The resources provided in this chapter can be used to provide guidance and other information on *in vitro* and other toxicology testing methods, on testing laboratories that can conduct the studies, and on teaching aids. Also provided is information on organizations offering various perspectives on the use of *in vivo* and/or *in vitro* methods, and about two directories of environmental testing laboratories.

IN VITRO AND OTHER TOXICOLOGY TESTING METHODS AND TEACHING AIDS AND ORGANIZATIONS OFFERING VARIOUS PERSPECTIVES ON THE USE OF *IN VIVO* AND/OR *IN VITRO* METHODS: SOURCES OF INFORMATION

Alternative Testing Methodologies (1998)

Published as a supplement to *Environmental Health Perspectives* (EHP) (**106,** Suppl. 2). Supplement co edited by W. Stokes, E. Marafante, D. Peakall, and B. Goldstein. Prepared for Scientific Group on Methodologies for the Safety Evaluation of Chemicals (SGOMSEC). Published on behalf on the Scientific Committee on Problems of the Environment (SCOPE) of the International Council of Scientific Unions (ICSU), the International Programme on Chemical Safety (IPCS) of the World Health Organization (WHO), the United Nations Environment Programme (UNEP), and the International Labour Organisation (ILO); the Joint Research Centre (JRC); the U.S. Food and Drug Administration (FDA); and the U.S. National Institute of Environmental Health Sciences (NIEHS). Includes numerous joint reports and papers, and a summary of the 13th meeting of SGOMSEC (1997 in Ispra, Italy). Coverage includes alternative testing methodologies for ecotoxicity.

Alternatives to Animal Testing (1996)
S. Liansky, R. Macmillan, and J. Dupus (Eds.)
CPL Press, Newbury, UK

This book contains the proceedings of a 1995 conference organized by the European Cosmetic, Toiletry and Perfumery Association (COLIPA). Includes the text of keynote addresses, roundtable discussions, and other presentations.

Alternatives to Animal Testing on the Web (Altweb or AltWeb) (Web site)
Web: http://altweb.jhsph.edu

A diverse group of organizations is working together to increase access to information on ways to reduce, replace, and refine the use of animals in research, education, and testing. The organizations intend to have this Web site serve as the most comprehensive resource on animal alternatives for scientists, educators, veterinarians, and individuals throughout the world. As of late 1998, the organizations sponsoring the Web site included the Alternatives Research & Development Foundation, the Hildegard Doerenkamp–Gerhard

Zbinden Foundation, the Humane Society of the United States (HSUS), the Procter & Gamble Company, the U.S. National Institute of Health's Office for Protection from Research Risks (OPRR), and the Regina Bauer Frankenberg Foundation for Animal Welfare. This effort is designed to bring together government agencies, the academic community, animal protection groups, and private industry to encourage the use of alternative methods via the ''Three R's'' that replace existing animal methods with nonanimal methods whenever possible, reduce the number of animals needed, or refine research procedures where animal use remains necessary to minimize the pain or discomfort of test animals. This site serves as a resource for scientists seeking technical information on alternatives in biological research and testing and education. It allows users to access host bulletin boards and discussion areas that share information. It also includes links to other sources of information on alternatives, and access to an Internet search engine that can be used to search the Internet for information on alternatives to animals in testing and education and research. Furthermore, it provides information specifically geared to educators and the general public interested in the three R's of alternatives. Included is AltNews, with information about research, technology, grants, corporate–scientific collaborations, government rulings, seminars, databases, educational resources, and issues and debates in the alternatives community (since late 1997, Altweb's AltNews replaced the printed issues of the *Center for Alternatives to Animal Testing Newsletter* from the Johns Hopkins University Press).

***Alternatives Research & Development Foundation* (*ARDF*)** (formerly known as The Demeter Fund)
Affiliated with American Anti-Visection Society
801 Old York Road #204
Jenkintown, PA 19046-0816
Phone: 215-887-0816
Web: http://www.aavs.org/html/ardf.html (also see Alternatives to Animal Testing on the Web listing)

Supports the development of alternatives to the use of animals in biomedical research, testing, and education. Dedicated to providing: (i) the motivation, funding, resources, and scientific expertise needed to replace animal use in laboratories; (ii) specific grants to develop alternatives; (iii) information on alternatives, and (iv) the promotion of alternatives through publications, lectures, seminars, and workshops. Examples of efforts include development of interactive, videodisc simulations and programs; three-dimensional, computer-assisted programs to teach basic surgical techniques; and a plastination laboratory to produce permanent anatomical specimens as alternatives to dissection.

Alternatives to the Use of Live Vertebrates in Biomedical Research and Testing (formerly *Alternatives to Animal Testing*)

Bibliography published quarterly by the staff of the Toxicology and Environmental Health Information Program (TEHIP) of the Specialized Information Services Division (SIS) of the National Library of Medicine. Available from the Robert W. Woodruff Center Library of Emory University's Internet World Wide Web ''MedWeb'' home page: http://www.medweb.emory.edu/MedWeb/.

***American Association for Laboratory Animal Science* (*AALAS*)**
9190 Crestwyn Hills Drive
Memphis, TN 38125
Phone: 901-754-8620
E-mail: info@aalas.org
Web: http://www.aalas.org

Nonprofit organization of over 7800 members whose mission is ''to serve society through education and the advancement of responsible laboratory animal care and use.'' Offers a certification program, training materials, and two journals (*Contemporary Topics in Laboratory Animal Science* and *Laboratory Animal Science—The International Journal of Comparative and Experimental Medicine*).

***American College of Laboratory Animal Medicine* (*ACLAM*)**
Dr. Melvin W. Balk
96 Chester Street
Chester, NH 23036
Phone: 603-887-2467
E-mail: mwbaclam@gsinet.net
Web: http://www.aclam.org

Activities include certification of specialists in laboratory animal medicine, support of education in laboratory animal science and medicine, and advance of biomedical research.

***American Fund for Alternatives to Animal Research* (*AFAAR*)**
c/o Dr. Ethel Thurston
175 W. 12th Street, No. 16-G
New York, NY 10011
Phone: 212-989-8073

Offers grants to develop and teach *in vitro* substitutes for tests currently involving animals and disseminates information of *in vitro* methods research to regulatory agencies, researchers, and others. Publishes a newsletter, *AFAAR News Abstracts,* and other documents.

***American Type Culture Collection* (*ATCC*)**
Phone: 800-359-7370 or 301-231-5566

E-mail: workshops@atcc.org
Web: http://www.atcc.org/atcc.html

Independent, nonprofit organization dedicated to the acquisition, preservation, and distribution of microorganisms, viruses, cell cultures, fungi, yeasts, protozoa, plant tissue culture, and recombinant DNA materials. Offers *in vitro* toxicology and other workshops.

Animal Welfare (journal)
Published by the Universities Federation for Animal Welfare (UFAW)
The Old School
Brewhouse Hill
Wheathampstead
Herts AL4 8AN, UK
Phone: 01582-831818
E-mail: ufaw@ufaw.org.uk
Web: http://www.ufaw3.dircon.co.uk

''Brings together the results of scientific research and technical studies related to the welfare of animals kept on farms in laboratories, as companions, in zoos or managed in the wild.''

***Animal Welfare Information Center* (*AWIC*)**
U.S. Department of Agriculture
Agricultural Research Service
National Agriculture Library
10301 Baltimore Ave., 5th Floor
Beltsville, MD 20705-2351
Phone: 301-504-6212
E-mail: awic@nal.usda.gov
Web: http://www.nal.usda.gov/awic/awic.htm

Government organization interested in improved animal care and use in research, teaching, and testing. Publishes a newsletter and other documents.

The Animal Welfare Institute
P.O. Box 3650
Washington, DC 20007
Phone: 202-337-2332
E-mail: awi@animalwelfare.com
Web: http://www.animalwelfare.com

Devoted to all aspects of animal welfare, including animals used in experimental research settings and alternatives to use of animals in laboratories.

***Association for Assessment and Accreditation of Laboratory Animal Care* (*AAALAC International*)** (formerly the American Association for Accreditation of Laboratory Animal Care)
11300 Rockville Pike, Suite 1211
Rockville, MD 20852-3035
Phone: 800-926-0066 and 301-231-5353
E-mail: accredit@aaalac.org
Web: http://www.aaalac.org

Private, nonprofit organization that ''promotes the responsible treatment of animals in science through a voluntary accreditation program.'' Accredits animal programs in research centers, universities, hospitals, and commercial and nonprofit organizations worldwide. Accreditation is a voluntary process for institutions to demonstrate a commitment to responsible, high-quality animal care and use.

ATLA, Alternatives to Laboratory Animals (journal)
Fund for the Replacement of Animals in Medical Experiments (FRAME)
Russell & Burch House, 96-98 North Sherwood Street
Nottingham NG1 4EE, UK
Phone: 44-0115-958-4740
E-mail: atla@frame-uk.demon.co.uk
Web: http://www.frame-uk.demon.co.uk/atlahome.htm

Covers ''all aspects of the development, validation, introduction, and use of alternatives to laboratory animals in biomedical research and toxicity testing.'' Includes editorials, commentaries, articles on original research, conference and workshop reports and book reviews.

The Basis of Toxicity Testing (1997)
D. J. Ecobichon
CRC Press, 2000 Corporate Blvd., NW, Boca Raton, FL 33431-9868
Phone: 800-272-7737
E-mail: orders@crcpress.com
Web: http://www.crcpress.com

Includes the principles and concepts behind various types of *in vivo* and *in vitro* toxicological studies; the design, conduct, and interpretation of studies; the latest developments in alternatives to animal studies; the types of studies required by regulatory agencies; and sections on various risk assessment-related topics.

Contemporary Topics in Laboratory Animal Science

[see American Association for Laboratory Animals Science (AALAS)]

Databases on Alternative Methods

[see European Centre for the Validation of Alternative Methods]

Doris Day Animal League
227 Massachusetts Avenue, NE, Suite 100
Washington, DC 20002
Phone: 202-546-1761

E-mail: ddal@aol.com.
Web: http://www.ddal.org/

One of the largest animal rights organizations in the U.S. ''Works to protect animals and the people who love them.'' Gathers and disseminates information on animal testing intended to improve federal and state legislation and regulations. Publishes a quarterly magazine.

***European Centre for the Validation of Alternative Methods* (*ECVAM*)**
TP 580
Joint Research Center (JRC)
European Commission, Environment Institute
21020 Ispra (VA), Italy
Phone: 39-0332-785996
E-mail: michael.balls@jrc.it
Web: http://www.etomep.net/NextIHCP/units/ECVAM.html

The main goal is to promote the scientific and regulatory acceptance of alternative methods which are of importance to the biosciences and which reduce, refine, or replace the use of laboratory animals. Interacts with other organizations, sponsors workshops, etc. Publications include the following, which discusses numerous databases and information services: Janusch, A., van der Kamp, M. D. O., Bottrill, K., Grune, B., Anderson, D. C., Ekwall, B., Howald, M., Kolar, R., Kuiper, H. J. D., Larson, J., Loprieno, G., Sauer, U. G., Smith, A. J., and van der Valk, J. B. F. (1997), Current status and future developments of databases on alternative methods. The report and recommendations of ECVAM Workshop 25. *ATLA* (*Alternatives to Laboratory Animals*) **25,** 411–422. This publication was followed up in ATLA's journal by: Langley, G., Broadhead, C., Bottrill, K., Combes, R., Ewbank, R., Hawkins, P., Hubrecht, R., Jennings, M., Newman, C., Rowe, S., Southee, J., Todd, M., and Ward, L. (1999), Accessing information on the reduction, refinement, and replacement of animal experiments. Report and recommendations of a focus on alternatives workshop. *ATLA* (*Alternatives to Laboratory Animals*) **27,** 239–245.

***Fund for the Replacement of Animals in Medical Experiments* (*FRAME*)**
Russell & Burch House
96-98 North Sherwood Street
Nottingham NG1 4EE, UK
Phone: 44-0115-958-4740
E-mail: atla@frame-uk.demon.co.uk
Web: http://www.frame-uk.demon.co.uk

As noted in a FRAME publication (Fentem, J. and Balls, M. *In vitro* alternatives to toxicity testing in animals, *Chem. Ind.* **6,** 207–211, 1992), ''FRAME is working towards a future in which the integrated use of computers to model structure–activity relationships and biochemical, physiological, and toxicological processes, and *in vitro* tests using human cells, will be used to assess human risk directly, without recourse to any animal testing of chemicals.'' Activities include support of research, cooperation with other organizations, publications, and publication of *ATLA* journal (see ATLA) and *FRAME News* (newsletter).

Handbook of in Vivo Toxicity Testing (1990)
D. L. Arnold, H. C. Grice, and D. R. Krewski (Eds.) Academic Press, San Diego.

***Industrial in Vitro Toxicology Group* (*IIVTG*)**
7562 Northfield Lane
Manlius, NY 13104
E-mail: invitro@invitro.org

This industry group's mission is to organize symposia and provide information and training on all topics related to the application of *in vitro* tests for product evaluation; its Internet World Wide Web site (http://www.invitro.org) contains news, *in vitro* test protocols, and Internet links to other sites with information about *in vitro* tests. Researchers can also publish their protocols on this site for others to review and possibly use. Official journal is *In Vitro & Molecular Toxicology*. A journal of Basic and Applied Research (see listing).

***Institute for in Vitro Sciences, Inc.* (*IIVS*)**
21 Firstfield Road, Suite 220
Gaithersburg, MD 20878
Phone: 301-947-6523
Web: http://www.iivs.org

''Advancing science and animal welfare together,'' this nonprofit organization was formed in 1997 to provide *in vitro* contract toxicity testing and to provide expertise and testing for international validation programs. Works closely with other groups active in the alternative methods area. Activities also include regulatory interactions and training on alternative methods, along with educational workshops and symposia and management of *in vitro* toxicity databases. Publishes a newsletter (*Institute Up-Date*).

***(U.S.) Interagency Coordinating Committee on the Validation of Alternative Methods* (*ICCVAM*)**
Dr. William S. Stokes (ICCVAM Co-Chair)
Associate Director for Animal and Alternative Resources
Environmental Toxicology Program
National Institute of Environmental Health Sciences
P.O. Box 12233, MD WC-505
Research Triangle Park, NC 27709
Phone: 919-541-7997
E-mail: stokes@niehs.nih.gov

The ICCVAM coordinates issues throughout the U.S. federal government that relate to the development, valadition, acceptance, and harmonization of toxicological test methods. It seeks to promote toxicological test methods that enhance the abilities of federal agencies to assess risks and make decisions and, where feasible and practical, to reduce animal use, refine animal procedures to make them less stressful, or replace animals in toxicological tests. A recent publication is ''Validation and Regulatory Acceptance of Toxicological Test Methods (National Institutes of Health Publication No. 97-3981).

***International Institute for the Advancement of Medicine* (*IIAM*)**
15 East Uwchlan Avenue, Suite 406
Exton, PA 19341
Phone: 800-486-4426 and 610-363-3600
Web: http://www.iiam.org

Nonprofit organization whose purpose is to facilitate the placement of nontransplantable human organs and tissues for research. Research applications include determining the most relevant animal model for human toxicity testing and other applications in toxicology, drug metabolism, and biochemistry.

In Vitro & Molecular Toxicology. A Journal of Basic and Applied Research (journal) (formerly *In Vitro Toxicology. A Journal of Molecular and Cellular Toxicology*)
Published by Liebert, Inc.
2 Madison Avenue
Larchmont, NY 10538
Phone: 914-834-3100
E-mail: liebert@pipeline.com
Web: http://www.liebertpub.com

The official publication of the Industrial in Vitro Toxicology Group. ''Reports on investigative work about the molecular and cellular basis and expression of diverse toxic phenomena.'' Includes a ''CAATSCAN'' section, reviewing animal alternatives news and information (publications, meetings, World Wide Web sites, etc.).

(*The*) *Johns Hopkins Center for Alternatives to Animal Testing* (*CAAT*)
111 Market Place, Suite 840
Baltimore, MD 21202-6709
Phone: 410-223-1693
E-mail: caat@caat.spharbor.jhu.edu
Web: http://altweb.jhsph.edu

Members include individuals and organizations interested in the development and validation of *in vitro* alternatives to the use of whole animals in toxicology. Mission includes fostering the development of scientifically acceptable *in vitro* and other alternatives for use in the development and safety evaluation of commercial and therapeutic products. Mission further includes catalyzing the validation of alternative methods and encouraging their use, where appropriate, while continuing to ensure the health of the public and to disseminate scientifically correct information about alternatives, their uses, advantages, and limitations. Also conducts education and research programs, and as recently as 1997 published two newsletters: *CAATALYST*, with information for middle-school students, and the *Center for Alternatives to Animal Testing Newsletter*. These newsletters contained information about the development and validation of *in vitro* alternatives to the use of whole animals in toxicology; however, since late 1997, Altweb's AltNews has replaced the printed issues of the *Center for Alternatives to Animal Testing Newsletter* [see Alternatives to Animal Testing on the Web (Altweb or AltWeb) listing]. CAAT also publishes other documents.

Join Hands
Phone: 800-933-8228
E-mail: info@joinhand.org
Web: http://www.joinhand.org/

A nonprofit health and safety educational alliance. Publications include ones on alternative research methods. Provides educational materials explaining ''the important role of biological research and product safety testing to protect people and the environment.'' Works closely with other organizations, e.g., American Association for Laboratory Animal Science (AALAS).

Lab Animal (journal)
Nature Publishing Company
345 Park Avenue South, 10th Floor
New York, NY 10010-1707
Phone: 212-726-9200
E-mail: labanimal@natureny.com
Web: http://www.labanimal.com/

A journal for professionals in animal research, emphasizing proper management and care. Editorial features include new animal models of disease; breeds and breeding practices; lab animal care and nutrition; new research techniques; personnel and facility management; facility design; new lab equipment; education and training; diagnostic activities; clinical chemistry; toxicology; genetics; and embryology, as they relate to laboratory animal science.

Laboratory Animal Science—the International Journal of Comparative and Experimental Medicine

[see American Association for Laboratory Animals Science (AALAS)]

Laboratory Animals (journal)
Published quarterly for Laboratory Animals Ltd. by the Royal Society of Medicine Press Ltd.
1 Wimpole Street
London W1M 8AE, UK
Phone: 44-0-171-290-2923
Web: http://www.lab.org.uk

Subtitled *The International Journal of Laboratory Animal Science and Welfare,* this journal is the official journal of several organizations (LASA, Laboratory Animal Science Association; GV-SOLAS, Gesellschaft für Versuchstierkunde; NVP, Nederlandse Vereniging voor Proefdierkunde; SGV, Schweizerische Gesellschaft für Versuchstierkunde; SECAL, Sociedad Española para las Ciencias del Animal de Laboratorio; and FELASA, Federation of European Laboratory Animal Science Associations).

National Anti-Vivisection Society
53 W. Jackson, Suite 1552
Chicago, IL 60604
Phone: 800-888-6287
E-mail: navs@navs.org
Web: http://www.navs.org/

Among activities is compilation of statistics on usage of laboratory animals for experiments. Also underwrites alternatives to animals research. Publishes a newsletter, *National Anti-Vivisection Society Bulletin,* and other documents.

***The Norwegian Reference Centre for Laboratory Animal Science and Alternatives* (*The NORINA Database*)**
Laboratory Animal Unit
Norwegian School of Veterinary Medicine
P.O. Box 8146 Dep.
N-0033 Oslo, Norway
Phone: 47-22-96-45-74
E-mail: adrian.smith@veths.no
Web: http://oslovet.veths.no/NORINA

The NORINA Database provides ''audiovisual alternatives to laboratory animals in teaching'' and is supported by *Laboratory Animals* (see listing for journal), the National Centre for Veterinary Contract Research and Commercial Services (VESO), Allkopi Printers (IPN), Universities Federation for Animal Welfare (UFAW), Swedish Fund for Research without Animal Experiments, the Association for Assessment and Accreditation of Laboratory Animal Care (AAALAC International; see listing), B&K Universal, and the Laboratory Animal Science Association (LASA). As of late 1998, NORINA containe information on over 3600 audiovisual aids (software, laser discs, films, etc.) that may be used as alternatives or supplements to the use of animals in student teaching. Also notes meetings of possible interest and contains numerous links to other Web sites.

***People for the Ethical Treatment of Animals* (*PETA*)**
501 Front Street
Norfolk, VA 23510
Phone: 757-622-PETA
Web: http://www.peta-online.org/

See http://www.peta-online.org/ Web site for information on German and European Web sites and offices. With over 600,000 members, PETA is the largest animal rights organization in the world. Dedicated to establishing and protecting the rights of all animals, with the principle that ''animals are not ours to eat, wear, experiment on, or use for entertainment.''

***Registry of Comparative Pathology* (*RCP*)**
c/o Armed Forces Institute of Pathology
Washington, DC 20306-0001
Phone: 202-782-2440
E-mail: oneill@afip.osd.mil
Web: http://www.afip.org/rcp

The Registry of Comparative Pathology, located at the Armed Forces Institute of Pathology, has focused attention on the broad field of comparative pathology, promoting and disseminating information about excellent models of human disease that are often spontaneously present in the animal kingdom. Also covers the increasing number of important animal models derived from transgenic biotechnology, and comparative studies of aquatic animals, such as fish, amphibians, and invertebrates, that have proven to be promising for the characterization of pertinent models. Publishes a handbook, newsletter, and other documents.

***The Scientists Center for Animal Welfare* (*SCAW*)**
7833 Walker Drive, Suite 410
Greenbelt, MD 20770-3229
Phone: 301-345-3500
E-mail: info@scaw.com
Web: http://www.scaw.com/

A nonprofit educational association of individuals and institutions, SCAW acknowledges the benefits and the need for biomedical experimentation on animals but also is dedicated to the principle that a humane concern for animals complements the conduct of science. SCAW serves as an objective, credible source of information for the research community regarding the appropriate use of animals in research. The Center also provides information for the general public and media. Publishes a newsletter and other documents. Newsletters cover national policies and how to comply, indus-

trial concerns, biomedical research issues in all research animals, book reviews, and information on association meetings.

***Registry of Comparative Pathology* (*RCP*)**
c/o Armed Forces Institute of Pathology
Washington, DC 20306-0001
Phone: 202-782-2440
E-mail: oneill@afip.osd.mil
Web: http://www.afip.org/rcp

The Registry of Comparative Pathology, located at the Armed Forces Institute of Pathology, has focused attention on the broad field of comparative pathology, promoting and disseminating information about excellent models of human disease that are often spontaneously present in the animal kingdom. Also covers the increasing number of important animal models derived from transgenic biotechnology, and comparative studies of aquatic animals, such as fish, amphibians, and invertebrates, that have proven to be promising for the characterization of pertinent models. Publishes a handbook, newsletter, and other documents.

***Society for in Vitro Biology* (*SIVB*)** (formerly the Tissue Culture Association)
9315 Largo Drive West, Suite 255
Largo, MD 20774
Phone: 301-324-5054
E-mail: sivb@sivb.org
Web: http://www.sivb.org

Members are interested in the collection and dissemination of information about the maintenance and experimental use of tissue cells *in vitro* and in the development and evaluation of procedures using tissue cells. Publications include *In Vitro Cellular and Developmental Biology* (separate Animal and Plant editions), and *Methods in Cell Science* (formerly *Journal of Tissue Culture Methods*). Newsletter is *In Vitro Report* (formerly *TCA Report*).

***Society of Toxicology* (*SOT*)**
1767 Business Ctr. Drive, Suite 302
Reston, VA 22090
Phone: 703-438-3115
E-mail: sothq@toxicology.org
Web: http://www.toxicology.org

Members include toxicologists and others in industry, academia, government, and elsewhere interested in toxicology and risk assessment. SOT has regional chapters in various parts of the United States and also has several specialty sections, e.g., inhalation toxicology and risk assessment. Publishes a newsletter, *Communique,* and two journals, *Toxicology and Applied Pharmacology* and *Toxicological Sciences* (formerly *Fundamental and Applied Toxicology*). A 1998 publication is ''Workshop overview: Scientific and regulatory challenges for the reduction, refinement, and replacement of animals in toxicity testing,'' *Toxicol. Sci.* **43,** 86–101.

State Network of Biomedical Research and Education Organizations
P.O. Box 14424
Columbus, OH 43214-0424
[Address is for Ohio member organization, Ohio Scientific and Research Association, OSERA]
Phone: 614-784-1961
E-mail: director@osera.org
Web: http://www.osera.org

Coalition of various state organizations for biomedical and product safety research committed to public education on the use of animals in research and safety testing until valid alternatives are developed.

Toxicology Methods (journal)
Taylor & Francis
47 Runway Rd., Suite G
Levittown, PA 19057-4700
Phone: 800-821-8312 or 215-269-0400
E-mail: info@taylorandfrancis.com
Web: http://www.taylorandfrancis.com/INDEX.htm

Provides a ''peer-reviewed forum for toxicologists to share and critically evaluate all aspects of the development, validation, and application of new and existing methods, techniques, and equipment.'' Includes *in vivo* studies, *in vitro* studies and alternative methodologies; molecular, biochemical, and cellular techniques; mathematical modeling; computer programs; risk assessment; etc. Subscribers can access this journal online.

Tufts Center for Animals and Public Policy
Tufts University School of Veterinary Medicine
200 Westboro Road
North Grafton, MA 01536
Phone: 508-839-7991
Web: http://www.tufts.edu/vet/cfa/aboutcfa.html

Activities include support, coordination, and funding of programs dealing with ethical, legal, scientific, and social issues concerning domestic and farm animals and wildlife. Includes interest in animal research ethics. Publications include a newsletter, *Animal Policy Report.*

University of California, Center for Animal Alternatives
School of Veterinary Medicine
One Shields Avenue
Davis, CA 95616-8684
Web: http://www.vetmed.ucdavis.edu/Animal_Alternatives/main.htm

Publications include resource guides and a newsletter. Also has an Internet mailing list (''UC-ANIMALT'') for the discussion of alternatives in research and education.

***U.S. National Academy of Sciences* (*NAS*), *Institute for Laboratory Animal Research* (*ILAR*)**
Institute for Laboratory Animal Research
Commission on Life Sciences
National Research Council
National Academy of Sciences
2101 Constitution Avenue NW
Washington, DC 20418
Phone: 202-334-2590
E-mail: ILAR@nas.edu
Web: http://www4.nas.edu/cls/ilarhome.nsf

ILAR's mission is to develop and make available scientific and technical information on laboratory animals and other biological research resources to the scientific community, the federal government, and the public. Convenes committees that prepare authoritative reports on subjects of importance to the animal care and use community, e.g., the *Guide for the Care and Use of Laboratory Animals,* to ''assist institutions in caring for and using animals in ways judged to be scientifically, technically, and humanely appropriate, and to assist investigators in fulfilling their obligation to plan and conduct animal experiments in accord with the highest scientific, humane, and ethical principles.'' ILAR also publishes the *ILAR Journal* and provides answers to questions about sources and uses of animal models.

TOXICOLOGY TESTING LABORATORIES

While there are no journals, newsletters, or professional or industry organizations in the United States that specifically deal with contract testing laboratories, the following book is available as a key information resource:

***1997 Directory of Toxicology Laboratories Offering Contract Services* (*DOTLOCS*)** (1997)
R. I. Freudenthal
Aribet Books
P.O. Box 15640
West Palm Beach, FL 33416-5640
Phone: 561-791-8370

A new edition is expected by early 2000. This book contains information on over 60 contract toxicology testing laboratories, obtained from literature provided by the laboratories, visits to many of the facilities, and from discussions and correspondence with the personnel in the facilities. For each organization, the name, address, and phone number of the contact person is provided, along with descriptions of the capabilities and specializations, species used, and associated support services. Three indexes are provided: facilities are indexed alphabetically by name, by capabilities, and by specializations. All laboratories listed have a Quality Assurance Unit and thus are able to conduct tests according to the appropriate good laboratory practice standards (GLPs). Another criterion for inclusion in the book is that the primary activity of a laboratory must be the performance of contract testing in one or more areas of toxicology. While the focus of the book is on toxicology services relevant to human risk assessments, the book also describes peripheral capabilities, such as analytical chemistry, environmental fate, ecological effects, and other types of studies.

Further, the *Institute for in Vitro Sciences (IIVS)* (see listing) is a nonprofit organization providing contract *in vitro* toxicity testing. Also offering contract *in vitro* testing is:

***In Vitro Technologies, Inc.* (*IVT*)**
1450 South Rolling Road
Baltimore, MD 21227
Phone: 410-455-1242
E-mail: info@invitrotech.com
Web: http://www.invitrotech.com

Dedicated exclusively to providing *in vitro* contract research services (e.g., *in vitro* models for predicting human pharmacokinetics and toxicity) and products (e.g., animal microsomes and cryopreserved hepatocytes for use in xenophobic metabolism research). Information about other contract laboratories providing *in vitro* testing services is available from resources noted in this chapter, e.g., the ''Contract Laboratories'' link on the Industrial in Vitro Toxicology Group's (IIVTG's) Web site (see listing).

ENVIRONMENTAL TESTING LABORATORIES

Directory of Environmental Testing Laboratories (1996)
DynCorp
S. Kolb
2000 Edmund Halley Drive
Reston, VA 20191
Phone: 703-715-4403
E-mail: kolbs@dyncorp.com

This book contains profiles of over 600 environmental testing laboratories, including analytical capabilities,

analytical instruments, certifications, participation in external quality assurance programs, and trade association memberships. Includes indexes to facilitate searches for laboratory characteristics of interest. Contact DynCorp for possible Web version available in 1999 or 2000.

International Directory of Testing Laboratories
American Society for Testing and Materials (ASTM)
100 Barr Harbor Drive
West Conshohocken, PA 19428-2959
Phone: 610-832-9610 (directory listings)
Phone: 610-832-9585 (purchase)
Web: http://www.astm.org/labs/

This directory lists the locations and capabilities of fee-based testing services from around the world. It is published annually providing standard directory information, including number of professionals at each site and narratives of the laboratory's capabilities. Web site provides online full text searching for services and locations of testing laboratories. Toxicology-related subjects covered in this directory include: air (indoor atmospheres, stack emissions, and noise), animal and fishery products, animal and human tissues, biological testing, chemical testing, environmental (biological materials), environmental impact, environmental simulation, fertilizers and feeds, pesticides, hazardous waste, solids (nuclear and chemical), pharmaceuticals, safety, and water (groundwater, wastewater, high purity, industrial effluent, saline, recycled, rain, surface, and process).

This Page Intentionally Left Blank

CHAPTER

19

Poison Control Centers

AMERICAN ASSOCIATION OF POISON CONTROL CENTERS

London . . . loses at least two out of three sunrises, owing to the environing smoke.

(John Ruskin, *Modern Painters*)

The following is a directory of regional poison centers certified by the American Association of Poison Control Centers (AAPCC) as of August 1999. The criteria for certification appear at the end of this list. The directory is kept up to date at AAPCC's Web site (http://www.aapcc.org).

Alabama

Alabama Poison Center, Tuscaloosa
2503 Phoenix Drive
Tuscaloosa, AL 35405
Emergency phone: 800-462-0800 (AL only); 205-345-0600

Regional Poison Control Center
The Children's Hospital of Alabama
1600 7th Ave. South
Birmingham, AL 35233
Emergency phone: 205-939-9201; 800-292-6678 (AL only); 205-933-4050

Arizona

Arizona Poison and Drug Information Center
Arizona Health Sciences Center, Rm. #1156
1501 N. Campbell Avenue
Tucson, AZ 85724
Emergency phone: 800-362-0101 (AZ only); 520-626-6016

Samaritan Regional Poison Center
Good Samaritan Regional Medical Center
Ancillary-1
1111 E. McDowell Road
Phoenix, AZ 85006
Emergency phone: 800-362-0101 (AZ only), 602-253-3334

California

California Poison Control System—Fresno
Valley Children's Hospital
3151 N. Millbrook, IN31
Fresno, CA 93703
Emergency phone: 800-876-4766 (CA only)

California Poison Control System—San Diego Division
UCSD Medical Center
200 West Arbor Drive
San Diego, CA 92103-8925
Emergency phone: 800-876-4766 (CA only)

California Poison Control System—Sacramento Division
UCDMC-HSF Room 1024
2315 Stockton Blvd.
Sacramento, CA 95817
Emergency phone: 800-876-4766 (CA only)

Colorado

Rocky Mountain Poison and Drug Center
8802 E. 9th Avenue
Denver, CO 80220-6800
Emergency phone: 800-332-3073 (outside metro-CO only); 303-739-1123 (Denver metro)

Connecticut

Connecticut Regional Poison Center
University of Connecticut Health Center
263 Farmington Avenue
Farmington, CT 06030
Emergency phone: 800-343-2722 (CT only)

Delaware

The Poison Control Center
3600 Market Street, Suite 220
Philadelphia, PA 19104
Emergency phone: 800-722-7112 (PA only);
215-386-2100

District of Columbia

National Capital Poison Center
3201 New Mexico Avenue, NW, Suite 310
Washington, DC 20016
Emergency phone: 202-625-3333;
202-362-8563 (TTY)

Florida

Florida Poison Information Center—Jacksonville
University Medical Center
University of Florida Health Science Center—
Jacksonville
655 West 8th Street
Jacksonville, FL 32209
Emergency phone: 904-549-4480;
800-282-3171 (FL only)

Florida Poison Information Center—Miami
University of Miami, School of Medicine
Department of Pediatrics
P.O. Box 016960 (R-131)
Miami, FL 33101
Emergency phone: 800-282-3171 (FL only);
305-585-5253

Florida Poison Information Center—Tampa
Tampa General Hospital
P.O. Box 1289
Tampa, FL 33601
Emergency phone: 813-253-4444 (Tampa);
800-282-3171 (FL only)

Georgia

Georgia Poison Center
Hughes Spalding Children's Hospital
Grady Health System
80 Butler Street S.E.
P.O. Box 26066
Atlanta, GA 30335-3801
Emergency phone: 800-282-5846 (GA only);
404-616-9000

Idaho

Rocky Mountain Poison & Drug Center
8802 E. 9th Avenue
Denver, CO 80220-6800
Emergency phone: 800-860-0620 (ID only);
303-739-1123

Illinois

Illinois Poison Center
222 S. Riverside Plaza, Suite 1900
Chicago, IL 60606

Indiana

Indiana Poison Center
Methodist Hospital of Indiana
I-65 at 21st Street
Indianapolis, IN 46206-1367
Emergency phone: 800-382-9097 (IN only);
317-929-2323

Kentucky

Kentucky Regional Poison Center
Medical Towers South, Suite 572
234 East Gray Street
Louisville, KY 40202
Emergency phone: 502-589-8222

Louisiana

Louisiana Drug and Poison Information Center
Northeast Louisiana University
School of Pharmacy, Sugar Hall
Monroe, LA 71209-6430
Emergency phone: 800-256-9822 (LA only)

Maryland

Maryland Poison Center
20 N. Pine Street
Baltimore, MD 21201
Emergency phone: 410-706-7701;
800-492-2414 (MD only)

National Capital Poison Center (DC suburbs only)
3201 New Mexico Avenue, NW, Suite 310
Washington, DC 20016
Emergency phone: 202-625-3333;
202-362-8563 (TTY)

Massachusetts

Massachusetts Poison Control System
300 Longwood Avenue
Boston, MA 02115
Emergency phone: 617-232-2120;
800-682-9211 (MA only)

Michigan

Spectrum Health Regional Poison Center
1840 Wealthy S.E.
Grand Rapids, MI 49506-2968
Emergency phone: 800-764-7661 (MI only)

Children's Hospital of Michigan Poison Control Center
4160 John R. Harper Office Bldg., Suite 616
Detroit, MI 48201
Emergency phone: 800-764-7661 (MI only); 313-745-5711

Minnesota

Hennepin Regional Poison Center
Hennepin County Medical Center
701 Park Avenue
Minneapolis, MN 55415
Emergency phone: 612-347-3141; 800-764-7661 (MN only)

Minnesota Regional Poison Center
8100 34th Avenue S.
P.O. Box 1309
Minneapolis, MN 55440-1309
Emergency phone: 800-222-1222 (MN only); 612-221-2113

Missouri

Cardinal Glennon Children's Hospital Regional Poison Center
1465 S. Grand Blvd.
St. Louis, MO 63104
Emergency phone: 314-772-5200; 800-366-8888 (MO only)

Montana

Rocky Mountain Poison and Drug Center
8802 E. 9th Avenue
Denver, CO 80220
Emergency phone: 800-525-5042 (MT only)

Nebraska

The Poison Center
8301 Dodge Street
Omaha, NE 68114
Emergency phone: 402-354-5555 (Omaha); 800-955-9119 (NE and WY only)

Nevada

Rocky Mountain Poison & Drug Center
8802 E. 9th Avenue
Denver, CO 80220-6800
Emergency phone: 800-446-6179 (NV only); 303-739-1123

Oregon Poison Center
Oregon Health Sciences University
3181 S.W. Sam Jackson Park Road
Portland, OR 97201
Emergency phone: 775-328-4129 (NV only)

New Jersey

New Jersey Poison Information and Education System
201 Lyons Avenue
Newark, NJ 07112
Emergency phone: 800-764-7661 (NJ only)

New Mexico

New Mexico Poison and Drug Information Center
University of New Mexico
Health Sciences Library, Room 125
Albuquerque, NM 87131-1076
Emergency phone: 505-272-2222; 800-432-6866 (NM only)

New York

Central New York Poison Control Center
SUNY Health Science Center
750 E. Adams Street
Syracuse, NY 13210
Emergency phone: 315-476-4766; 800-252-5655 (NY only)

Finger Lakes Regional Poison Center
University of Rochester Medical Center
601 Elmwood Avenue
P.O. Box 321
Rochester, NY 14642
Emergency phone: 800-333-0542 (NY only); 716-275-3232

Hudson Valley Regional Poison Center
Phelps Memorial Hospital Center
701 North Broadway
Sleepy Hollow, NY 10591
Emergency phone: 800-336-6997 (NY only); 914-366-3030

Long Island Regional Poison Control Center
Winthrop University Hospital
259 First Street
Mineola, NY 11501
Emergency phone: 516-542-2323 (TDD Nassau County), 516-924-8811 (TDD Suffolk County)

New York City Poison Control Center
N.Y.C. Department of Health
455 First Avenue, Room 123
New York, NY 10016
Emergency phone: 212-340-4494; 212-POISONS; 212-447-2205

Western New York Regional Poison Control Center
Children's Hospital of Buffalo
219 Bryant Street
Buffalo, NY 14222
Emergency phone: 800-888-7655 (NY western regions only); 716-878-7654

North Carolina

Carolinas Poison Center
Carolinas Medical Center
5000 Airport Center Parkway, Suite B
P.O. Box 32861
Charlotte, NC 28232-2861
Emergency phone: 704-355-4000; 800-848-6946 (NC only)

Ohio

Central Ohio Poison Center
700 Children's Drive
Columbus, OH 43205-2696
Emergency phone: 614-228-1323; 800-682-7625 (OH only)

Cincinnati Drug & Poison Information Center Regional Poison Control System
2368 Victory Parkway, Suite 300
Cincinnati, OH 45206
Emergency phone: 513-558-5111; 800-872-5111 (OH only)

Oregon

Oregon Poison Center
Oregon Health Sciences University
3181 S.W. Sam jackson Park Road
Portland, OR 97201
Emergency phone: 503-494-8968; 800-452-7165 (OR only)

Pennsylvania

Central Pennsylvania Poison Center
Penn State University Hospital
Milton S. Hershey Medical Center
Hershey, PA 17033
Emergency phone: 800-521-6110 (PA only); 717-531-6111

The Poison Control Center
3600 Market Street, Suite 220
Philadelphia, PA 19104
Emergency phone: 800-722-7112 (PA only); 215-386-2100

Pittsburgh Poison Center
3705 Fifth Avenue
Pittsburgh, PA 15213
Emergency phone: 412-681-6669

Rhode Island

Lifespan Poison Center
Rhode Island Hospital
593 Eddy Street
Providence, RI 02903
Emergency phone: 401-444-5727

Tennessee

Middle Tennessee Poison Center
The Center for Clinical Toxicology
Vanderbilt University Medical Center
1161 21st Avenue South
501 Oxford House
Nashville, TN 37232-4632
Emergency phone: 800-288-9999 (TN only); 615-936-2034

Texas

Central Texas Poison Center
Scott & White Memorial Hospital
2401 S. 31st Street
Temple, TX 76508
Emergency phone: 800-764-7661 (TX only); 254-724-7401

North Texas Poison Center
5201 Harry Hines Blvd.
P.O. Box 35926
Dallas, TX 75235
Emergency phone: 800-764-7661 (TX only)

South Texas Poison Center
University of Texas Health Science Center
Forensic Science Building, Room 146
7703 Floyd Curl Drive
San Antonio, TX 78284-7849
Emergency phone: 800-764-7661 (1-800-POISON-1)

Southeast Texas Poison Center
The University of Texas Medical Branch
301 University Avenue
Galveston, TX 77555-1175
Emergency phone: 409-765-1420; 800-764-7661 (TX only)

West Texas Regional Poison Center
4815 Alameda Avenue
El Paso, TX 79905
Emergency phone: 800-764-7661 (TX only)

Utah

Utah Poison Control Center
410 Chipeta Way, Suite 230
Salt Lake City, UT 84108
Emergency phone: 801-581-2151; 800-456-7707 (UT only)

Virginia

Blue Ridge Poison Center
University of Virginia Health System
P.O. Box 437
Charlottesville, VA 22908
Emergency phone: 804-924-5543;
800-451-1428 (VA only)

National Capital Poison Center (Northern VA only)
3201 New Mexico Avenue, NW, Suite 310
Washington, DC 20016
Emergency phone: 202-625-3333

Virginia Poison Center
Virgina Commonwealth University
P.O. Box 980522
Richmond, VA 23298-0522
Emergency phone: 800-552-6337 (VA only);
804-828-9123

Washington

Washington Poison Center
155 N.E. 100th Street, Suite #400
Seattle, WA 98125
Emergency phone: 206-526-2121;
800-732-6985 (WA only)

West Virginia

West Virginia Poison Center
3110 MacCorkle Ave. S.E.
Charleston, WV 25304
Emergency phone: 800-642-3625 (WV only),
304-348-4211

Wyoming

The Poison Center
8301 Dodge Street
Omaha, NE 68114
Emergency phone: 402-354-5555 (Omaha);
800-955-9119 (WY and NE only)

CURRENT CRITERIA FOR CERTIFICATION OF POISON CENTERS AND POISON CENTER SYSTEMS

(Revised September 14, 1998.)

Introduction

The purpose of this document is to establish criteria by which Poison Centers and Poison Center Systems can be recognized as possessing the qualifications needed to adequately serve their designated population.

Definitions

A Poison Center is an organization which provides the following services to a region which it has been designated to serve: (1) poison information, telephone management advice and consultation about toxic exposures; (2) hazard surveillance to achieve hazard elimination; and (3) professional and public education in poison prevention, diagnosis, and treatment.

A Poison Center System consists of two or more Poison Centers functionally and electronically linked to provide Poison Center services.

A Certified Poison Center System consists of a Poison Center System which either (1) collectively meets the same criteria as a single Certified Poison Center, or (2) consists of a number of Centers serving a given region, all of which are certified individually. There cannot be any state-designated non-certified centers in the region of a Certified System unless they are components of the System.

I. DETERMINATION OF REGION

A. Geographical characteristics. A Certified Poison Center or System may serve a single state, a multi-state area, or only a portion of a state. The region should be determined by state authorities in conjunction with local health agencies and health care providers. In instances where multiple states are involved, designation from each state is necessary. Documentation of state designations of Poison Centers and Systems must be in writing and must clearly delineate the region to be served, the services to be provided, and the exclusivity of the designation. In instances where a state declines in writing to designate any Poison Center or System, designation by other political or health jurisdictions (e.g., county, health district) may be an acceptable alternative. In instances where more than one Center or System is designated to serve the same area, evidence of cooperative arrangements must be provided.

B. Population base. The Certified Poison Center or Poison Center System must provide evidence that it adequately serves its entire region. It is unlikely that a single Poison Center could adequately serve more than 10 million people.

C. Penetrance. The penetrance of a Poison Center or System in a region is defined as the number of human poison exposure cases handled per 1000 population per year. Penetrance is assumed to be most affected by the public's awareness of the appropriate use of the Poison Center. A Certified Poison Center or System must demonstrate a minimum average penetrance of 7.0 throughout its service area. Poison

Centers and Poison Center Systems should strive to achieve a penetrance of 12 to 15 throughout the region served, by increasing or maintaining awareness of Poison Center services.

II. REGIONAL POISON INFORMATION SERVICE

A. The Certified Poison Center or System shall provide information 24 hours/day, 365 days/year to both health professionals and the public. This criterion will be considered to be met if the Certified Poison Center has at least one Specialist in Poison Information in each Center at all times, sufficient additional staff to promptly handle each Center's incoming calls, and has the availability of the medical director or qualified designee, on-call by telephone, at all times. **Only if part of a System,** Certified Poison Centers may divert calls to another Certified Poison Center within the same state, within a contiguous region, or to the closest Certified Poison Center, if: (1) unequivocal continuity of clinical care is achieved through functional access to all open patient records, and (2) the receiving Certified Poison Center staff are fully trained and informed about all health care, EMS, and lab facility capabilities and regional toxicology variations. (The criteria relating to diversion of calls, functional access to open patient records, and knowledge of facilities and regional toxicology vaiations do not apply when assisting another Poison Center in a disaster situation.)

B. The Certified Poison Center or System shall be readily accessible by telephone from all areas within the region.

1. The Certified Poison Center or System must maintain a direct incoming telephone system that is extensively publicized throughout the region to both health professionals and the public.
2. The Certified Poison Center or System must maintain a telecommunications system adequate to assure ready access and must provide data verifying ready access.
3. In the absence of a toll-free system, the Certified Poison Center or System must demonstrate that the lack of a toll-free service is not an impediment to public use of the Center.
4. A Certified Poison Center or System may not impose a direct fee to individual members of the lay public (either by direct billing or pay-for-call services) for poison exposure emergency calls received from the public within its region.
5. The Certified Poison Center or System must be able to respond to inquiries in languages other than English as appropriate to the region using language translation services, interpreters, and/or bilingual staff.
6. Access for hearing-impaired individuals must be provided.
7. A plan to provide Poison Center services in response to natural and technological disasters must be in place.

C. The Certified Poison Center or System shall maintain comprehensive poison information resources (at each site). This criterion will be considered to be met if each Center maintains:

1. One or more comprehensive product information resources, immediately available to the Specialist in Poison Information at all times.
2. Current comprehensive references covering both general and specific aspects of acute and chronic poisoning management immediately available to the Specialist in Poison Information at all times. There must be access to the most current primary information resources and ready availability of a major medical library or comparable online resources.
3. Evidence of the competency of all specialists and information providers in using texts, information resources, and primary literature.

D. The Certified Poison Center or System shall maintain written operational guidelines which provide a consistent approach to evaluation and management of toxic exposures. This criterion will be considered to be met if the Certified Poison Center or System provides written operational guidelines which include but are not limited to the follow-up of all potentially toxic exposures and appropriate criteria for patient disposition. These guidelines must be available in the Center at all times and must be approved in writing by the medical director of the program. In addition, these guidelines must have evidence of periodic review, and the Center must provide evidence of action taken to remedy problems with guideline content or guideline adherence through quality assurance programs and staff education.

E. Staffing requirements and qualifications for the Certified Poison Center or System.

1. **Toxicological supervision.** Certified Poison Centers and each Center within a Certified Poison Center System must provide full-

time toxicological supervision. This must include at least one full-time equivalent of on-site toxicological supervision and appropriate back-up. These components must meet the specific criteria listed below. Each site of a Certified Poison Center System must meet the requirements for Medical and Managing direction.

(A) Medical direction and medical back-up.

(1) Medical direction may be provided by a single Medical Director or by more than one individual. If more than one individual provides medical direction, one individual must be designated as Medical Director and that person is responsible for approving other individuals involved and for coordinating their activities.

(2) The medical director and all other individuals designated as providers of medical direction must be board certified in medical toxicology or board-prepared in medical toxicology as determined by a letter from the Board indicating that the candidate will be allowed to sit for the next examination. Such board-prepared physicians must successfully complete the examination within two consecutive administrations of the exam. Board certification through either the American Board of Medical Toxicology (pre-1994) or through the American Board of Medical Specialties subspecialty exam in medical toxicology (after 1994) is acceptable. Physicians without board certification in medical toxicology will be considered qualified as Medical Directors for the purpose of determining compliance with the current criteria if: 1) the physician served as Medical Director of a Poison Center certified by AAPCC as of September 14, 1998; and 2) the physician met the immediately previous AAPCC criteria for Medical Directors on September 14, 1998.

(3) The Medical Director and all other individuals designated as providers of medical direction must have medical staff appointments at an in-patient treatment facility, must be involved in the management of poisoned patients, and must regularly consult with Specialists in Poison Information about the management of poisoned patients.

(4) The individual or individuals providing medical direction must individually or collectively devote at least 20 hours per week of professional activity time to toxicology. An additional 10 hours per week of medical direction time must be provided for each 25,000 human poison exposure cases per year received by the Certified Poison Center, above the initial 25,000 human poison exposure cases. Time applied to this total should conform to the following standards:

a. Up to 10 hours per week of the total time applied to medical direction may consist of toxicology activities not directly related to Certified Poison Center operation, such as clinical, academic, teaching, and research activities. No more than 10 percent of clinical time in emergency department, clinic, ward, or intensive care unit service will apply to this total, unless specific documentation is provided to verify that the additional time was directly related to toxicology.

b. The remainder of the total time applied to medical direction activities must consist of Poison Center operational activities during the time that is 100 percent dedicated to on-site medical direction at each Certified Poison Center or site of a Poison Center System. To summarize the time requirements for Medical Direction:

# Human poison exposures/year	*100% PC hr*	*Total tox hr*
25,000	10	20
50,000	20	30
75,000	30	40
100,000	40	50
125,000	50	60

(5) Medical backup must be available, in a timely manner, at all times. If

not provided by the Medical Director, medical backup may be provided by those providing medical direction or other individuals designated by the Medical Director. All medical backup must be provided by board-certified or board-prepared medical toxicologists. Other individuals identified and qualified by the Medical Director (e.g., fellows, Managing Director) may serve as immediate Certified Poison Center backup if timely secondary backup is provided at all times by a board-certified or board-prepared medical toxicologist. Direct clinical effort as backup can be applied to item 4.A. above.

(B) Managing direction.

(1) The Managing Director provides direct toxicological supervision of Poison Center staff, strategic planning, and oversight of administrative functions of programs, e.g., staff training, quality assurance, budgeting, etc.

(2) Managing direction may be provided by a single Managing Director or may be provided by more than one individual, each with the qualifications identified below. If more than one individual is involved in providing managing direction, one individual must be designated as Managing Director (or comparable title), and that person is responsible for coordinating managing direction activities.

(3) The Managing Director must be a nurse with a baccalaureate degree, associate degree, or three-year diploma; pharmacist; physician; or may hold a degree in a life science discipline if a diplomate of the American Board of Applied Toxicology. If the Managing Director is also the Medical Director, this peson must have a full time commitment to the Poison Center.

(4) The Managing Director with toxicological supervision responsibilities must be board certified or board prepared as evidenced by a letter from the appropriate board indicating that the candidate will be allowed to sit for the next examination. For physicians this Board can be the ABMT (pre-1994) or the ABMS subspecialty examination in medical toxicology (post-1994). For all others, the board must be the American Board of Applied Toxicology. Candidates for the board examination must successfully complete the examination within two consecutive administrations of the examination. Individuals without board certification in applied toxicology will be considered qualified as Managing Directors for the purpose of determining compliance with the current criteria if: (1) the individual served as Managing Director of a Poison Center certified by AAPCC as of September 14, 1998; and (2) the individual met the immediately previous AAPCC criteria for Managing Directors on September 14, 1998.

2. Specialists in Poison Information. A Specialist in Poison Information must be on duty in the Certified Poison Center, or at each functioning site of a Poison Center System, at all times.

(A) Specialists in Poison Information must be (1) a nurse with a baccalaureate degree, associate degree, or three-year diploma; pharmacist; or physician; or (2) currently certified by AAPCC as a Specialist in Poison Information; or (3) a diplomate of the American Board of Applied Toxicology; or (4) a board-certified medical toxicologist. Specialists in Poison Information must be qualified to understand and interpret standard poison information resources and to transmit that information in a logical, concise, and understandable way to both health professionals and the public.

(B) All Specialists in Poison Information must complete a training program approved by the Medical Director and, unless a diplomate of the American Board of Applied Toxicology or a board-certified medical toxicologist, must be certified by AAPCC as a Specialist in Poison Information within two

examination administrations of his or her initial eligibility for certification. If a Specialist in Poison Information fails to pass a certification exam within two exam administrations of his or her initial eligibility for certification, he or she may work only as a Poison Information Provider under direction as described in Section II.E.3. If an individual fails a recertification examination or does not take a recertification examination, that person reverts to the position of Specialist in Poison Information.

(C) Specialists in Poison Information not currently certified by AAPCC as Specialists in Poison Information must spend an annual average of no fewer than 16 hours per week in Poison Center related activities, including providing telephone consultation, teaching, public education, or in Poison Center operations. Specialists in Poison Information currently certified by AAPCC as Specialists in Poison Information must spend an annual average of no fewer than 8 hours per week in Poison Center related activities, including providing telephone consultation, teaching, public education, or in Poison Center operations. Individuals who do not meet this criterion may work as Poison Information Providers with direction as described in II.E.3.

(D) All Specialists in Poison Information, whether full-time or part-time, must be 100% dedicated to Poison Center activities during periods when they are assigned to the Center. Poison Center calls must be their first priority. In cases where a Poison Center assumes other roles, the Center must demonstrate policies and safeguards that assure that Poison Center calls are given priority and that these other activities pose no conflict with poison exposure cases and cause no reduction of service quality or quantity within the Certified Poison Center's region.

(E) At the time of initial application for Poison Center certification and thereafter, at least 50% of Specialist in Poison Information full time equivalent positions (FTE's) must be filled by Certified Specialists in Poison Information. For Certified Poison Center Systems, at least 50% of Specialists in Poison Information FTE's at each site must be Certified Specialists in Poison Information.

(F) To maintain experience and expertise, on average each Certified Poison Center must handle at least 2,000 human poison exposures per SPI/PIP full time equivalent.

3. **Other poison information providers.** Other poison information providers must be qualified to understand and interpret standard poison information resources and to transmit that information understandably to both health professionals and the public. This requirement will be considered to be met if the person has an appropriate health-oriented background and has specific training and/or experience in poison information sciences. While they may be part-time staff or have a part-time commitment to the Poison Center. 100% of their time should be dedicated to Poison Center activities while assigned to the Center. At all times, poison information, providers must be under the on-site direction of a Certified Specialist in Poison Informatin, a qualified Managing Director, or the Medical Director; these individuals may provide direction for no more than two poison information providers at one time.
4. **Certified Poison Center specialty consultants.** Certified Poison Center specialty consultants should be qualified by training or experience to provide sophisticated toxicology or patient care information in their area(s) of expertise. These consultants should be available on-call and provide consultation on-call on an as-needed basis. The list of consultants should reflect the type of poisonings encountered in the region.
5. **Administrative staff.** Certified Poison Center administrative personnel should be qualified by training and/or experience to supervise finances, operations, personnel, data analysis, and other administrative functions of the Certified Poison Center.
6. **Education Staff.**
   (A) Professional education. Professional education personnel should be qualified by training or experience to provide quality professional education lectures or materials to health professionals. This role will be supervised by the Medical Director.

(B) Public education. Public education personnel should have proven skills in communication and program planning, implementation, and evaluation, and/or an appropriate educational background with which to provide public-oriented presentations about Poison Center awarenes and the value of the Poison Center, poison prevention and first aid for poisoning. This role will be supervised by the Medical and/or Managing Director.

F. The Certified Poison Center or System shall have an ongoing quality improvement program.

1. A Certified Poison Center or System shall implement quality assurance activities which incorporate specific monitoring parameters and staff education programs.
2. A Certified Poison Cener or System shall demonstrate that patient outcomes are monitored regarding high risk, high volume, or problem-prone cases. The corrective actions taken to improve patient care shall be documented. In addition, the Certified Poison Center should demonstrate monitoring of customer satisfaction and assessment of staff competency.

III. REGIONAL TREATMENT CAPABILITIES

The Certified Poison Center or System shall identify the treatment capabilities of the treatment facilities of the region. At a minimum, the Certified Poison Center or System should: identify emergency and critical care treatment capabilities within the region for adults and children; have a working relationship with all poison treatment facilities in its region; understand the analytical toxicology facilities in the region and how to interface with them; understand how the region's prehospital transportation system is structured and how to interface with it; know where critical antidotes are available within the region and how they can be transferred between facilities when necessary.

IV. DATA COLLECTION SYSTEM

A. The Certified Poison Center or System shall keep records of all cases handled by the Center in a form that is acceptable as a medical record. This criterion will be considered to be met if the Center completes a record that contains data elements and sufficient narrative to allow for peer review and medical and/or legal audit, and such records are retrievable.

B. The Certified Poison Center or System must submit all its human exposure data (except as noted in IV.B.1.) to AAPCC's Toxic Exposure Surveillance System meeting specified submission deadlines and quality requirements and including all required data elements.

1. The submission of human exposure data derived from industry contracts is encouraged but not required for certification.
2. Certified Poison Centers that withhold industry-derived human exposure data must annually submit the number of industry-derived human exposures that were withheld.

C. The Certified Poison Center or System shall tabulate its experience for regional program evaluation and hazard surveillance on at least an annual basis. This criterion will be considered to be met if the Center completes an annual report summarizing its own experience.

D. The Certified Poison Center shall monitor the emergence of poisoning hazards and take specific actions to eliminate poisoning hazards.

V. PROFESSIONAL AND PUBLIC EDUCATION PROGRAMS

A. The Certified Poison Center or System shall provide information on the management of poisoning to the health professionals throughout the region who care for poisoned patients. This criterion will be considered to be met if the Certified Poison Center offers ongoing information about Poison Center access and services and updates on new and important advances in poisoning management to the health professionals throughout the region.

B. The Certified Poison Center or System shall provide a variety of public education activities targeting identified ''at-risk'' populations. The programs shall address poisoning dangers, poison prevention strategies, first aid for poisoning, and when and how to access Poison Center services. These programs must be implemented throughout the Certified Poison Center's region.

VI. ASSOCIATION MEMBERSHIP

The applicant Poison Center and each site in a Poison Center System must be an institutional member in good standing of the American Association of Poison Control Centers.

CHAPTER

20

Assessment of Physical Hazards

P. J. (BERT) HAKKINEN

A friend told him that the particular drink he was drinking was slow poison, and he replied, ''So who's in a hurry?''
(Nathaniel Benchley in *Robert Benchley*, spoken by Robert Benchley)

Toxicologists are often asked to assess the overall (chemical- and design-related) risks of likely exposures to a consumer product. Such a risk assessment would include the potential physical hazards associated with the consumer product. This chapter offers organizations and Internet locations of possible usefulness in assessing physical hazards. Also included is a thorough bibliography of available guidance and research publications related to physical hazards that is organized as follows:

- General Guidance Publications
- Surveys of the Causes of Childhood Product-Related Accidents
- Asphyxiation/Aspiration/Choking/Foreign Body Incidents/Suffocation
- Burns/Heat
- Combustion/Flammability
- Hearing/Noise/Sound
- Leaching/Migration/Volatilization (references included, but not actually physical hazards per se)
- Strangulation
- Trauma
- Vibration
- General Review of Measurement of Physical Hazards (see other publications in this chapter for methods related to a specific hazard)

The publications can be used to provide resources and guidance on identification and assessment of a wide array of physical hazards and can also serve to provoke thoughts about possible risk management steps that may be judged to be needed.

ORGANIZATIONS AND INTERNET LOCATIONS

The International Consumer Product Health and Safety Organization (ICPHSO) (P.O. Box 3425, York, PA 17402; phone: 717-757-2888) is a potentially valuable source of information. Founded under the sponsorship of the Association of Food and Drug Officials (AFDO), ICPHSO's mission is to promote the health and safety of consumer products, and members are from industry, government agencies, and elsewhere. ICPHSO holds an annual symposium, and a newsletter (*ICPHSO Update*) is published several times a year.

Other organizations of possible interest include the U.S. Consumer Product Safety Commission (CPSC; Web: http://www.cpsc.gov), the Society for Risk Analysis (SRA; 1313 Dolley Madison Blvd., Suite 402, McLean, VA 22101-3926; phone: 703-790-1745; Web: http://www.sra.org), and the National Safety Council (NSC; 1121 Spring Lake Drive, Itasca, IL 60143-3201; phone: 630-285-1121; Web: http://www.nsc.org).

Furthermore, the ''RISKANAL'' Internet mailing list from the ''Columbia-Cascades'' chapter of the Society for Risk Analysis and the Pacific Northwest Laboratory serves as a possible source of information. As of early 1999, this mailing list had more than 1500 members in 43 countries. Users (''subscribers'') are invited to ask

and answer questions and to send news items and announcements. To join this mailing list, the following message should be sent via the Internet to lyris@lyris.pnl.gov (messages about any questions or problems with this mailing list can be sent to js_dukelow@pnl.gov):

subscribe riskanal first_name last_name (e.g., subscribe riskanal Bert Hakkinen)

BIBLIOGRAPHY OF GUIDANCE AND RESEARCH PUBLICATIONS RELATED TO PHYSICAL HAZARDS

General Guidance Publications (Includes Workplace-Related Publications with Information Transferable to Assessment of Consumer Products)

Anonymous (1994). Report of the International Workshop on the Harmonization of the Classification of the Physical Hazards of Chemicals. International Program on Chemical Safety (IPCS), Geneva.

Benedyk, R., and Minister, S. (1998). Applying the BeSafe method to product safety evaluation. ***Appl. Ergonomics*** **29,** 5–13.
Discussed is how BeSafe (Behavioural Safety), an ergonomic method developed to assess and reduce risk in industrial contexts, could be used for consumer products.

DePaolis, M. V., and Cottrell, J. E. (1981). Miscellaneous hazards: Radiation, infectious diseases, chemical and physical hazards. ***Int. Anesthesiol. Clin.*** **19,** 131–148.
Physical hazards discussed include noise and radiation.

Liffers, M. (1991). Physical hazards from start-up to manufacturing. ***Occup. Med.*** **6,** 183–191.

Mattila, M. K. (1985). Job load and hazard analysis: A method for the analysis of workplace conditions for occupational health care. ***Br. J. Ind. Med.*** **42,** 656–666.
Includes guidance on identification of physical hazards.

Niedringhaus, L., and Niedringhaus, L. (1987). Avoiding physical hazards. ***Operations Forum*** **4,** 7–11.
Includes discussions of thermal stress, sound hazards, electrical hazards, and machinery hazards.

Rhodehamel, E. J. (1992). Overview of biological, chemical, and physical hazards. In ***HACCP (Hazard Analysis and Critical Control Points): Principles and Applications*** (M. D. Pierson and D. A. Corlett, Jr., Eds.), pp. 8–28. Van Nostrand–Reinhold, New York.

Schoone-Harmsen, M. (1990). A design method for product safety. ***Ergonomics*** **33,** 431–437.
Discussed is a method to detect and solve product safety problems. The approaches can be used by both ergonomists and product designers.

Shusterman, D. J., and Sheedy, J. E. (1992). Occupational and environmental disorders of the special senses. ***Occup. Med. State Art Rev.*** **7,** 515–542.
Physical hazards discussed include microwaves, infrared and ultraviolet radiation, visible light, vibration, and rapid ambient pressure changes.

Sommargren, C. E., (1995). Environmental hazards in the technological age. ***Crit. Care Nurs. North Am.*** **7,** 287–295.
Physical hazards discussed include radiant energy, electricity, and noise.

van Weperen, W. (1993). Guidelines for the development of safety-related standards for consumer products. ***Accid. Anal. Prev.*** **25,** 11–17.

Surveys of the Causes of Childhood Product-Related Accidents

Adesunkanmi A. R. K., Oginni L. M., Oyelami A. O., and Badru O. S. (1998). Epidemiology of childhood injury. ***J. Trauma Injury Infect. Critical Care*** **44,** 506–511.

Dunn, K. A., Runyan, C. W., Cohen, L. R., and Schulman, M. D. (1998). Teens at work: A statewide study of jobs, hazards, and injuries. ***J. Adolescent Health*** **22,** 19–25.

Hayward, G. (1988). Fatal home accidents—A product database. ***Accid. Anal. Prev.*** **20,** 399–410.

Hayward, G. (1996). Risk of injury per hour of exposure to consumer products. ***Accid. Anal. Prev.*** **28,** 115–121.
Survey of adults, along with use of hospital data, to determine risk of injury per hour associated with use of 76 common kitchen, do-it-yourself, and household products.

Laflamme, L., and EilertPetersson, E. (1998). Injuries to pre-school children in a home setting: Patterns and related products. ***ACTA-Paediatr.*** **87,** 206–211.

Lindblad, B. E., Terkelsen, C. J., and Lindblad, L. N. (1990). Product-related childhood accidents. A survey of 1590 cases. ***Scand. J. Soc. Med.*** **18,** 269–271.

Schulman, M. D., Evensen, C. T., Runyan, C. W., Cohen, L. R., and Dunn, K. A. (1997). Farm work is dangerous for teens: Agricultural hazards and inju-

ries among North Carolina teens. ***J. Rural Health*** **13,** 295–305.

Physical hazards include exposures to various types of machines found in farms and homes, and burns and cuts are among the types of injuries.

Tokuhata, G. K., Colfresh, V. G., Digon, E., Ramaswamy, K., Mann, L. A., and Hartman, T. (1974). Childhood injuries associated with consumer products. ***Prev. Med.*** **3,** 245–267.

Tokuhata, G. K., Hartman, T., Digon, E., and Colfresh, V. (1977). Fatal injuries attributed to consumer products in Pennsylvania, 1971. ***Public Health Rep.*** **92,** 374–382.

Werner, P. (1982). Playground injuries and voluntary product standards for home and public playgrounds. ***Pediatrics*** **69,** 18–20.

Asphyxiation/Aspiration/Choking/Foreign Body Incidents/Suffocation

See Rider and Wilson and Rimell *et al.* (below) for the most recent and most thorough analysis of these types of accidents and their causes and prevention.

Anonymous. (1997) Window-blind cords a strangulation hazard. ***Can. Med. Assoc. J.*** **157,** 241.

Baker, M. D. (1989). Near-miss asphyxiation from a toy ball: A small parts failure. ***Pediatr. Emergency Care*** **5,** 34–36.

Baker, S. P., and Fisher, R. S. (1980). Childhood asphyxiation by choking or suffocation. ***J. Am. Med. Assoc.*** **244,** 1343–1346.

Baker, S. P., and Halperin, K. (1995). Editorial: Designing the death out of balloons. ***J. Am. Med. Assoc.*** **274,** 1805.

Burton, E. M., Brick, W. G., Riggs, J. D., Jr., and Houston, C. S. (1996). Tracheobronchial foreign body aspiration in children. ***Southern Med. J.*** **89,** 195–198.

Byard, R. W. (1996). Mechanisms of unexpected death in infants and young children following foreign body ingestion. ***J. Forensic Sci.*** **41,** 438–441.

Byard, R. W., and Beal, S. M. (1997). V-shaped pillows and unsafe infant sleeping. ***J. Pediatr. Child. Health*** **33,** 171–173.

Campbell, A. J., Bolton, D. P., Williams, S. M., and Taylor, B. J. (1996). A potential danger of bedclothes covering the face. ***Acta Paediatr.*** **85,** 281–284.

Cataneo, A. J. M. Reibscheid, S. M., Ruiz, R. L., and Ferrari, G. F. (1997). Foreign body in the tracheobronchial tree. ***Clin. Pediatr.*** **36,** 701–705.

Cybowski, T. J. (1992). Sheepskin rugs linked to crib death. ***Wisconsin Med. J.*** **91,** 485–486.

Fergusson, J. A. E., Malecky, G., and Simpson, E. (1997). Lead foreign body ingestion in children. ***J. Pediatr. Child. Health*** **33,** 542–544.

Flynn, D. (1996). Letter: Reducing choking deaths in children. ***J. Am. Med. Assoc.*** **275,** 1313–1314.

Same pages also include another letter on this topic by H. D. Kerr.

Francois, M., Hamrioui, R., and Narcy, P. (1998). Nasal foreign bodies in children. ***Eur. Arch. Oto Rhino Laryngol.*** **255,** 132–134.

Gilbert-Barness, E., and Emery, J. L. (1996). Deaths of infants on polystyrene-filled beanbags. ***Am. J. Forensic Med. Pathol.*** **17,** 202–206.

Gomes, C. C., Sakano, E., Lucchezi, M. C., and Porto, P. R. (1994). Button battery as a foreign body in the nasal cavities. ***Special Aspects Rhinol.*** **32,** 98–100.

Holida, D. L. (1993). Latex balloons: They can take your breath away. ***Pediatr. Nurs.*** **19,** 39–43.

Jay, A. (1978). Letter: Suffocation and sudden infant death. ***Br. Med. J.*** **1,** 511.

Johnson, C. M., III (1986). Disposable plastic diapers: A foreign body hazard. ***Otolatyngol. Head Neck Surg.*** **94,** 235–236.

Johnson, D. G., and Condon, V. R. (1998). Foreign bodies in the pediatric patient. ***Curr. Problems Surg.*** **35,** 275.

Kemp, J. S., and Thach, B. T. (1991). Sudden death in infants sleeping on polystyrene-filled cushions. ***N. Engl. J. Med.*** **324,** 1858–1864.

Kraus, J. F. (1985). Effectiveness of measures to prevent unintentional deaths of infants and children from suffocation and strangulation. ***Public Health Rep.*** **100,** 231–240.

Langlois, J. A., Wallen, B. A., Teret, S. P., Bailey, L. A., Hershey, J. H., and Peeler, M. O. (1991). The impact of specific toy warning labels. ***J. Am. Med. Assoc.*** **265,** 2848–2850.

Consumer research on impact of different types of warning labels about choking hazard on adult's intent to purchase or not purchase a toy for a young child.

Lifschultz, B. D., and Donoghue, E. R. (1996). Deaths due to foreign body aspiration in children: The continuing hazard of toy balloons. ***J. Forensic Sci.*** **41,** 247–251.

Matthes, J., Sibert, J., and Levene, S. (1992). Letter: Children choking on foreign bodies from toys. ***Arch. Dis. Child.*** **67,** 664.

Parker, K., and Miles, S. H. (1997). Deaths caused by bedrails. ***J. Am. Geriatr. Soc.*** **45,** 797–802.

Petruk, J., Shields, E., Cummings, G. E. and Francescutti, K. H. (1996). Fatal asphyxiations in children involving drawstrings on clothing. ***CMAJ*** **155,** 417–419.

Polson, C. J., and Gee, D. J. (1972). Plastic bag suffocation. ***Z. Rechtsmed.*** **70,** 184–190.

Rauchschwalbe, R., and Mann, N. C. (1997). Pediatric window-cord strangulations in the United States, 1981–1995. ***J. Am. Med Assoc.*** **277,** 1696–1698.

Rauchschwalbe, R., Brenner, R. A., and Smith, G. S. (1997). The role of bathtub seats and rings in infant drowning deaths. ***Pediatrics*** **100,** E1–E5.

Reilly, J. S. (1990). Prevention of aspiration in infants and young children: Federal regulations. ***Ann. Otol. Rhinol. Laryngol.*** **99,** 273–276.

Reilly, J. S., and Walter, M. (1992). Consumer product aspiration and ingestion in children: Analysis of emergency room reports to the National Electronic Injury Surveillance System. ***Ann. Otol. Rhinol. Laryngol.*** **101,** 739–741.

Reilly, J. S., Cook, S. P., Stool, D., and Rider, G. (1996). Prevention and management of aerodigestive foreign body injuries in childhood. ***Pediatr. Clin. North Am.*** **43,** 1403.

Rider, G., and Wilson, C. L. (1996). Small parts aspiration, ingestion, and choking in small children: Findings of the small parts research project. ***Risk Anal.*** **16,** 321–330.

Rimell, F. L., Thome, A., Jr., Stool, S., Reilly, J. S., Rider, G., Stool, D., and Wilson, C. L. (1995). Characteristics of objects that cause choking in children. ***J. Am. Med. Assoc.*** **274,** 1763–1766.

Commentary and letters in response: Baker, S. P., and Halperin, K., ***J. Am. Med. Assoc.*** **274,** 1805 (1995); Kerr, H. D., ***J. Am. Med. Assoc.*** **275,** 1313–1314 (1996); and Flynn, D., ***J. Am. Med. Assoc.*** **275,** 1313–1314 (1996).

Ryan, C. A., Yocoub, W., Paton, T., and Avard, D. (1990). Childhood deaths from toy balloons. ***Am. J. Dis. Child.*** **144,** 1221–1224.

Simkiss, De, Sheppard, I., and Pal, B. R. (1998). Airway obstruction by a child's pacifier—Could flange design be safer? ***Eur. J. Pediatr.*** **157,** 252–254.

Strauss, R. H., Thompson, J. E., and Macasaet, A. (1977). Accidental strangulation by a motor vehicle window. ***Pediatr. Emergency Care*** **13,** 345–346.

Sunderland, R., and Rylance, G. (1992). Letter: Consumer safety and child choking attacks. ***Arch. Dis. Child.*** **67,** 664.

Weiss, R. L., Goldstein, M. N., Dharia, A., Zahtz, G., Abramson, A. I., and Patel, M. (1996). Clear plastic cups: A childhood choking hazard. ***Int. J. Pediatr. Otorhinolaryngol.*** **37,** 243–251.

Burns/Heat

Aggarwal, A., Edlich, R. F., and Himel, H. N. (1995). Steam vaporizer burn injuries. ***J. Emergency Med.*** **13,** 55–58.

Aslam, A., and Khoo, C. T. K. (1997). No sense, no sensibility—A tale of two adult hairdrier burns. ***Burns*** **23,** 454–457.

Bond, S. J., Schnier, G. C., Sundine, M. J., Maniscalco, S. P., and Groff, D. B. (1998). Cutaneous burns caused by sulfuric acid drain cleaner. ***J. Trauma Injury Infect. Crit. Care*** **44,** 523–526.

Cassell, O. C. S., Hubble, M., Milling, M. A. P., and Dickson, W. A. (1997). Baby walkers—Still a major cause of infant burns. ***Burns*** **23,** 451–453.

Fisher, L. (1973). Editorial: Lessening risks associated with roasting bags and other consumer products. ***Am. J. Public Health*** **63,** 1020–1021.

Lynch, M. T., Bellian, K. T., Edlich, R. F., and Himel, H. N. (1994). Model rocket engine burn injuries: The need for stricter regulations. ***J. Emergency Med.*** **12,** 325–330.

Oleson, J., Samulski, T., Clegg, S., Das, S., and Grant, W. (1994). Heating rate modeling and measurements in phantom and in vivo of the human upper extremity in a defective 2450 MHz microwave oven. ***J. Microwave Power Electromagn. Energy*** **29,** 101–108.

Powell, E. C., and Tanz, R. R. (1993). Comparison of childhood burns associated with use of microwave ovens and conventional stoves. ***Pediatrics*** **91,** 344–349.

Risch, S. (1993). Safety assessment of microwave susceptors and other high temperature packaging materials. ***Food Addit. Contam.*** **10,** 655–661.

Rossignol, A. M., Locke, J. A., Boyle, C. M., and Burke, J. F. (1985). Consumer products and hospitalized burn injuries among elderly Massachusetts residents. ***J. Am. Geriatr. Soc.*** **33,** 768–772.

Schieber, R. A., and Switzer, D. W. (1996). Injuries from propane gas grills. ***J. Am. Med. Assoc.*** **275,** 886.

Tarantino, M. D., and Nugent, D. J. (1994). Letter: Severe electrical burns in a hemophiliac wearing a medical alert chain. ***Clin. Pediatr. Philadelphia*** **33,** 382–383.

Walker, A. R. (1990). Fatal tapwater scald burns in the USA, 1979–86. ***Burns*** **16,** 49–52.

Zubair, M., and Besner, G. E. (1997). Pediatric electrical burns: Management strategies. ***Burns*** **23,** 413–420.

Combustion/Flammability

Kaplan, H. L. (1988). Evaluating the biological hazards of combustion products. In ***Product Safety Evaluation Handbook*** (S. C. Gad, Ed.), pp. 409–471. Dekker, New York.

This chapter includes a historical review, reviews of the toxicity of smoke, combustion test methods, and methods for evaluating the biological hazards of combustion products.

Milliken, R. A., and Bizzari, D. V. (1985). Flammable surgical drapes—A patient and personnel hazard. ***Anesth. Analg.*** **64,** 54–57.

Non-consumer product publication, but possibly useful for insight on flammability hazards.

Orzel, R. A. (1993). Toxicological aspects of firesmoke: Polymer pyrolysis and combustion. ***Occup. Med.*** **8,** 414–429.

Skolnick, A. A. (1993). Philip Morris recalls Marlboro cigarette lighter, considered ''enticing fire hazard for children''. ***J. Am. Med. Assoc.*** **269,** 1353–1356.

Wagner, J. P., and Caraballo, S. A. (1997). Toxic species emissions from controlled combustion of selected rubber and plastic consumer products. ***Polymer Plastics Technol. Eng.*** **36,** 189–224.

Hearing/Noise/Sound

Hellstrom, P. A., Dengerink, H. A., and Axelsson, A. (1992). Noise levels from toys and recreational articles for children and teenagers. ***Br. J. Audiol.*** **26,** 267–270.

McMillan, P. M., and Kileny, P. R. (1994). Hearing loss from a bicycle horn. ***J. Am. Acad. Audiol.*** **5,** 7–9.

Yaremchuk, K., Dickson, L., Burk, K., and Shivapuja, B. G. (1997). Noise level analysis of commercially available toys. ***Int. J. Pediatr. Otorhinolaryngol.*** **41,** 187–197.

Leaching/Migration/Volatilization

Cooper, S. D., Raymer, J. H., Pellizzari, E. D., and Thomas, K. W. (1995). The identification of polar organic compounds found in consumer products and their toxicological properties. ***J. Expo. Anal. Environ. Epidemiol.*** **5,** 57–75.

Methods to collect and identify volatile organic compounds emitted from consumer products.

Milana, M. R., Ziemacki, G., Feliciani, R., and Gramiccioni, L. (1993). Little toys: Elution test and evaluation of possible impact on disposal of wastes. ***Toxicol. Environ. Chem.*** **39,** 61–64.

Poore, M. W., and Houston, T. E. (1996). Determination of exempt and prohibited compounds in consumer products by headspace gas chromatography mass spectrometry. ***J. Air Waste Manage. Assoc.*** **46,** 1093–1095.

Rastogi, S. C., and Pritzl, G. (1996). Migration of some toxic metals from crayons and water colors. ***Bull. Environ. Contam. Toxicol.*** **56,** 527–533.

Rickman, E. E., Jr., Howe, G. B., Jayanty, R. K., and Whitfield, J. K. (1997). Interlaboratory study of a test method for measuring total volatile organic compound content of consumer products. ***J. Air Waste Manag. Assoc.*** **47,** 608–613.

Risch, S. (1993). Safety assessment of microwave susceptors and other high temperature packaging materials. ***Food Addit. Contam.*** **10,** 655–661.

Strangulation

Chin, N., and Berns, S. D. (1995). Near-hanging caused by a toy necklace. ***Ann. Emergency Med.*** **26,** 522–525.

Feldman, K. W., and Simms, R. J. (1980). Strangulation in childhood: Epidemiology and clinical course. ***Pediatrics*** **65,** 1079–1085.

Hord, J. D., and Anglin, D. (1993). Letter: Accidental strangulation of a toddler involving a wall light switch. ***Am. J. Dis. Child.*** **147,** 1038–1039.

Little, A. S. (1994). Letter: Drapery cord injury and strangulation in babies. ***Am. Family Physician*** **49,** 335.

Rauchschwalbe, R., and Mann, N. C. (1997). Pediatric window-cord strangulations in the United States, 1981–1995. ***J. Am. Med. Assoc.*** **277,** 1696–1698.

Trauma

Al Salem, M., and Sheriff, S. M. (1984). Ocular injuries from carbonated soft drink bottle explosions. ***Br. J. Ophthalmol.*** **68,** 281–283.

Altchek, E. (1998). Dental flossing and digital trauma. ***Plastic Reconstruct. Surg.*** **101,** 243–244.

Amirjamshidi, A., Abbassioun, K., and Roosbeh, H. (1997). Air-gun pellet injuries to the head and neck. ***Surg. Neurol.*** **47,** 331–338.

Anonymous (1995). Serious eye injuries associated with fireworks—United States, 1990–1994. ***Morb. Mortal. Weekly Rep.*** **44,** 449–452.

Baker, S. P., Fowler, C., Li, G., Warner, M., and Dannenberg, A. L. (1994). Head injuries incurred by children and young adults during informal recreation. ***Am. J. Public Health*** **84,** 649–652.

Bank, D. E., and Carolan, P. L. (1993). Cerebral abscess formation following ocular trauma: A hazard associated with common wooden toys. ***Pediatr. Emergency Care*** **9,** 285–288.

Bratton, S. L., Dowd, M. D., Brogan, T. V., and Hegenbarth, M. A. (1997). Serious and fatal air gun injuries: More than meets the eye. ***Pediatrics*** **100,** 609–612.

Bullock, J. D., Ballal, D. R., Johnson, D. A., and Bullock, R. J. (1997). Ocular and orbital trauma from water balloon slingshots. A clinical, epidemiologic, and experimental study. ***Ophthalmology*** **104,** 878–887.

Calle, S. C., and Eaton, R. G. (1993). Wheels-in-line roller skating injuries. ***J. Trauma*** **36,** 946–951.

Champa, J. R., Hennrikus, W. L., Gerardi, J. A., and LaPoint, J. M. (1989). Four cases of injury involving soda vending machines. ***J. Orthop. Trauma*** **3,** 64–67.

Chan, T., O'Keefe, M., Bowell, R., and Lanigan, B. (1995). Childhood penetrating eye injuries. ***Ir. Med. J.*** **88,** 168–170.

Chorich, L. J., Davidorf, F. H., Chambers, R. B., and Weber, P. A. (1998). Bungee cord-related ocular injuries. ***Am. J. Ophthamol.*** **125,** 270–272.

Christoffel, K. K., Tanz, R., Sagerman, S., and Hahn, Y. (1984). Childhood injuries caused by nonpowder firearms. ***Am. J. Dis. Child.*** **138,** 557–561.

Coleman, S. G., and Vickers, D. W. (1982). Digital amputations by slippery slides. ***Med. J. Aust.*** **1,** 339–341.

Drago, D. A., Winston, F. K., and Baker, S. P. (1997). Clothing drawstring entrapment in playground slides and school buses. Contributing factors and potential interventions. ***Arch. Pediatr. Adolesc. Med.*** **151,** 72–77.

Edlich, R. F., Rodeheaver, G. T., and Edgerton, M. T. (1978). Airless paint gun injuries: An update. ***JACEP*** **7,** 397–400.

Francis, P. J., and Chisholm, I. H. (1998). Ocular trauma from party balloons. ***Br. J. Ophthamol.*** **82,** 203.

Friedman, D., Hammond, J., Cardone, J., and Sutyak, J. (1996). The air gun: toy or weapon? ***Southern, Med. J.*** **89,** 475.

Geller, E., Yoon, M. S., Loiselle, J., Crisci, K. L., and Bierbrauer, K. S. (1997). Head injuries in children from plastic hairbeads. ***Pediatr. Radiol.*** **27,** 790–793.

Gould, J. H., and DeJong, A. R. (1994). Injuries to children involving home exercise equipment. ***Arch. Pediatr. Adolesc. Med.*** **148,** 1107–1109.

Harrell, W. A. (1997). Letter: Epidemiology of shopping cart-related injuries to children. ***Arch. Pediatr. Adolesc. Med.*** **151,** 105–106.

Kotch, J. B., Chalmers, D. J., Langley, J. D., and Marshall, S. W. (1993). Child day care and home injuries involving playground equipment. ***J. Paediatr. Child. Health*** **29,** 222–227.

Kronisch, R. L. (1998). Mountain biking injuries—Fitting treatment to the causes. ***Physician Sports Med.*** **26,** 64–70.

Manary, M. J., and Hollifield, W. C., Jr. (1993). Childhood sledding injuries in 1990–91. ***Pediatr. Emergency Care*** **9,** 155–158.

McNeill, A. M., and Annest, J. L. (1995). The ongoing hazard of BB and pellet gun-related injuries in the United States. ***Ann. Emergency Med.*** **26,** 187–194.

Mooney, D. P., Malcynski, J. T., Gupta, R., and Shorter, N. A. (1996). An unusual case of penetrating cardiac injury in a child. ***J. Pediatr. Surg.*** **31,** 707–708.
''This child's injury could have been prevented through increased parental supervision or a modified toy design that takes into account predictable patterns of abuse.''

Myre, L. E., and Black, R. E. (1987). Serious air gun injuries in children: Update of injury statistics and presentation of five cases. ***Pediatr. Emergency Care*** **3,** 168–170.

Powell, E. C., and Tanz, R. R. (1996). In-line skate and rollerskate injuries in childhood. ***Pediatr. Emergency Care*** **12,** 259–262.

Ruddy, R., Bacchi, D., and Fleisher, G. (1985). Injuries involving household furniture: Spectrum and strategies for prevention. ***Pediatr. Emergency Care*** **1,** 184–186.

Sastry, S. M., Copeland, R. A., Jr., Mezghebe, H. M., Siram, S. M., Spencer, M., and Cowan, C. L., Jr.

(1995). Consumer product-related ocular trauma. ***Nat. Med. Assoc.* 87,** 349–352.

See, L. C., and Lo, S. K. (1994). Epidemiology of fireworks injuries: The National Injury Surveillance System. ***Ann. Emergency Med.* 24,** 46–50.

Selbst, S. M., Baker, M. D., and Shames, M. (1990). Bunk bed injuries. ***Am. J. Dis. Child.* 144,** 721–723.

Singer, W., and Lutner, L. (1982). Trauma from toy boxes. ***J. Pediatr.* 100,** 242–243.

Smith, G. A., Dietrich, A. M., Garcia, C. T., and Shields, B. J. (1995). Epidemiology of shopping cart-related injuries to children. An analysis of national data for 1990 to 1992. ***Arch. Pediatr. Adolesc. Med.* 149,** 1207–1210.

Smith, G. A., Bowman, M. J., Luria, J. W., and Shields, B. J. (1997). Babywalker-related injuries continue despite warning labels and public education. ***Pediatrics* 100,** E11–E15.

Sternberg, P., Jr., deJuan, E., Jr., Green, W. R., Hirst, L. W., and Sommer, A. (1984). Ocular BB injuries. ***Ophthalmology* 91,** 1269–1277.

Tanz, R., Chritoffel, K. K., and Sagerman, S. (1985). Are toy guns dangerous? ***Pediatrics* 75,** 265–268.

Tay, J. S., and Garland, J. S. (1987). Serious head injuries from lawn darts. ***Pediatrics* 79,** 261–263.

Torg, J. S., and Das, M. (1985). Trampoline and minitrampoline injuries to the cervical spine. ***Clin. Sports Med.* 4,** 45–60.

Totten, V. Y., FaniSalek, M., and Chandramohan, K. (1998). Hyphema associated with air bag deployment in a pediatric trauma patient. ***Am. J. Emergency Med.* 16,** 102–103.

Walsh-Kelly, C. (1987). Electric mixer-inflicted scalp injury: A case report and review of CPSC data. ***Pediatr. Emergency Care* 3,** 166–167. [Also notes electrical shock potential]

Wellman, S., and Paulson, J. A. (1984). Baby walker-related injuries. ***Clin. Pediatr. Philadelphia* 23,** 98–99.

Vibration

Shaikh, N. (1994). Low vibration hand held tools for safety and health. ***CRISP Data Base of National Institutes of Health.*** (Abstract available via National Library of Medicine's TOXLINE database)

Thonnard, J. L., Masset, D., Penta, M., Piette, A., and Malchaire, J. (1997). Short-term effect of hand-arm vibration exposure on tactile sensitivity and manual skill. ***Scand. J. Work Environ. Health* 23,** 193–198.

General Review of Measurement of Physical Hazards (See Other Publications in this Chapter for Methods Related to a Specific Hazard)

Wells, A. M., Giampaoli, E., and Zidan, L. N. (1983). ***Physical Hazards.*** Fundacentro, Sao Paulo, Brazil. Physical hazards discussed in this textbook include methodologies for assessing noises and vibrations, extreme temperatures, electromagnetic radiation, and abnormal pressures.

This Page Intentionally Left Blank

CHAPTER

21

Patents: Toxicological Information Resource

ROBERT O. BEAUCHAMP, JR.

After a heated argument on some trivial matter Nancy. . . shouted, ''If I were your wife I would put poison in your coffee!'' Whereupon Winston [Churchill] with equal heat and sincerity answered, ''And if I were your husband I would drink it.'' (Consuelo Vanderbilt Balsam, *Glitter and Gold*, spoken by Nancy Astor)

The objective of the patent system is to advance technological progress by encouraging inventors to construct and report their inventions and to reward them by protecting the unique intellectual property of the inventor. The global patent literature contains many patents pertaining to biomedical information, including topics such as disclosures on new compositions of matter, new methods or syntheses of chemical or electronic structures, and novel applications and uses of new or existing materials. From the standpoint of obtaining a patent, it must fall in one of three patent statuatory classes: utility, plant, and design. An application for a patent must contain sufficient background information to establish its uniqueness and not duplicate prior inventions. In patents dealing with some aspect of biological or biomedical sciences, the applicant or inventor may include relevant data, possibly related to toxicology or pharmacology, on the subject matter being considered. These data, when incorporated into the issued patent, can be retrieved by searching one of several computer files with appropriate search terms. Full-text searching of patents may be performed that may include inventors, assignees, references providing background information on the patent, abstract, description or background, specific examples of preparation of patented art, and claims defining the range of patent coverage. Each of the foregoing sections or fields of the patent may be searched separately or in combination depending on the interest of the searcher.

From this broad definition of the information contained in patents, it is apparent that biological, and possibly toxicological, activity may be an integral part of pharmaceutical or pesticidal patents. Biological test results may be listed for animals or humans, as may *in vitro* testing affecting genetic, reproduction, developmental, teratology, immunology, or endocrinology systems. The relative activity observed and reported in the patent can be compared to other information located in journals or reports and together used to establish a ''toxicological profile'' on a given substance or chemical class.

This chapter outlines proposed techniques for utilizing the patent literature as a potential source of biomedical and toxicological information in either research or development of biologically active materials. Typical information resources are described and examples of their application are illustrated. However, it must be kept in mind that patents are principally drawn for legal purposes and to protect the inventor's property for a stipulated period of time. The biomedical activity in many instances is of secondary importance and this factor should guide the searcher in examining patents and structuring search queries.

SOURCES OF PATENT INFORMATION

When considering patents as a source of information, the searcher should be familiar with the various sections of a patent and how to address information in each section. In Fig. 21.1a, a typical United States patent accessed via the U.S. Patent and Trademark Office on the Internet is illustrated. The individual sections of the patent are limited to the patent number, date of issuance, title, inventors, assignee, application number, file date(s), related application data, classifications, background references, and abstract. As mentioned previously, there are three different classes of patents and this factor will impose some restrictions on the search procedures. The patent shown in Fig. 21.1a discloses methods of preventing chlorohydrocarbon toxicity. Figure 21.1b is the same patent as printed from the Chemical Abstracts file. Similar reference citation information is given. However, the abstract includes more experimental detail.

The original patent or its application, when available, is the primary document reporting specific data on the biological activity of a chemical or nonchemical agent (e.g., physical/electromagnetic phenomena). A specific patent may be found by means of the patent number, inventor, assignee, assigner, title, patent classification or subclassification, or combinations thereof. Free-text terms can be used to determine if a concept or specific chemical has been included in a previous patent. In most cases, searches are conducted on multiple topics with modifiers. Sets of patents along with other types of information are listed from journals and periodicals to focus on references of interest. In Fig. 21.2 a typical search in the U.S. patent collection yielded the following patent titles where the patent file (1970–1996) was searched for the term ''toxicity'' in the patent title. From the set of 113 U.S. patents retrieved, the patents may be printed simply by title as in Fig. 21.2 for rapid scan or in a more complete format with abstract and claims for analysis. Figure 21.2 lists the first 40 titles, and item No. 38 corresponds to the patent in the previous figures (http://www.uspto.gov).

The foregoing illustrations have been confined to the use of the U.S. patent file. Other patent files or sources which may contain patent references, and other types of bibliographic information, are listed in Table 21.1. These files may be queried either electronically by means of computer databases or via corresponding printed indexes. Scanning printed indexes is usually a time-consuming task but does have the advantage of determining pertinent search terms that may be used in optimizing a subsequent more costly computer search.

Searches can be conducted in one or several of these computer files (provided they are from the same vendor) simultaneously [in either Dialog or Science and Technical Information Network (STN)] and duplicates removed if desired. Formats of the patents may range from a complete patent printout to a single patent number which then may be examined in such files as U.S. patents or World Patent Index (WPI). When a patent is cited in the bibliography of an article or report, judgment is required to determine the context in which it was used. An abstract of the cited patent can be retrieved from a computer file to determine the relevancy to the original search request.

Primary patent information sources such as U.S. patents, WPI, and INPADOC will not be described in detail because each source requires special analysis. These computer files can be accessed according to certain search fields/sections, and patent classifications can be an integral part of this search designation. Free-text allows extensive coverage and retrieval of sets of patents for examination and selection. Patent seminars are conducted frequently by vendors to orient the potential user in making the optimum use of computerized information.

Several comprehensive computer files incorporate patent information along with other technical information (see Table 21.1) which may relate to biomedical concerns. A few of these files are summarized to help the searcher in the selection of databases of value in preparing background information for patent applications related to research and development.

Chemical Abstracts: Section codes indicating a broad technical discipline are applied to each reference according to its content. This number(s), corresponding to one or more major sections, can be incorporated in the search statement. One large section titled Toxicology includes patent references along with various periodical references. In the most recent three years (1992–1996), a total of 1407 patents were coded in this category. Restricting the search to this section for only the patents, one can focus on searches dealing with toxicity. For example, searching for the term ''toxicity'' in the title retrieves 50 citations which can be perused quickly for relevant patents.

BioBusiness: This file (Dialog 285; STN BioBusiness/RN) provides information on business applications of biological and biomedical research. The information is collected by BIOSIS and includes U.S. patents since 1985. There are a total of 112,000 patents in the file; 201 patents are recorded in the subject code (21200) for drugs (as of 1996) and 570 patents in the subject code for environment (70313). Free-text terms, author, title, and other codes may be employed in locating patents of interest.

a

United States Patent **5,198,432**
Fariss **Mar. 30, 1993**

Method of preventing chlorohydrocarbon toxicity using sterol derivatives

Inventors: **Fariss; Marc W.** (Manakin-Sabot, VA).
Assignee: **Center for Innovative Technology** (Herndon, VA); **Virginia Commonwealth University** (Richmond, VA).

Appl. No.: **678,110**
Filed: **Apr. 1, 1991**

Related U.S. Application Data

Continuation-in-part of Ser No. 316,789, Feb. 28, 1989, which is a continuation-in-part of Ser. No. 149,764, Jan. 29, 1988, abandoned.

Intl. Cl. : **A61K 31/56, A01N 29/02**
U.S. Cl.: **514/182; 514/758**
Field of Search: **514/182, 758**

References Cited [Referenced By:]

U.S. Patent Documents

2,350,713	Jun., 1944	Baxter et al.	549/413
2,680,749	Jun., 1954	Cawley	549/410
3,825,563	Jul., 1974	Ahrens	549/410
4,269,835	May, 1981	Whittle	424/263
4,931,275	Jun., 1990	Shinitzky et al.	424/88

Foreign Patent Documents

871298	Sept., 1979	BE
76125755	May, 1977	JP
83/96428	Dec., 1985	JP

Other References

Suslov et al., ''Sodium Succinate in Experimental Tuberculosis'', Probl Tuberk, 2:57-9, (1980).

Toivanen, ''Effects of Selenium, Vitamin E and C on Human Prostacyclin and Thromboxane Synthesis in Vitro'', Prostaglandins Leukotrienes and Medicine, 26, 265-280, (1987).

Gershon et al., ''Anti-fungal Properties of 2-Bromo-3-fluorsuccinic Acid Esters and Related Compounds'', J. of Medicinal Chemistry, vol. 20, No. 4, (1977).

Abstract

Ionizable congeners of aromatic and aliphatic alcohols provide potent cytoprotective properties in vivo and in vitro. Alpha-tocopherol succinate, cholesteryl succinate, cholesteryl sulfate, dihydrocholesterol succinate, dihydrocholesterol sulfate, and ergosterol analogs are particularly good cytoprotective agents. In addition, the tris salts of these compounds have superior cytoprotective properties.

5 Claims, 45 Drawing Figures

b

119153879 CA: 119(15)153879u PATENT
Method of preventing chlorohydrocarbon toxicity using sterol and other alcohol derivatives
Inventor (Author): Fariss, Marc W.
Location: USA
Assignee: Center for Innovative Technology; Virginia Commonwealth University
Patent: United States ; US 5198432 A Date: 930330
Application: US 678110 (910401) *US 149764 (880129) *US 316789 (890228)
Pages: 47 pp. Cont.-in-part of U.S. Ser. No. 316,789.
CODEN: USXXAM
Language: English
Class: 514182000; A61K-031/56A; A01N-029/02B
Section:
CA204003 Toxicology
Identifiers: poison antidote alc deriv, chlorohydrocarbon toxicity sterol deriv

FIGURE 21.1 (a) Portion of patent from U.S. Patent and Trademark Office Web site (http://www.uspto.gov). (b) Portion of patent from Chemical Abstracts (through Dialog Information Services).

	Pat. No.	Title
51.	5,498,252	*Toxicity* resistant, self-fitting and adjustable, self-closing tampon structure
52.	5,481,815	System to reduce sediment *toxicity*
53.	5,476,455	*Toxicity* resistant tampon structure
54.	5,475,113	Tetrahydronaphthyl and thiazole, oxazole or imidazole substituted ethene derivatives having retinoid-like activity, reduced skin *toxicity* and reduced teratogenecity
55.	5,474,757	Prevention of acetaminophen overdose *toxicity* with organosulfur compounds
56.	5,470,822	Low-*toxicity* invert emulsion fluids for well drilling
57.	5,460,819	Method for treating PQQ-responsive heavy metal *toxicity*
58.	5,460,668	Nonazide gas generating compositions with reduced *toxicity* upon combustion
59.	5,459,070	Apparatus for rapid *toxicity* testing of a liquid sample
60.	5,449,474	Low *toxicity* solvent composition
61.	5,442,001	Use of low *toxicity* solvents in waterborne adhesives
62.	5,441,982	Therapeutics for management of cocaine induced *toxicity*
63.	5,426,035	Method of compensating *toxicity* test data for the measured *toxicity* of a reference sample
64.	5,416,005	Method for rapid *toxicity* testing of a liquid sample
65.	5,413,916	Colorimetric *toxicity* test
66.	5,393,464	Biodegradable corrosion inhibitors of low *toxicity*
67.	5,389,359	Pharmaceutical preparation containing L-aspartate or L-asparagine for preventing ethanol *toxicity,* and process for preparation thereof
68.	5,388,519	Low *toxicity* primer composition
69.	5,370,877	Method for improving delivery and reducing *toxicity* of biologically active substances using novel .alpha.-amino dicarboxylic acid derivatives
70.	5,366,723	Method of alleviating *toxicity* originating from treatment with anticancer platinum compounds
71.	5,342,331	*Toxicity* resistant tampon structure
72.	5,336,694	Expanded polymer product with high distortion temperature, high flame resistance and low smoke *toxicity* and opacity
73.	5,324,840	Method of treatment with compounds having retinoid-like activity and reduced skin *toxicity* and lacking teratogenic effects
74.	5,310,551	Method for inhibiting pulmonary oxygen *toxicity*
75.	5,292,497	Method of reducing chemotherapy *toxicity* using (methylaminopropylamino)propyl dihydrogen phosphorothioate
76.	5,260,340	Prevention and amelioration of acetaminophen *toxicity* with beta-carotene
77.	5,254,603	Low *toxicity* radiation curable resins and coatings made therefrom
78.	5,242,684	Antimicrobial, low *toxicity,* non-irritating composition comprising a blend of bis-quaternary ammonium compounds coprecipitated with a copolymer of vinylpyrrolidone and an acrylamido or vinyl quaternary ammonium monomer
79.	5,229,373	Use of exogenous gangliosides as a protective factor against *toxicity* by antitumor drug vincristine
80.	5,229,109	Low *toxicity* interleukin-2 analogues for use in immunotherapy
81.	5,225,333	Process and apparatus for the detection of *toxicity* in surface waters as well as drinking water and industrial water
82.	5,218,027	Low *toxicity* fire retardant thermoplastic material
83.	5,217,974	Method for treating gar-transformylase tumors in mammals and reducing mammalian *toxicity*
84.	5,216,030	Antimicrobial, low *toxicity,* blend composition of bis-quaternary ammonium compounds and polyvinylpyrrolidone
85.	5,207,800	Low *toxicity,* biodegradable salt substitute for dyeing textiles: magnesium acetate in direct or reactive dyeing of cotton
86.	5,204,073	*Toxicity* elimination and comprehensive utilization of chrome residues
87.	5,202,354	Composition and method for reducing acetaldehyde *toxicity*
88.	5,200,184	Lipopolysaccharides of reduced *toxicity* and the production thereof
89.	5,198,432	Method of preventing chlorohydrocarbon *toxicity* using sterol derivatives
90.	5,196,135	Antimicrobial, low *toxicity,* blend composition of bis-quaternary ammonium compounds

FIGURE 21.2 Some U.S. Patents with ''toxicity'' in the title (from the U.S. Patent and Trademark Office Web site).

BIOSIS Previews: U.S. patents associated with research in the biological and biomedical sciences were included for the period from 1986 through 1989. Search techniques used with this file (Dialog 5; STN BIOSIS Previews/RN) include concept codes, concept names, assignee, patent number, and corporate sources. The U.S. patent information retrieved from BIOSIS files can serve as examples of related patents which may be found. Examination of the complete U.S. patent may suggest additional search terms and focus the search on a particular topic.

SciSearch: Patent literature (or single patents) is not abstracted in this file but patent references are reported in the bibliographies as cited references (CRs). If a U.S. patent is cited as a reference it can be checked by expanding with the mnemonic, e.g., CR = us 5000000; U.S. patents will be listed by patent number and the number of times a patent has been cited will be indicated as well. Then, the related set can be searched and complete references can be displayed to determine the relationship of the patent to the subject matter covered in the original reference. This technique is

TABLE 21.1 Sources of Patent Information

Computer	Hard copy
U.S. patents	
Internet	*Patent Gazette* (GPO)
U.S. Patent and Trademark Office (http://www.uspto.gov)	
IBM Patent Server) (http://patent.womplex.ibm.com)	
ChemCenter (http://www.ChemCenter.org/dbsearch.html)	
Dialog[a] (file 652)	
STN[a] (USPATFULL)	
World patents	
WPI	Derwent
Dialog (file 350, 351)	
STN (WPIDS/WPINDEX)	
INPADOC	European Patent Office
Dialog file 345	
STN INPADOC	
Japanese patents	
JAPIO (Dialog 347; STN JAPIO)	
Patents abstracted/cited in other computer files	
Beilstein	
BioBusiness	
BIOSIS Previews	
Biotechnology Abstracts	
Chemical Abstracts	
Food Science & Technology	
Kirk–Othmer	
Life Sciences: Cambridge	
Merck Index	
Nuclear Science Abstracts	
Pascal	
SciSearch	
World Translations Index	

[a] Computer files can be selected from either Dialog or STN database collections or through Internet addresses.

useful as a research tool which allows the searcher to observe how other researchers are utilizing the patent in novel applications.

SUMMARY

The patent literature is a potentially rich source of toxicological, pharmacological, or environmental data and is certainly worth examining as a primary resource or adjunct to any standard literature search. Evaluating patents may lead to additional sources of information, including inventors, organizations, foreign references, and peripheral literature. Patent applications are prepared after thorough analysis of the literature by competent patent agents and should be given a prominent position as a toxicological information resource.

References

Derwent (http://www.derwent.com; 1-800-451-3451).
Dialog Corporation, Cary, NC 27511 (1-800-334-2564).
STN. Science and Technical Information Network, Columbus, OH. Chemical Abstracts Services (1-800-848-6538).
U.S. Patents (http://www.uspto.gov, http://patent.womplex.ibm.com, http://www.ChemCenter.org/dbsearch.html).

Note that in addition to Dialog and STN, many other vendors, such as Orbit and Questel, offer databases containing patent information. The Internet may be searched for other sources of patent information by querying the subject directories (Yahoo, Magellan, and Cyberbound) or the search engines (Alta Vista, Excite, Infoseek, and Lycos).

This Page Intentionally Left Blank

CHAPTER

22

Overview of International Activities

C. E. COWAN-ELLSBERRY, M. J. IRWIN, AND C. C. LALLY

I got them before they could get me.

(Vachel Lindsay, last words after drinking Lysol)

The discipline of toxicology has been flourishing in many countries throughout the world. In fact, several countries have established societies of toxicology and links with toxicology societies in the United States and Europe to expand educational programs. Although traditionally the emphasis in these countries has been on the control of infectious diseases, authorities in these countries have begun to examine the potential effects on humans and the environment of the production, use, and release of chemicals. The purpose of this chapter is to provide perspective on the global drivers for collection, evaluation, and dissemination of human and environmental toxicology information on chemical hazards, to identify which international agencies are currently involved in these activities, and to describe the role of toxicology data and risk assessment within these areas.

HISTORIC DRIVERS FOR TOXICOLOGY AND TOXICOLOGY INFORMATION DISSEMINATION

Since the late 1960s and early 1970s, there have been governmental systems in many industrialized countries which use toxicology data in managing chemicals: for example, the United States' Toxic Substances Control Act, the European Union's Dangerous Substances Directive, Canadian Environmental Protection Act, and Japan's Chemical Substance Control Law. Furthermore, responsible multinational companies have long used toxicology data in the development and promotion of environmentally responsible manufacturing and commercial products [Hakkinen and Leep, 1996; Pittinger *et al.*, 1996; Cowan *et al.*, 1995; Feijtel and Lally, 1995; Schmidheiny, 1992; Chemical Manufacturers Association (CMA), 1985]. A major push in the recent expansion of the use of toxicology data globally came from the United Nations Conference on Environment and Development. This meeting, held in June 1992 in Rio de Janeiro, Brazil, has also been referred to as the Earth Summit or Rio Conference. The objective of this conference was to promote globally the development of strategies to halt and reverse the effects of environmental degradation within the context of sustainable economic and environmental development. The major output of this conference was Agenda 21 (United Nations, 1992; http://sedac.ciesin.org/pidb/texts/a21/a21-contents.html), a comprehensive program of action to be implemented from 1992 and into the twenty-first century by governments, development agencies, United Nations organizations, and independent sector groups in every area where human and economic activity affect the environment. Agenda 21 lists nearly 40 action areas, including combating poverty, protecting and promoting human health, land resource use, and solid waste problems.

Chapter 19 of Agenda 21, ''Environmentally Sound Management of Toxic Chemicals Including Prevention of International Traffic in Toxic and Dangerous Products,'' is a major driver for international dissemination and use of toxicology data. Chapter 19 recognizes that the use of chemicals is essential to meet the social and

economic goals of the world community. The challenge is to develop and promote globally the use of chemicals in a cost-effective manner and with a high degree of safety within the principles of sustainable development and improved quality of life for man. However, especially in developing countries, lack of scientific information, methods, and resources for assessing the risks of many existing chemicals are serious obstacles to developing and implementing sound management of chemicals. To address this challenge, Chapter 19 proposes six major program areas:

Expansion and acceleration of international assessment of chemical risks
Harmonization of classification and labeling of chemicals
Information exchange on toxic chemicals and chemical risks
Establishment of risk reduction programs
Strengthening of national capabilities and capacities for management of chemicals
Prevention of illegal international traffic in toxic and dangerous products.

For each program area, goals are established through the Year 2000, with collection, evaluation, and dissemination of toxicology data on chemicals crucial to successfully accomplishing these goals.

ROLES OF INTERNATIONAL ORGANIZATIONS

The responsibility for implementation of the Agenda 21 goals has been assumed by the United Nations (UN), which sponsored the Rio Summit, and other partner international organizations. The UN Environment Program (UNEP), established as a result of the 1972 Stockholm conference on the Human Environment, is the lead agency within the UN. However, other partners such as those listed in Table 22.1 are taking active roles in addressing chemical safety, and coordinating and overseeing the activities directed toward meeting the goals of Chapter 19. Regulatory authorities such as the U.S. Environmental Protection Agency, U.S. Food and Drug Administration, the European Union, Environment Canada, and Health Canada are also participants in these international agencies and have an influence on the agendas and decisions made within these international fora. Moreover, such regulatory authorities have the legislative power to implement these programs in their countries and require compliance.

In the toxicology area, the trend has been to incorporate national authorities' databases, created in the course of their chemical management activities, into international databases. For example, the International Register of Potentially Toxic Chemicals (IRPTC) was established in 1972 to promote global exchange of information on chemicals. This register contains 17 categories of data, including environmental fate and effects data, and toxicity data such as carcinogenicity and neurotoxicity. The data in IRPTC has come from databases such as the European Union's recently established International Uniform Chemical Information Database (IUCLID). Most of the data in databases such as IRPTC are for existing chemicals. Therefore, in February 1996, the Organization for Economic Cooperation and Development (OECD) organized a workshop to examine ways for countries to more effectively share information about new chemicals assessments, including mechanisms for sharing toxicity data. In addition, the World Health Organization (WHO), International Labour Organization (ILO), UNEP, and OECD have initiated a project to establish a ''Global Information Network on Chemicals'' (GINC). GINC would be an electronic network for sharing information on sound chemical management and would enhance the capability of developing countries in establishing and operating their own chemical information systems.

INTERNATIONAL ASSESSMENT OF CHEMICAL RISKS

Assessing the risks to humans and the environment is a prerequisite to planning for the safe and beneficial use of chemicals. Therefore, the objective of the first program area of Chapter 19 of Agenda 21 is strengthening international risk assessment. To help achieve this objective, the International Program on Chemical Safety (IPCS) has established a goal of completing risk assessments for 200 chemicals by the Year 1997 and a total of 500 by the Year 2000. The 1997 goal was not achieved. IPCS will collect information from many existing sources, including OECD, International Agency for Research on Cancer (IARC), WHO, and various national authorities. New data generation will not be part of this program. IPCS will evaluate the quality of the data collected for risk assessment purposes and summarize the results in Concise International Chemical Assessment Documents (CICAD). These CICADs will become sources of data on the effects of the subject chemicals on experimental animals and *in vitro* test systems, humans, and organisms in the environment.

In 1990, the OECD member countries decided to undertake the investigation and assessment of high-production volume (HPV) chemicals in a cooperative manner. This program is a voluntary one and not a

TABLE 22.1 Major International Agencies Involved in Sound Chemical Management Activities

Abbreviation	Name	Description and purpose	Web site location
IFCS	Intergovernmental Forum on Chemical Safety	Established in 1974. Cooperation among governments for promoting chemical risk assessment and the environmentally sound management of chemicals. Noninstitutional arrangement whereby representatives of governments meet with intergovernmental and nongovernment organizations with the aim to consolidate and coordinate national and international efforts to promote chemical safety.	http://www.who.int/ifcs
IOMC	Inter-Organization Programme for the Sound Management of Chemicals	Established in 1995. Promotes coordination of policies and activities pursued by UNEP, ILO, FAO, WHO, UNIDO, and OECD to achieve the sound management of chemicals.	http://www.who.int/iomc
OECD	Organization for Economic Cooperation and Development	Founded after World War II as a forum for monitoring economic trends in its member countries, the free-market democracies of North America, Western Europe, and the Pacific. One of the principal objectives of the chemicals program is to assist member countries' efforts to protect human health and the environment through improving chemical safety.	http://www.oecd.org
WHO	World Health Organization	Founded in 1948. Objective is the attainment by all people of the highest possible level of health.	http://www.who.int
FAO	Food and Agriculture Organization	Founded in 1945. Mandate to raise levels of nutrition and standards of living, to improve agricultural productivity, and to better the condition of rural populations. Autonomous agency within the United Nations system.	http://www.fao.org
ILO	International Labour Organization	Created in 1919. Seeks to promote social justice and internationally recognized human and labor rights.	http://www.ilo.org
IARC	International Agency for Research on Cancer	Established in 1965 by the WHO. Coordinates and conducts research on the causes of human cancer and develops scientific strategies for cancer control.	http://www.iarc.fr
UNIDO	United Nations Industrial Development Organization	Created in 1966. Assists in industrial development projects aimed at promoting and accelerating development in developing countries in a harmonious and balanced manner.	http://www.unido.org

regulatory or mandatory one. These HPV chemicals are all chemicals reported to be produced or imported in excess of 10,000 tons per year in any one member country or in excess of 1000 tons per year in two or more countries. In the process of making the first evaluation of the HPV chemical, a minimum data set is reviewed to assess the potential hazards. This data set, the Screening Information Data Set (SIDS), outlines the minimum data elements essential for determining whether a chemical requires further evaluation. When data gaps in the SIDS are found, testing is requested to be carried out by the chemical industry in the sponsoring country. When dossiers are complete for the chemical, the results are made available worldwide through various UN bodies, particularly the IRPTC.

In 1998, the U.S. Environmental Protection Agency initiated a voluntary program with industry to increase the development and public availability of the SIDS data set for 2800 HPV chemicals for which these data are currently lacking. In addition, the International Council of Chemical Associations launched a global initiative to increase the speed of data collection and chemical assessment for 1000 HPV chemicals. These initiatives and others that will likely emerge in the next few years will dramatically increase the amount of available toxicity data.

CLASSIFICATION AND LABELING

One crucial element of the sound management of chemicals is developing and implementing communication to people who come in contact with chemicals regarding potential risks that could result from that

contact. The second program area of Chapter 19 of Agenda 21 has the objective of developing by the Year 2000 a globally harmonized hazard classification and compatible labeling system. OECD and ILO are the lead agencies for this effort, which examines all types of potential hazards—physical, chemical, human, and environmental—and focuses on promoting the safe use of chemicals in the workplace and home. The classification system builds on the current UN system for safe transport of dangerous goods, but OECD has expanded the current UN scheme for transportation, which considers mainly acute hazards of chemicals. In late 1998, a harmonized classification system for substances was adopted by OECD. The current focus of OECD work is on developing a harmonized system for mixtures and preparations. The labeling system will likely include material safety data sheets and easily understandable symbols. A key challenge in developing a global labeling system is creating a system which protects people from real risks without overlabeling so many substances that people fail to heed any of the labels. Toxicology data, along with exposure information, will play a crucial role in this effort. Choosing appropriate test methods to develop the toxicology data and establishing the right criteria for labeling a chemical will be the keys to a meaningful and successful classification and labeling program.

INFORMATION EXCHANGE

The objective of the third program area is to promote the exchange of information on chemical safety, use, and emissions among all involved parties. This includes implementation of the Prior Informed Consent (PIC) procedure globally. This program element would encourage the exchange among countries of information on the benefits and risks associated with the use of chemicals, including scientific, technical, economic, and legal information on all chemicals, with special emphasis on chemicals that are banned or severely restricted in some industrialized countries. It will also promote the exchange of data for assessing the risks to humans and the environment of possible alternatives to these banned or severely restricted chemicals.

This program area has promoted the strengthening of international networks responsible for information exchange, such as IRPTC. An integral part of this effort is providing training in the interpretation of toxicology data. Several of the UN's international partners have been preparing training programs and/or decision guidance documents, including IPCS, IARC, and the Food and Agriculture Organization.

RISK REDUCTION PROGRAMS

Reduction of risk to humans and the environment can sometimes be achieved by using alternatives to some of the chemicals in use or even nonchemical techniques. Therefore, the emphasis of the fourth program area is on exchange of information on chemicals and pollution prevention technologies facilitating substitution of alternative chemicals or technologies, if appropriate, to reduce risk over the entire life cycle of the chemical. An activity included within this program area is the development of criteria to identify chemicals which may be candidates for international risk reduction actions (e.g., CMA, 1996; UK Department of the Environment, 1995; Environment Canada, 1995; European Union, 1993, 1994). Examples of such chemicals include Persistent Organic Pollutants (POPs) and certain metals and NOx which are under discussion within the UN and its partner agencies.

The development of these criteria and the process of determining whether a chemical should be considered for international risk reduction action both depend on the availability of toxicology data. As with the hazard classification program, toxicology data are used in both development of the criteria and determining if a chemical meets the criteria. Under the current proposals, an integral part of this determination will be international human and environmental risk assessments. Conducting these assessments will require both extensive toxicology and realistic exposure data.

STRENGTHENING NATIONAL CAPABILITIES

Some countries, including many developing countries, lack adequate scientific means to collect and interpret data on the use and misuse of chemicals and to judge their impacts on humans and/or the environment. Among the activities included in this program area are development of emergency response systems and national coordinating actions for promoting chemical safety. Integral to the success of such activities are the availability of safety information on chemicals and registries for the collection and interpretation of field monitoring data on chemicals of high concern, such as POPs.

PREVENTION OF ILLEGAL TRAFFIC

The objective of this program area is to reinforce national capacities to detect and halt illegal traffic in toxic and dangerous products and to assist countries

in obtaining information concerning illegal trade in these products. Unlike the previous program areas, this one does not have a direct link to either collection or dissemination of toxicology data. Rather, the link is secondary, relating to the initial risk assessments that designated the chemical as deserving control.

FUTURE DIRECTIONS

As the various elements of the six program areas reach maturity and take on a greater international emphasis, the importance of both toxicology and exposure data will increase. At the same time, the greatest challenges will be disseminating the most recent data on a chemical, ensuring the use of the most appropriate and realistic data in assessments, and using the most appropriate evaluation approaches.

References

Chemical Manufacturers Association (CMA) (1985). *Risk Analysis in the Chemical Industry.* CMA, Arlington, VA.

Chemical Manufacturers Association (CMA) (1996). *PTB Policy Implementation Guide.* CMA, Arlington, VA.

Cowan, C. E., Versteeg, D. J., Larson, R. J., and Kloepper-Sams, P. J. (1995). Integrated approach for environmental assessment of new and existing substances. *Regul. Toxicol. Pharmacol.* **21,** 3–31.

Environment Canada (1995). *Toxic Substances Management Policy.* Environment Canada, Ottawa, Ontario.

European Union (1967). Council Directive 67/548/EEC on the approximation of laws, regulations and administrative provisions relating to the classification, packaging and labeling of dangerous substances and subsequent Amendments and Adaptations.

European Union (1993). Commission Directive 93/67/EEC laying down the principles for the assessment of risks to man and the environment of substances notified in accordance with Council Directive 67/548/EEC.

European Union (1994). Commission Regulation (EC) No. 1488/94 laying down the principles for the assessment of risks to man and the environment of existing substances in accordance with the Council Regulation (EEC) No. 793/93.

Feijtel, T. C. J., and Lally, C. (1995). Components of human and ecological risk assessments. *Hum. Ecol. Risk Assessments* **1**(5), 470–477.

Hakkinen, P. J., and Leep, C. J. (1996). Industry's use of risk, values, perceptions, and ethics in decision making. In *Handbook for Environmental Risk Decision Making: Values, Perceptions & Ethics* (C. R. Cothern, Ed.) Lewis, New York.

Pittinger, C. A., Cowan, C. E., Hindle, P., and Feijtel, T. C. J. (1996). Corporate chemical management: A risk based approach. In *Handbook of Environmental Risk Assessment and Management* (P. Callow, Ed.), Vol. 2. Blackwell, Oxford.

Schmidheiny, S., with The Business Council for Sustainable Development. (1992). *Changing Course. A Global Business Perspective on Development and the Environment.* MIT Press, Cambridge, MA.

UK Department of the Environment (1995). Selecting criteria for prioritizing persistent organic pollutants. Prepared for the UNECE LRTAP preparatory workgroup on Persistent Organic Pollutants, Oxfordshire, UK.

United Nations (1992). Agenda 21. FINAL-A/CONF.151/26/Rev.1.

United States (1976). Toxic Substances Control Act. 15 U.S.C.A. § 2601 et. seq.

This Page Intentionally Left Blank

CHAPTER

23

International Register of Potentially Toxic Chemicals National Correspondents

INTERNATIONAL REGISTER OF POTENTIALLY TOXIC CHEMICALS

Television is the thalidomide of the 1990s. In 1995, American children spend about one-third of their awake time watching television. (Robert Bly, *The Sibling Society*)

National Correspondents have been nominated by their respective governments as official national authority for cooperation with the United Nations Environment Program (UNEP) Chemicals International Register of Potentially Toxic Chemicals (IRPTC) in the field of chemical management. They play an important role by assisting in obtaining information on following:

Relevant national legislation and regulations on control of chemicals hazard
The existence of national criteria documents
The existence of database and other information systems relevant to UNEP Chemicals (IRPTC) requirements

They also assist in operation of the Query–Response Service and are responsible for promoting and distributing UNEP Chemicals (IRPTC) publications within their countries.

NORTH AMERICA

Canada
Chief
Monitoring and Criteria Division
Health Protection Branch
Environmental Health Centre
Health and Welfare Canada
Tunney's Pasture
Ottawa, Ontario K1A OL2, Canada
(Attn.: Roderick A. Raphael)

United States
Director
Chemical Control Division (CCD/OPPT)
Office of Pollution Prevention and Toxics (TS-794)
U.S. Environmental Protection Agency
401 M Street, SW
Washington, DC 20460
Phone: 202-260 3749
Fax: 202-260 8168
(Attn.: Mr. C. Auer)

LATIN AMERICA AND THE CARIBBEAN

Argentina
El Director
Dirección de Calidad Ambiental
Secretaria de Vivienda y Calidad Ambiental
Ministerio de Salud y Actión Social
Av. 9 de Julio 1925, Piso 17
C.P. 1332 Buenos Aires
Phone: 54-1-381-1949 or 54-1-383-8741
Fax: 54-1-331-0680

Bahamas
The Chief Medical Officer
Ministry of Health
P.O. Box N-3730
Nassau, N.P.

Barbados
The Chief Medical Officer
Ministry of Health
St. Michael
(Attn.: B. Miller)

Belize
The Secretary
Pesticides Control Board
Cayo
Belize
Fax: 501-92-2640
(Attn.: Mario Fernandez)

Bolivia
El Director
Instituto de Investigaciones Quimicas
FCPN–UMSA
Universidad Boliviana
Casilla 303
La Paz
Phone: 792238 or 795878
Fax: 591-279-2238

Brazil
El Director
Instituto Brasileiro do Meio Ambiente et dos Recursos Naturais Renovaveis
IBAMA
SAIN Av L4 Norte
70800 Brasilia, D.F.

Chile
Jefe de Division Programas de Salud
Dept. Programas Sobre el Ambiental
Ministerio de Salud
E. Mac-Iver St. No. 541
Santiago
(Attn.: Dr. Patricio Rojas)

Colombia
Subdirector de Ambiente y Salud
Ministerio de Salud
Carrera 13 No 32-74 Piso 140
Santa Fe de Bogotá
Phone/Fax: 0057-1-3360182

Costa Rica
Jefe Seccion Productos Quimicos
Dpto. de Sustancias Tóxicas y Medicina del Trabajo
Ministerio de Salud
P.O. Box 10123
1000 - San Josè
Phone/Fax: (00506) 229625

Cuba
Vice-Presidente
Centro de Gestion e Inspeccion Ambiental
Ministerio de Ciencia, Tecnologia y Medio Ambiente
Calle 18 #4110 e/41 y 47, Playa
C. Habana
Phone: 33 1188 or 33 8654
Fax: (00 53 7) 33 0559
(Attn.: Eng. Herminia Serrano Mendez)

Dominican Republic
Departamento de Sanidad Vegetal
Secretaria de Estado de Agricultura
Centro de los Heroes
Santo Domingo
Fax: 809-535-4590

Ecuador
Presidente
Comite Consultivo de Sustancias Quimicas
Ministerio de Agricultura y Ganaderia
Quito
Fax: (00 593) 2-228-448
(Attn.: Mr. Rafael Poveda)

Guatemala
Jefe
Departamento de Control y Registro de Agroquimicos
Dirección Tecnica de Sanidad Vegetal
7A Avenida 3-67, zona 13
Guatemala City
Fax: (5022) 720163
(Attn.: Arnoldo Arevalo Jucub)

Guyana
The Head of Plant Protection
National Agricultural Research Institute
Mon Repos, East Coast Demerara
Phone: 020-2842 or 020-2881/3
(Attn.: Leslie Munroe)

Haiti, Republic of
Monsieur le Directeur
Dèpartement de la santè publique et de la population
Port-au-Prince

Honduras
Dr. Carlos Medina
Ministro del Ambiente

SEDA
Tegucigalpa
Fax: 504-37-5726

Mexico
Director General de Salud Ambiental
Ocupacional y Saneamiento Básico, SSA
San Luis Potosì No. 192, 4o piso
Col. Roma, 06700 Mèxico, D.F.
Phone: 584-5260
(Attn.: Dr Gustavo Olaiz Fernandez)

Nicaragua
Sub-Director
Calidad Ambiental IRENA
Km 12 1/2 Carretera Norte
Apartado No. 5123
Managua
(Attn.: Helio C. Zamora Baca)

Panama
Sub-Director
Departamento de Farmacia y Drogas
Ministerio de Salud
Avenida Peru y Calle 37
Apartado 2048
Panama 1
Fax: (507) 276637
(Attn.: Mr. Jeeps Chillambo R.)

Peru
Director General
Instituto Nacional de Recursos Naturales
Dirección General de Medio Ambiente
Apartado Postal 4452
Calle 17 No. 355, San Isidro
Lima
Phone/Fax: (51 14) 414606
(Attn.: Jorge Millones Olano)

El Salvador
Jefe Departamento de Saneamiento Ambiental
Ministerio de Salud Pública y Asistencia Social
Dirección Avenida Rossvelt,
Edificio Ex-Escuela de Enfermeria
Fte. al Parque Euseatau
San Salvador
Phone: 23-2661
Fax: 23-0991

Suriname
The Chairman
Pesticide Working Group
Central Laboratory
P.O. Box 1911
Paramaribo

Trinidad and Tobago
Pesticides & Toxic Chemicals Board
Ministry of Finance and Planning
Eric Williams Financial Complex
Eric Williams Plaza
Port-of-Spain

Uruguay
El Director
Division Sustancias Peligrosas
Direccion Nacional de Medio
Ambiente (DINAMA)
Zabala 1427
Montevideo
(Attn.: Sra. Silvia Aguinaga)

Venezuela
Dra. Maritza Rojas
Directora de Investigaciones
Toxicas de la Universidad de Carabobo
Valencia

Director General
Oficina de Educación Ambiental
Desarrollo Profesional y Relaciones Internacionales
Ministerio del Ambiente y de los Recursos Naturales Renovables (MARNR)
Apartado 6623
Caracas 1010
Phone: 58 02 545 2821
(Attn.: Dra. Beatriz Pineda)

EUROPE

Albania
Dr. Gazmend Gjyli, Director
Research Institute of Chemical Technology and Design
Bloek Vasil Shanto
Tirana
Phone: (35542) 33336 or (35542) 27907
Phone/Fax: (35542) 23466

Armenia
Ms. E. Sh. Melikian
Chief Specialist Information Centre
Ministry of Nature and Environmental Protection of the Republic of Armenia
35 Moskovian Street
375002 Yerevan
Phone/Fax: (8852) 53 80 13

Azerbaijan Republic
Deputy Main State Sanitary Physician of the Azerbaijan Republic State

Committee on Ecology and Control of Nature Utilization
Ministry of Health
Istiglaliyat Str.31
370001 Baku
(Attn.: Dr. V. K. Kasumov)

Belgium
Chef de la Section Toxicologie
Institut d'Hygiène et d'Epidèmiologie
Ministère de la Santé Publique et de l'Environnement
14 rue Juliette Wytsman
B-1050 Bruxelles
Phone: 02/6425111
Fax: 02/6425001
Telex: 21 034 IHEBRU
(Attn.: Dr. Th. Lakhanisky)

Bulgaria
National Centre of Hygiene, Ecology and Nutrition
D Nestorov Str. 15
Sofia 1431
Phone: 591011
Fax: (03592) 598148
Telex: 22712 maprez bg
(Attn.: Fina Kaloyanova)

Cyprus
The Director-General
Department of Agriculture
Ministry of Agriculture Natural Resources and Environment
Nicosia

Czech, Republic of
Deputy Minister
Ministry of the Environment
Vrsovicka 65
10010 Prague 10
(Attn.: Dr. Vladislav Bizec)

Denmark
Deputy Director
Danish Agency of Environmental Protection
Ministry of the Environment
29, Strandgade
DK-1401 Copenhagen K
Phone: (4532) 66 01 00
Fax: (4532) 66 04 79
(Attn.: Dr. Niels Juuls Jensen)

Finland
Finnish Environment Agency
Chemicals Division
P.O. Box 140
FIN-00251 Helsinki
Phone: +358-0-40 300 528
Fax: +358-0-40 300 591
E-mail: jukka.malm@vyh.fi
(Attn.: Mr. Jukka Malm)

France
Bureau des Substances et Préparations Chimiques
Direction de la Prévention des Pollutions et des Risques
Ministère de l'Environnement
20 avenue de Ségur
75 302 Paris 07 SP
Phone: 1-42 19 20 21

Germany
FIZ CHEMIE BERLIN
Fraklinstraße 11 (Charlottenbourg)
10587 Berlin
Phone: (030) 3 90 76-0
Fax: (030) 3 90 76-333
(Attn.: Ute Schock-Schmelzer)

Greece
The Director
Department of Forensic Medicine and Toxicology
School of Medicine, University of Athens
Ipsilandou 18-Colonaki
Athens

Hungary
The Director General
National Institute of Occupational Health
P.O. Box 22
H-1450 Budapest
(Attn.: Dr. G. Ungváry)

Iceland
The Director
Office of Chemicals
Environmental and Food Agency Iceland
P.O. Box 8080
IS-128 Reykjavík
Phone: 354-1-688848
Fax: 354-1-681896
(Attn.: Mrs. Sigurbjörg Gísladóttir)

Ireland
Environment Program
EOLAS
Galsnevin
Dublin 9
(Attn.: Mr. Martin Reilly)

Israel
Ministry of the Environment
P.O. Box 6234
Jerusalem 910621
(Attn.: AH. Dr. Israel Peleg)

Italy
The Director
European Union Referenceion
Laboratory for Residues
Istituto Superiore di Sanità
Viale Regina Elena 299
00161 Roma
Phone: 39-6-4440112
Fax: 39-6-49902366
(Attn.: Dr. S. Caroli)

Kazakhstan, Republic of
Ms. Goulnar B. Bektourova
Unit of Science and Technology
Main Department of Scientific and Technical Environmental Problems
Ministry of Ecology and BioResources
106 Panfilov Street
480091 Almaty
Phone: 63 12 73 or 63 12 13
Fax: 7 3272 636634

Kyrgyzstan, Republic of
Mr. Narynbek Myrsaliev
First Category Expert,
Department of Radiological Control,
Soil Protection, Utilization and Disposal Wastes
State Committee of Nature Protection of the Republic of Kyrgyzstan
Bishtek

Latvia, Republic of
Chief Toxicologist
Latvian Toxicological Centre
Ministry of Welfare
Riga Clinical Hospital No. 7
Hippocrat Street 2
Riga LV-1038
Fax: (3712) 539524
(Attn.: Dr Viesturs Liguts)

Lithuania, Republic of
Dr. Julius Ptashekas
Head
Department of International Relations and Programs Coordination
State Public Health Centre
Public Health Services of Lithuania
Kalvariju 153
2042 Vilnius
Phone: 370 2 779041
Fax: 370 2 765281

Luxembourg
Chef de Division
Laboratoire National de la Santé
B.P. 1102
1011 Luxembourg

Malta
Director
Regional Marine Pollution Emergency
Response Centre for the Mediterranean Sea
Gzira GZR03, Manoel Island
Phone: +356 337296/7/8
Fax: +356 339951
Telex: 1464 UNROCC MW
Telex: 1396 UNROCC MW
(Attn.: J. C. Sainlos)

Moldova, Republic of
The Director
Principal Department of Hygiene and Epidemiology
Ministry of Health
Str. Hîncesti, 1
277028 Chinsinau
Phone: (373-2)729716
Fax: (373-2)738781
(Attn.: Mr Mihai Dutca)

Netherlands
Chemicals Division
Ministry of Housing, Physical Planning and the Environment
Directorate for Chemicals, External Safety and Radiation Protection
P.O. Box 30945
2500 GX The Hague
(Attn: Dr. K. A. Gijsbertsen)

Norway
The Product Control Department
State Pollution Control Authority
P.O. Box 8100 Dep.
N-0032 Oslo 1
Phone: +47 22 573400
Fax: +47 22 676706
(Attn.: Herald Rensvik)

Poland
Director of the Institute
Institute of Occupational Medicine
8 Teresy Street, P.O. Box 199
90-950 Lodz
(Attn.: Prof. Janusz A. Indulski)

Portugal
Direccao-General de Qualidade do Ambiente
Secretaria de Estado do Ambiente
Rua do Seculo, No.51-2o
1200 Lisboa
Phone: 362751
Telex: 13322

Romania
Head
Department of Research and Engineering
Spl. Independentei nr. 294, Sector 6
77703 Bucharest 78
Fax: (40-1) 3121293
(Attn.: Dr. Aurel Varduca)

Russian Federation
The Director
Russian Register of Potentially Hazardous Chemicals and Biological Substances
Vadkovsky per. 18/20
101479 Moscow
(Attn.: Dr Boris A. Kurlyandsky)

Slovak Republic
The Head
Ecotoxicological Centre Bratislava
Research Institute for Chemical Technology
Nádrazna 36
900 28 Ivanka Pri Dunaji
Phone/Fax: 31 437443
(Attn.: Mr Martin Murín)

Spain
Head
Departamento de Toxicologia
Instituto de Salud Carlos III
28220 Majadahonda, Madrid
Phone: 341-638-9911
Fax: 341-638-5992
(Attn.: Bartolome Ribas Md PhD)

Sweden
Senior Officer
Hazrd and Risk Assesment Division
National Chemicals Inspectorate
P.O. Box 1384
S-171 27 Solna
Phone: 468-730 5700 or 468-730 6669
Fax: 468-735 7668
E-mail: ingrid.petterson@kemi.se
(Attn.: Ingrid Petterson)

Switzerland
Vice-Directeur
Office Fédéral de l'Environnement, des Forêts et du Paysage (OFEFP)
Hallwylstrasse 4
CH-3003 Berne
Phone: 031/322 9323
Fax: 031/351 3187
(Attn.: Rudolf Bärfuss)

Tajikistan, Republic of
Mr. Davlatsho K. Goulmamadov
Deputy Minister
Ministry for Environment Protection
Bokhtar St.12
743025 Dushanbe
Phone: 23 2878 or 27 4815

Turkey
The Director
Refik Saydam Hygiene Center
Poison Research Directorate
Cemal Gursel Cad. No. 18
Sihhiye 06100, Ankara
Phone: 90-312-4337001
Fax: 90-312-4337000
(Attn.: Nida Besbelli)

Ukraine
The Director
Institute for Occupational Health
75, Saksaganskogo Str.
252033 Kiev
Phone: 220 8030
Fax: (44) 220 6677
(Attn.: Prof. Yu. I. Kundiev

United Kingdom
Chief Librarian and Service Manager
Department of the Environment
Room P3/006
2 Marsham Street
London, SW1P 3EB
Phone: 0171 276 4786
Fax: 0171 276 5662
(Attn.: Peter Gibbs)

Uzbekistan
The Leading Expert
State Committee for Nature Protection
A. Kadyri Av. 5-A
700128 Tashkent
Phone: 41 4843
Fax: 41 3990
(Attn.: Ms Tatiana P. Petrova)

WEST ASIA

Bahrain
The Director and Vice-Chairman
Environmental Protection Committee

P.O. Box 26909
Adliya - Manama
Phone: (973) 293693
Fax: (973) 293694

Iraq
The Director-General
Environmental Protection Centre (EPC)
Ministry of Health
P.O. Box 10062
Baghdad
Phone: (964) 415 4539
Fax: (964) 886 2523 UNDP

Jordan
The Director
Environmental Research Centre
Royal Scientific Society
P.O. Box 925819
Amman
Phone: (9626) 844701
Fax: (9626) 844806

Kuwait
The Director
Environment Protection Dept.
Ministry of Public Health
P.O. Box 24395
Safat - Kuwait 13104
Phone: (965) 245 1784
Fax: (965) 245 6838

The Secretary-General
Environment Protection Council
P.O. Box 33750
Al-Rawdah
Kuwait City
Phone: (965) 245 2790 or (965) 245 6835
Fax: (965) 242 1993 or (965) 245 6836

Oman Sultanate
The Director-General
Health Affairs
Ministry of Health
P.O. Box 393
Muscat Code No. 113
Phone: (968) 705 405
Fax: (968) 706 126

Director-General of Environmental Affairs
Ministry of Regional Municipality and Environment
P.O. Box 323
Muscat Code No. 113
Phone: (968) 696 444
Fax: (968) 696 460

Qatar
The Director
Medical & Public Health Services
Ministry of Public Health
P.O. Box 42
Doha
Phone: (974) 419 452
Fax: (974) 415 246

The Director
Department of Environment
Ministry of Municipal Affairs & Agriculture
P.O. Box 7634
Doha
Phone: (974) 671 010 or (974) 675 174
Fax: (974) 415 246

Saudi Arabia
The Director
Division of Environmental Standards
Meteorology and Environmental Protection Administration (MEPA)
P.O. Box 1358
Jeddah 21431
Phone: (966) 26518676
Fax: (966) 26511424

Syria
Mr. Fouad El-Ok
Environmental & Scientific Research Centre
Ministry of the Environment
P.O. Box 36782
Mazzeh-Westren Villas
Damascus
Phone: (963) 11 333 0510
Fax: (963) 662 2309

The Director
Syrian Poison Information Centre
Ministry of Health
Allepo Street
Damascus
Phone: (963) 11 223 4309 or (963) 11 662 2309

United Arab Emirates
The Director
Federal Environment Agency
P.O. Box 5951
Abu Dhabi
Phone: (971) 422 5141 or (971) 421 4298

Chairman of EPC
Ministry of Health
P.O. Box 848
Abu Dhabi
Phone: (971) 434 8885
Fax: (971) 434 8714

Yemen Republic
The Director
Environment Protection Council
P.O. Box 7055
Sana'a
Phone: (967) 126 2350 or (967) 121 5604

ASIA AND THE PACIFIC

Australia
The Assistant Secretary
Environment Standards Branch
Commonwealth Environment Protection Agency (CEPA)
Department of the Environment, Sport and Terrritories
40 Blackall Street
Barton ACT 2600
(Attn.: Ms. Kaye Dal Bon)

Bangladesh
The Director
Environment Pollution Control (EPC)
6/11/F Lalmatia Housing Estate
Satmasjid Rd.
Dacca - 7

China, People's Republic of
The Director of IRPTC/China
Institute of Environmental Health Monitoring
Chinese Academy of Preventive Medicine
7 Pan Jia Yuan
Chao Yang District
Beijing 100021
(Attn.: Dr. Xu Li-Juan)

Cook Islands
The Secretary
Ministry of Agriculture
P.O. Box 96
Rarotonga

India
The Director
Industrial Toxicology Research Centre
Mahatma Gandhi Marg
P.O. Box 80
Lucknow - 226001, U.P.

Joint Secretary to the Government of India
Ministry of Environment and Forests
Paryavaran Bhawan, C.G.O. Complex
Lodi Road
New Delhi 110003
Phone: (+91 11) 436 13 41
Fax: (+91 11) 436 06 78

Additional Director
Hazardous Substance
Management Division
Ministry of Environment and Forests
Paryavaran Bhavan, GCO Complex
Lodi Road
New Delhi 110003
Phone: +91 11 4363021
Fax: +91 11 4360678

Indonesia
The Chairman
Technical Team for Toxic and Hazardous Substances Management
State Ministry for Population and Environment
Jalan Merdeka Barat 15
Jakarta

Iran, Islamic Republic of
The Director
Department of the Environment
Ministry of Health and Welfare
P.O. Box 4335
Teheran

Japan
Chemical Product Safety Division
Basic Industries Bureau, MITI
1-3-1 Kasumegaseki
Chiyoda-ku
Tokyo 100
(Attn.: Mr. Yamauchi)

Korea, Republic of
The Director
Toxic Substances Control Division
Ministry of Environment
7-16 Sincheon-dong, Songpa-gu
Seoul 134-2405

Malaysia
The Director-General
Department of Environment
Ministry of Science, Technology and Environment
13th Floor, Wisma Sime Darby
Jalan Raja Laut
50662 Kuala Lumpur
(Attn.: Mariana Md. Nor)

Maldives
Resident Representative UNDP
Male
Phone: (960) 324 504

Mongolia
Director
Science Monitoring and International Co-operation Department
Ministry for Nature and Environment
Hudaldaany gudamj-5
Ulan-Bator-II
(Attn.: Ms. Ts. Adyashren)

Myanmar
Joint Secretary
National Commisson for Environment Affairs
37, Than Ta Man Road
Yangon
(Attn.: Mr. Kyi Tun)

New Zealand
Deputy Secretary Environment
Policy Development Branch
Ministry for the Environment
Grand Annexe, 84 Boulcott Street
P.O. Box 10-362
Wellington
Phone: (+64 4) 473 40 90
Fax.: (+64 4) 471 01 95
(Attn.: Mr. John Gilbert)

Pakistan
DAWN
Haroon House
Dr Ziauddin Ahmad Road
Karashi
(Attn.: Mr. Bhagwandas)

Papua New Guinea
Associate Professor in Environmental Science and Co-ordinator of Environmental Science
Principle Investigator Pesticide Project
South Pacific Regional
Environment Programme
The University of Papua New Guinea
P.O. Box 320 University NCD
Phone: 675 267 413, 675 267 659, or 675 267 210
Fax: 675 267 187
(Attn.: David Mowbray)

Philippines, Republic of
Chief NRPTC Manager
Chemicals and Waste Management Section
Environmental Management Bureau
99-101 Topaz Building
cor. Kalayaan and Kamias Streets
Quezon City
Phone/Fax: +632 531 14 11
Fax: +632 924 85 53
(Attn.: Ms. Angelita T. Bravante)

Singapore
Institute of Science and Foreign Medicine
Department of Scientific Services
Outram Road
Singapore 0316
(Attn.: Mr. Wong Yen Sin)

Sri Lanka
Director/Environment Protection
Central Environmental Authority
Maligawatte New Town
Colombo 10
Phone: 449455/6 or 437487/8/9
Fax: 01-446749
(Attn.: Ms. Ramani Ellepola)

Thailand
Director
Toxic Substances Sub-Division
Office of the National Environmental Board
Pollution Control Department
Ministry of Science Technology and Environment
Phahon Yothin Centre Building, Floor 3, 6-8
404 Phahon Yothin Road, Phayathai
Bangkok 10400
Phone: (+66.2) 61 92 299
Fax: (+66.2) 61 92 285
(Attn.: Dr. Jarupong Boon-Long)

Tonga
The Director
Ministry of Agriculture and Forestry
P.O. Box 14
Nuku'alofa
Phone: 23038
Fax: 676-24271

Vanuatu
The Environmental Adviser
Environment Unit
Ministry of Lands, Energy and Water Supply
P.O. Box 151
Port Vila

Vietnam
The Director of NACESTID
Ministry of Science, Technology and Environment
24, Ly Thuong Kiet
Hanoi
Phone/Fax: 84 42 63/27
(Attn.: Nguyen Van Khanh)

Western Samoa
The Director General of Health
Department of Health
Private Bag
Apia
(Attn.: Dr. G. A. Schuster)

AFRICA

Algeria
Ministère de l'Enseignement Supérieur
Direction de la Post-Graduation et de la Recherche Scientifique
Route de Dely Brahim
Ben-Aknoun - Alger

Burundi, Republic of
Monsieur le Directeur Général de l'Urbanisme et de l'Habitat
B.P. 1860
Bujumbura
Phone: 5547
(Attn.: Salvator Nahimana)

Cameroon
Monsieur le Directeur Général
Direction de la Recherche Scientifique et Technique
Ministère de l'Enseignement Supérieur et de la Recherche Scientifique
B.P. 1457
Yaoundé

Egypt
Head of Egyptian Environment Affairs Agency (EEAA)
Cabinet of Ministers
17, Teiba Street
El-Mohandeseen
Dokki Giza, Cairo
Phone: (202) 360 1191 or (202) 360 1326
Fax: (202) 361 0764
E-mail: eeaa@idsc.gov.eg
(Attn.: Dr. Mohamed El Zarka)

Gabon
Monsieur le Directeur Adjoint
Centre Nationale Anti-Pollution
Ministere de l'Environnement et de la Protection de la Nature
B.P. 3241
Libreville

Ghana
Deputy Director
Technical Services
Environmental Protection Council
P.O. Box M.326
Accra
(Attn.: Mr. J. K. Danso)

Guinea, Republic of
Monsieur le Chef
Correspondant national du RISCPT
Section contrôle des produits chimique
Direction nationale de l'environnement
B.P. 3118
Conakry

Kenya
Ministry of Environment and Natural Resources
Kencom House
National Environment Secretariat
P.O. Box 67839
Nairobi
Phone: 229261
(Attn.: N. Kinyanjui)

Liberia
The Director
Division of Environmental and Occupational Health
Bureau of Preventive Services
Ministry of Health & Social Welfare
P.O. Box 10 - 9009
1000 Monrovia 10
(Attn.: S. Glean Cooper)

Libya
The Director
Technical Centre for Environment Protection
P.O. Box 83618
Tripoli
(Attn.: Dr. A. A. Abufayed)

Madagascar
Monsieur le Directeur
Laboratoire de Biochimie
Service de Biologie Végétale et de Biochimie, E.E.S. Sciences
Université de Madagascar
B.P. 906
Tananarive

Monsieur le Chef du Département de Chimie
Centre National de Recherches Pharmaceutiques (CNRP)
B.P. 702
Tananarive

Malawi
The Secretary
Research and Environmental Affairs
Office of the President and Cabinet
P.O. Box 30745
Lilongwe 3
Phone: 781 111
Fax: 781 487

Mali, Republic of
Monsieur le Directeur
Laboratoire Central Veterinaire
Ministère de l'Environment
Bamako
(Attn.: M. Boubacar Seck)

Mauritius
The Chairman
Pesticide Control Board
Ministry of Health
Atchia Building
Suffren Street
Port Louis
(Attn.: Dr. Ravinandan Sibartie)

Nigeria
The Director/Chief Executive
Federal Environment Protection Agency
Federal Secretariat
Phase II, 1st Floor
P.M.B. 12620
Ikoyi - Lagos

Rwanda
Monsieur le Directeur
Projet Environnement Développement
Ministère du Plan
B.P. 46
Kigali

Sénégal
Ministère de l'Environnement et de la Protection de la Nature
Direction de l'Environnement
B.P. 4049
Dakar
(Attn.: Mme. Fatimata Touré)

Seychelles, Republic of
The Chief Environmental Health Officer
Ministry of Health and Social Services
P.O. Box 52
Victoria

Sierra Leone
The Director
Government Medical Stores
Ministry of Health
New England, Freetown

Sudan, Republic of
National Chemical Laboratories
Ministry of Health
P.O. Box 287
Khartoum

Swaziland
The Factories Inspector
Department of Labour
P.O. Box 198
Mbabane

Tanzania, United Republic of
The Chief Government Chemist
Government Chemical Laboratory
Ministry of Health
P.O. Box 164
Dar-es-Salaam
Phone: +(255 51) 29406 or +(255 51) 25021/2
Fax: +(255 51) 39951
(Attn.: Dr. V. J. Mpore)

Togo
Monsieur le Directeur
Service de la Protection des Végétaux
Ministère de l'Aménagement Rural
B.P. 1263
Lomé

Tunisia
Monsieur le Directeur
Direction Générale de l'Industrie
Ministère de l'Economie Nationale
Place du Gouvernement
La Kasbah
Tunis

Uganda
Division of Monitoring and Control
Ministry of Natural Resources
P.O. Box 9629
Kampala
Phone: (041) 257976, (041) 245623, or (041) 255473
Fax: 256-41-236819
(Attn.: Mr. P. L. Kamanda)

Zaire
Directeur-Chef du Service
Direction des Etablissements Humaines et Protection de l'Environnement
Ministère de l'Environnement et Conservation de la Nature
15 Avenue des Cliniques
B.P. 12343 Kin 1
Kinshasa/Gombe
(Attn.: M. Kabeya Mukenyi)

Zambia
Action Secretary
Food Drugs Board
Ministry of Health

P.O. Box 30205
Lusaka

Zimbabwe
The Director
Hazardous Substances and
Articles Department
Ministry of Health
P.O. Box 8204
Causeway Harare

Note: To keep up-to-date on the National Correspondents, who change periodically, please consult the following IRPTC URL: http://irptc.unep.ch/irptc/irptc/capbuild.html.

CHAPTER

24

Member Societies of the International Union of Toxicology (IUTOX)

INTERNATIONAL UNION OF TOXICOLOGY

. . . rotten little verses transformed by the innocent, the decent, the good and the young into hymns of detonated twilights along toxic shores. . .

(Jane Miller, *Far Away*)

IUTOX MEMBER SOCIETIES

Argentinian Society of Toxicology
ASIATOX
Australian Society of Clinical and Experimental Pharmacologists and Toxicologists
Brazilian Society of Toxicology
British Toxicology Society
Chinese Society of Toxicology
Danish Society of Pharmacology and Toxicology
Deutsche Gesellschaft für Experimentelle und Klinische Pharmakologie und Toxicologie e.V.
Egyptian Society of Toxicology
European Association of Poison Centres and Clinical Toxicologists
EUROTOX
Finnish Society of Toxicology
French Society of Clinical Toxicology
French Society of Toxicology
Hellenic Society of Toxicology
Irish Society of Toxicology
Israeli Society of Toxicology
Italian Society of Toxicology
Japanese Society of Clinical Toxicology
Japanese Society of Toxicology
Korean Society of Toxicology
Mexican Society of Toxicology
Netherlands Society of Toxicology
Norwegian Society of Pharmacology and Toxicology, Toxicology Section
Polish Society of Toxicology
Russian Society of Toxicology
Society of Toxicologic Pathologists
Society of Toxicology of Canada
Society of Toxicology, India
Society of Toxicology, USA
Spanish Association of Toxicology
Swedish Society of Toxicology
Swiss Society of Pharmacology and Toxicology
The Thai Society of Toxicology
The Toxicology Society of Taiwan
The Turkish Society of Toxicology
Union of Hungarian Toxicologist

Argentinian Society of Toxicology

President: Dr. Alberto Gurni
1088 Capital Federal
Buenos Aires, Argentina
Phone/Fax: 54-1-381-6919
E-mail: aagurni@huemul.ffyb.uba.ar

Secretary: Dr. Theodore Stadler
A. Alsina 1441, of. 302
1088-Buenos Aires, Argentina
Phone/Fax: 54-1-381-6919
E-mail: postmaster@partox.edu.ar

ASIATOX

President: Dr. Tomoji Yanagita
Preclinical Research Laboratories

Central Institute for Experimental Animals
1433 Nogawa, Miyamae-ku, Kawasaki
Kanagawa 213, Japan
Phone: 81-44-754-4400
Fax: 81-44-751-6065

Secretary: Dr. K. H. Yang
Department of Biological Sciences
Korea Advanced Institute of Science and Technology
373–1, Kusong–dong Yusong-gu
Taejon 305-701, Korea
Phone: 82-42-869-2623
Fax: 82-42-869-2683
E-mail: khang@sorak.kaist.ac.kr

Australian Society of Clinical and Experimental Pharmacologists and Toxicologists

President: Prof. Felix Bochner
Clinical & Experimental Pharmacology
University of Adelaide
Adelaide, SA 5005
Australia
Phone: 61-8-8303-5571
Fax: 61-8-8224-0685
E-mail: fbochner@medicineadelaide.edu.au

Secretary: Prof. Andrew Somogyi
Clinical & Experimental Pharmacology
University of Adelaide
Adelaide, SA 5005
Australia
Phone: 61-8-8303-5572

Brazilian Society of Toxicology

President: Dermeval De Carvalho
Rua Soares Romeu
404 CEP 14020-370-Ribeirao
Preto-SP, Brazil
Phone: 016-623-2520
Fax: 016-624-9362

Secretary General: Dr. Alice A. da Matta Chasin
Sociedade Brazileira de Toxicologia
Rua Pamplona, 788-3 andar conjunto 32
CEP Sao Paulo, Brazil 01405-001
E-mail: alimoily@usp.br

British Toxicology Society

General Secretary: Sandy Wilson
Inveresk Research International, Ltd.
EH 33 2NE
Tranent, Scotland
Phone: 44-1875-614545
Fax: 44-1875-614555
E-mail: sandy_wilson@sgsgroup.com

Chinese Society of Toxicology

Secretary–General: Prof. Chengyao Shen
Institute of Radiation Medicine
27 Tai Ping Road
Beijing 100850, China
Phone: 86-10-6818-3899
Fax: 86-10-6821-4653
E-mail: chntox@nic.bmi.ac.cn

Danish Society of Pharmacology and Toxicology

Secretary: Connie Sanchez
Institute for Biologi
Neuropharmacology Screening Dept.
H. Lundbeck A/S
Ottiliavej 9
Dk-2100 Copenhagen-Valby
Denmark
Phone: +45 3630 1311
Fax: +45 3630 5267
E-mail: cs@lundbeck.com

Deutsche Gesellschaft für Experimentelle und Klinische Pharmakologie und Toxicologie e.V.

Chairman: Prof. Dr. Med. Manfred Goethert
Deutsche Gesellschaft fur experimentelle und klinische Pharmakologie und Toxikologie
e.V.
Institut fuer Pharmakologie und Toxikologie der Universitaet
Reuterstr. 2b
D-53113 Bonn, Germany

Secretary: Prof. Dr. Alexander Walland
Boehringer Ingelheim KG
Dept. of Pulmonary Research
Allg. Pharmakologie
D-55215 Ingelheim, Germany
Phone: 49-6132-772 973
Fax: 49-6132-773 016

Egyptian Society of Toxicology

Secretary: Prof. Dr. Abdalla Gomaa Radwan
Department of Pharmacology
Faculty of Medicine
Al-Azhar University
11884, Nasre City
Cairo, Egypt
Phone: 202-2981453/4034052
Fax: 202-2981453/4020184
E-mail: radwan@frcu.eun.eg

European Association of Poison Centres and Clinical Toxicologists

President: Albert Jaeger

Secretary: Dr. Jan Meulenbelt
National Poisons Control Center
National Institute of Public Health and Environment
P.O. Box 1
NL-3720 BA Bilthoven, The Netherlands

Phone: 31-30 250 8561
Fax: 31-30 254 1511

EUROTOX

President: Prof. Herman Bolt
Institut Für Arbeitsphysiologie
Universitaet Dortmund Ardeystrasse 67
D-44139 Dortmund, Germany
Phone: 49-231-1084 348
Fax: 49-231-1084 403
E-mail: bolt@arb-phys.uni-dortmund.de

Secretary: Eino Hietanen
Dept. Clinical Physiology, University of Turku
FIN-20520 Turku
Finland
Phone: 358-2-261-2664
Fax: 358-2-261-1666
E-mail: eino.hietanen@utu.fi

Finnish Society of Toxicology

Secretary: Pirjo Lindstrom-Seppa
Univ. of Kuopio
Dept. of Physiology
P.O. Box 1627
FIN-70211 Kuopio, Finland
Phone: 358-17-163-095
Fax: 358-17-163-112
E-mail: pirjo.lindstromseppa@uku.fi

French Society of Clinical Toxicology

President: Pr. Henri Lambert
Centre Antipoison Hopital Central
54035 Nancy Cédex, France
Phone: 33-83-32 36 36
Fax: 33-83-85 26 16

Secretary: Dr. Patrick Harry
Centre Antipoison
CHU
49033 Angers Cédex 01, France
Phone: 33-02-41-48 21 21
Fax: 33-02-41-3 55 07

French Society of Toxicology

President: Dr. Rémi Glomot
6, Boulevard Saint-Michel
75006 Paris, France
Phone/Fax: 33-16 1 46 33 18 67

Secretary: Anne-Marie Batt
Centre du Médicament-URA
CNRS 597
30 rue Lionnois
54000 Nancy, France
Phone: 33-83 17 88 78
Fax: 33-83 32 13 22

Hellenic Society of Toxicology

Secretary General: Dr. Aristidis Tsatsakis
Faculty of Medicine, University of Crete
P.O. Box 1393
GR–71409 Heraklion
Crete, Greece
Phone: 3081 394679/261.970-5
Fax: 3084 261.978
E-mail: tsatask@edu.uch.gr

Irish Society of Toxicology

President: Professor M. Ryan (until October 1999)
Department of Phamacology
University College
Dublin 4, Ireland
Fax: 353-1-706-1557
E-mail: michael.p.ryan@ucd.ie

Vice-President: Mrs. C. M. Chambers (President from Oct. 1999–Oct. 2001)
Department of Pharmacology and Therapeutics
Trinity College
Dublin 2, Ireland
Phone: 353-1-608-1403 (voice mail)
Fax: 353-1-671-3504
E-mail: CCHMBERS@TCD.IE

Secretary: Dr. John Moriarty
Department of Agriculture
Model Farm Road
Cork, Ireland
Phone: 353-(0)21-543090
Fax: 353-(0)21-546153
E-mail: jmdingle@iol.

Israeli Society of Toxicology

President: Yona Amiatai, M.D.
Department of Pediatrics
Hadassah University Hospital
Mt. Scopus, Jerusalem
Israel

Italian Society of Toxicology

Marina Marinovich
Inst. of Pharmacological Sciences
University of Milan
Via Balzaretti 9
20133 Milan, Italy
Phone: 39 02 20488225
Fax: 39 02 29404961
E-mail: marina.marinovich@unimi.it

Organizing Secretary: Ida Ceserani
20129 Milan, Italy
Phone: 39-02-29520311
Fax: 39-02-29520179
E-mail: sifcese@imiucca.unimi.it

Japanese Society for Clinical Toxicology

President: Yasuhiro Yamamote, M.D., Ph.D.
Chairman and General Secretary
c/o Dept. of Emergency and Critical Care Medicine
Nippon Medical School
1-1-5, Sendagi, Bunkyo-ku
Tokyo, Japan 113-8603
Phone: 81-3-3822-2131, ext. 6804
Fax: 81-3-3821-5102

Japanese Society of Toxicology

Chairman: Dr. Hideaki Karaki
Dept. of Veterinary Pharmacology
Graduate School of Agriculture & Life Sciences
The Univ. of Tokyo
Bunkyo-ku
Tokyo, Japan 113-8657
Phone: 81-3-5802-2959
Fax: 81-3-3813-2776
E-mail: ahkrki@hongo.ecc.u-tokyo.ac.jp

Korean Society of Toxicology

President: Dr. Kyu Hwan Yang
Dept. of Biological Sciences
Korea Advanced Institute of Science and Technology
373-1 Kusungdon, Yusung
Traejon, Korea
Phone: 82-42-869-4013
Fax: 82-42-869-2683
E-mail: khyang@sorak.kaist.ac.kr

Mexican Society of Toxicology

Directora of Relaciones: Dra. Lilia A. Albert
Ap. Postal 474
91000 Xalapa, Mexico
Phone: 52-28-18-09-50
Fax: 52-28-18-92-84
E-mail: albert@gorsa.net.mex

Secretary: Ma. Elena Castilla
Fax: 52 5 62237

Netherlands Society of Toxicology

President: Prof. Dr. W. Seinen
Research Institute Toxicology (RITOX)
P.O. Box 80.176
3508 TD Utrecht
The Netherlands
Phone: 31-30-253 5400
Fax: 31-30-253 5077
E-mail: w.seinen@ritox.dgk.ruu.nl

Secretary: Dr. A. Wübenga
Koningskade 2.
NL 2596 AA s Gravenhage,
The Netherlands
Phone: 31-70-441 6605
Fax: 31-70-441 7926

Norwegian Society of Pharmacology and Toxicology, Toxicology Section

President: Dr. Jan Alexander
Department of Environmental Medicine
National Institute of Public Health
Geitmyrsveien 75
N-0462 Oslo, Norway
Phone: 47-2204-2253
Fax: 47-2204-2686
E-mail: jan.alexander@folkehelsa.no

Secretary: Marit Låg
Department of Environmental Medicine
National Institute of Public Health
Geitmyrsveien 75, 0462 Oslo, Norway
Phone: 47-2204-2339
Fax: 47-2204-2686

Polish Society of Toxicology

Secretary: Dr. Maria Kala
Department of Forensic Toxicology
Institute of Forensic Research
ul. Westerplatte 9. PL-31-033 Krakow
Poland
Fax: +48-12-422-38-50

Russian Society of Toxicology

Chairman: Professor B. A. Kurlyandski
Vadkovsky per, 18-20, 101479
Moscow
Russia
Phone: +7-095-973-3021
Fax: +7-095-973-2651 (do not omit zero on fax)

Society of Toxicologic Pathologists

Exec. Secretary: Ms. Stephanie Dickenson
19 Mantua Road
Mount Royal, NJ 08061
Phone: 609-423-3610
E-mail: stphq@stp.smarthub.com

Society of Toxicology of Canada

Secretary: Dr. Thomas E. Massey
Dept. of Pharmacology and Toxicology
Queen's University
Kingston, Ontario K7L 3N6, Canada
Phone: 613-545-6115
Fax: 613-545-6412
E-mail: masseyt@post.queensu.ca

Exec. Dir.: Dr. Gordon Krip

For more information, visit the Society of Toxicology of Canada Web site

Society of Toxicology, India

President: Dr. S. K. Tandon
Assistant Director, Industrial Toxicology Research Center
Lucknow-226001, UP, India
Phone: 91-0522-214 118/213 786
R: 210298
Fax: 91-0522-228-227
E-mail: sktandonintox@itrc.sirnetd.ernet.in

Secretary: Dr. M. Athar
Professor and Head of Department of Medical Elementology and Toxicology
Hamrad Univ. Hamrad Nagar
New Delhi-110062, UP, India
Phone: 91-11-698-9686/3685
R: 698-5501
Fax: 91-11-698-8874

Society of Toxicology, USA

President: Jay Goodman, Ph.D.
Michigan State University
Dept. of Pharmacology and Toxicology
B-440 Life Sciences Bldg.
East Lansing, MI 48824-1020
Phone: 517-353-9346
Fax: 517-353-8915
E-mail: goodman3@pilot.msu.edu

Secretary: Jay Gandolfi

Executive Director: Shawn L. Lamb
Society of Toxicology
1767 Business Center Drive
Suite 302
Reston, VA 20190
Phone: 703-438-3115
Fax: 703-438-3113
E-mail: sotq@toxicology.org
For more information, visit the Society of Toxicology USA Web site.

Spanish Association of Toxicology

President: Prof. Eugenio Vilanove Gisbert
Instituto the Neurociencias
Campus Universitario de San Juan
03550-Alicante
Spain
Phone: 34-6-5903-889
Fax: 34-6-5903-896
E-mail: evilanova@ua.es

Secretary: Dr. Victoria Carrera
Instituto the Neurociencias
Campus Universitario de San Juan
03550-Alicante
Spain
Phone: 34-6-5903-889
Fax: 34-6-5903-896
E-mail: aetox@ua.es
For more information, visit the Spanish Association of Toxicology Web site.

Swedish Society of Toxicology

President: Sten Flodstrom
National Chemicals Inspectorate
P.O. Box 1384
SE-17127 Solna, Sweden
Phone: 46-8-730-7698
E-mail: stenf@kemi.se

Secretary: Annika Hanberg
Institute of Environmental Medicine
Karolinska Institutet
P.O. Box 210
S-17177 Stockholm, Sweden
Phone: 46-8-728 75 26
Fax: 46-8-34 38 49
E-mail: annika.hanberg@imm.ki.se

Swiss Society of Pharmacology and Toxicology, Toxicology Section

President: Urs T. Ruegg
University of Lausanne
1015 Lausanne
Switzerland
Phone: 21-6924-531
Fax: 21-6924-515

Secretary: Dr. P. Donatsch
Novartis, Ltd.
Bau 881/012
4132 Muttenz, Switzerland
Phone: 61-3241-371
Fax: 61-3241-565

The Thai Society of Toxicology

President: Prof. Palarp Sinhaseni

Secretary: Prof. Anong Bintvihok
The Thai Society of Toxicology
Satabun & Building
Chulalongkorn University
Phya Thai Road
Pathumwan, Bangkok 10330
Thailand
National Yang Ming University
Phone: 662-218-812
Fax: 662-253-2395
E-mail: spalarp@chula.ac.th

The Toxicology Society of Taiwan

President: Tzuu-Huei Ueng, Ph.D., Professor
Institute of Toxicology

College of Medicine
National Taiwan University
#1, Sec. 1, Jen-Ai Rd.
Taipei, Taiwan 100
Fax: 886-2-2341-0217

Secretary General: Shing-Hwa Liu, Ph.D., Professor
Institute of Toxicology
College of Medicine
National Taiwan University
#1, Sec. 1, Jen-Ai Rd.
Taipei, Taiwan 100
E-mail: shliu@ha.ms.ntu.edu.tw

The Turkish Society of Toxicology

Professor: Dr. Ali E. Karakaya
President of the Turkish Society of Toxicology
Turk Toksikoloji Dernegi
Gazi University, Faculty of Pharmacy
Eczacilik, 06330, Hipodron-Ankara
Turkey
Phone: +90-312-212 30 09
Fax: +90-312-222 23 26
E-mail: ek03@servis2.net.tr

Union of Hungarian Toxicologists

President: Dr. Alice Druga
Institute for Drug Research Ltd.
H-1325 Budapest
P.O. Box 82
Hungary
Phone: 36-1-169-1425
Fax: 36-4-169-3229

Secretary: Dr. Istvan Kiss
Veszprem University
Dept. of Biology
H-8200 Veszprem
Egyetem u. 10.
Hungary
Phone: 36-88-422-022

Note: IUTOX membership changes periodically. To keep current, consult the IUTOX World Wide Web URL at http://www.toxicology.org/iutox/.

CHAPTER

25

Countries

Canada

EDMUND M. K. LUI, CATHERINE A. M. SUZUKI, AND JOHN R. BEND

BOOKS, JOURNALS, AND OTHER PUBLICATIONS

Original Research Articles in Toxicology

Many Canadian authors routinely submit their original research articles in toxicology to international publications, particularly the official journals of the U.S. Society of Toxicology. In addition, review articles and book chapters frequently appear in books that are edited and published in the United States. Consequently, readers are referred to the detailed descriptions of books and journals that appear in the appropriate section of this text dealing with the United States because these frequently contain articles of Canadian origin.

In addition, there are some Canadian journals that describe original research in toxicology. For example, there is a pharmacology and toxicology section in the *Canadian Journal of Physiology and Pharmacology*, and articles concerned with environmental toxicology are routinely published in the *Canadian Fisheries Journal*.

Occupational Health and Safety

Information which pertains to occupational health and safety with emphasis on hazardous exposures is primarily published by the Southham Magazine and Information Group (1450 Don Mills Rd., ON M3B 2X7): *Occupational Health and Safety Canada* (published six times per year) and *Canadian Occupational Health and Safety News* (a weekly report)—evaluates employee exposure and indoor air quality.

In addition, *Workplace: Environmental Health and Safety*, published by Templegate Information Services (Toronto), reports on regulations, standards, and guidelines pertaining to occupational health.

Environmental Health

The following publications (Southam Information and Technology Group) deal primarily with environmental health and the impact of toxic substances on the environment. Some also discuss the regulatory aspects of toxic substances. *Ecolog Canadian Pollution Legislation* contains environmental pollution legislation of both the federal and provincial governments. A weekly report on waste management and industrial pollution control is also available.

Environmental Compliance Report is a supplement to *Ecolog Canadian Pollution Legislation*. This monthly publication discusses legislative changes, regulatory amendments, and recent cases.

Toxicology Newsletters

S.T.C. News is an official newsletter of the Society of Toxicology of Canada (P.O. Box 517, Beaconsfield, QC H9W 5V1).

CNTC News is produced by the Canadian Network of Toxicology Centres (Bovey Bldg., Gordon St., Guelph, ON N1G 2W1).

Wildlife Toxicology is a quarterly publication by the World Wildlife Fund, Canada highlighting wildlife toxicology concerns in the Great Lakes/St. Lawrence region.

Government Publications

While the following publication series do not exclusively deal with the subject of toxicology, they are publications which periodically have editions pertaining to toxicology from a technical, health assessment, or regulatory standpoint.

Health Canada Publications
Ottawa, ON
Canada K1A 0S9

Environment Canada Publications
Hull, QC
Canada K1A 0H3

Proposed Regulatory Decision Documents
Pest Management Regulatory Agency
Ottawa, ON
Canada K1A 0C6

COMPUTERIZED INFORMATION RESOURCES

Database and Information Vendors

CCINFO
Produced by Canadian Centre for Occupational Health and Safety (CCOHS) (Hamilton, ON)

This computerized information service provides information on occupational health and safety via CD-ROM (CCINFOdisc), diskettes, and an online system (CCINFOWeb). It gives access to a collection of more than 50 databases, including chemical evaluation search and retrieval (CESARS), workplace hazardous materials information system (WHMIS), MSDS, CHEM Source, NIOSHTIC, OSH CanData, Toxline, and Hazardous Substances Data Bank. Information on pest control products (active ingredients, maximum residue limits in foods, and new experimental products) is also available. This system also covers topics such as chemical hazards, environmental hazards, workplace safety and occupational health, as well as toxicological and Canadian (federal and provincial) health and safety-related legislation.

INTOX
Produced by CCOHS in collaboration with the International Programme on Chemical Safety (IPCS) of the World Health Organization

Information on the diagnosis and treatment of poisoning in a computerized information package in a set of printed manuals or CD-ROM. It provides a database on chemical and pharmaceutical substances and natural toxins.

Canadian Research Index
Produced by Micromedia (Ottawa, ON)

An index and abstracting service which covers publications issued by all levels of government in Canada as well as selected research organizations. Formats include CD-ROM, microfiche, an online system, and published material.

Canadian Poisonous Plants Information System
Produced by D. B. Munro, Crop Protect Program, Research Branch, Agriculture and Agri-food Canada (Ottawa, ON)

This information system provides details taken from literature references for more than 250 plants that can poison livestock, pets, and humans in Canada.

Great Lake Wildlife Toxicology Database
Produced by Ecological Conservation Branch, Conservation Services Division, Environment Canada (Ottawa, ON)

It contains toxicology data for 3000 samples from 11 tissues from 16 wildlife collected from 157 sites in the Great Lakes Basin during 1970–1994. Contaminants include metals, organochlorine compounds, dioxins, furans, and PCBs.

WEB SITES

Information Providers

Alberta Environmental Centre (Environmental Toxicology): http://www.arc.ah.ca/
Bonnell Environmental Consulting: http://infoweb.magi.com/~tauceti
British Columbia Research Inc.: http://www.bcr.bc.ca
Canada Centre for Inland Waters: http://www.cciw.ca
Canadian Poisonous Plants Information System: http://res.agr.ca/brd/poisonpl
Canadian Society of Forensic Science: http://www.csfs.ca/
Canora Inc.: http://www.eco-web.com/register/02209.html
Cantox Inc.: http://www.cantox.com/reg.htm
CCOHS' databases (CCINFOWeb) on occupational health and safety subject and resource organizations as well as environmental and chemical information: http://ccinfoweb.ccohs.ca cheminfo/search.html
Environment Canada: http://www.ec.gc.ca/

Environmental Toxicology—directory of cytochrome P450-containing systems (Department of Biology, University of Waterloo): http://www.science.uwaterloo.ca/biology/research.html
Evs Environment Consultants: http://www.evs–eco.com/
General Testing Laboratories (SGS Canada, Ltd.): http://www.sgs.ca/
Great Lakes Wildlife Toxicology Database: http://cciw.ca/green-lane/wildlife/wild-monitoring/wild-toxicology/toxicology.html
Health Canada Online: http://www.hc-sc.gc.ca/english
Justice Department of Canada (Consolidated Statutes of Canada): http:// canada.justice.gc.ca
Klohn–Crippen Consultants Ltd.: http://www.klohncrippen.com/kc/about.html
Laboratory Service Branch (Health Ministry of Ontario): http://www.phlo.com/content/labinfo
Nova Scotia Innovation Corporation (InNOVAcorp): http://www.innovacorp.ns.ca
Ontario Hydro International Inc.: http://www.hydro.on.ca
Pest Management Regulatory Agency (index of information products): http://www.hc-sc.gc.ca/pmra-arla/qcont-e.html
Pollutech EnviroQuatics Ltd.: http://www.pollutech.com/peql.htm
Prairie Biological Research Ltd.: http://www.ispex.ca/pbr/toxicology/index.htm
Society of Toxicology of Canada: http://meds.queensu.ca/stcweb/
Bodycote Technitrol, Inc.: http://www.astm.org/labs/PAGES/103700.htm
Wildlife Toxicology Division (Environment Canada): http://www.cws-scf.ec.gc.ca/nwrc/wildtox.htm

Sites with Links to Other Internet Resources

Canadian Centre for Occupational Health and Safety (CCOHS). Direct links to key safety resources, environmental, chemical, and medical sites: http://www.ccohs.ca
Canadian Network for Toxicology Centres: http://www.uoguelph.ca/cntc
Department of Pharmacology and Toxicology, Queen's University: http://meds-ss10.meds.queensu.ca/medicine/pharm/
Department of Pharmacology and Toxicology, University of Western Ontario: http://www.pharmtox.med.uwo.ca/www/resource.html
Ecology Action Centre: http://www.chebucto.ns.ca/Environment/EAC/EAC-Home.html

LEGISLATION AND REGULATORY ISSUES

Canadian federal laws, including those which govern the control of toxic substances, are compiled in the *Consolidated Statutes of Canada*. These statutes are updated annually and revised volumes are periodically published in their entirety or as statements of current law called the *Revised Statutes of Canada*. They are also available online through the *Justice Department of Canada*. Proposals for new laws and amendments to existing ones are published in the *Canada Gazette* (Part I) which appears weekly and is available to the public. Once proposals are announced, interested parties have 60 days to voice their opinions and/or objections before any changes are implemented. Part II of the *Canada Gazette* reports on new statutory regulations and is published biweekly, whereas Part III, published on an ad hoc basis, announces Public Acts of parliament as they are enacted.

The Canadian statutes which deal specifically with toxic substances are listed along with their location in the *Statutes of Canada*, the federal department(s) responsible for their enforcement, and a brief description of the law as it pertains to toxicology.

Arctic Waters Pollution Prevention Act
Chapter A-12
Northern Affairs

This act provides the legislation to prevent pollution of the Arctic waters which are adjacent to the mainland and islands of the Canadian Arctic. The act also prohibits the release of substances which would cause the water to be unsuitable for man, animals, plants, or fish.

Canadian Environmental Protection Act
Chapter C-16
Environment Canada, Health Canada

This act regulates the manufacture and importation of industrial chemicals and other potentially toxic substances not covered by other legislation in order to protect the environment and human life and health. This law sets the minimum standard for assessing substances to which other federal acts regulating toxic substances must adhere. Under this act, the ministers of both departments are jointly responsible for compiling a ''Priority Substances List'' which will specify substances to which priority should be given in assessing their toxicity.

Fisheries Act
Chapter F-14
Fisheries and Oceans, Environment Canada

One of the mandates of this law is the protection of fish and their habitats against harm by toxic substances by prohibiting the discharge of any deleterious substance into water frequented by fish.

Food and Drugs Act
Chapter F-27
Health Canada

This act regulates the manufacture, preservation, packaging, and storage of food, drugs, cosmetics, and medical devices. Under this legislation, all these items must be reviewed and found to meet all defined criteria to ensure the safety to human health and life prior to their use in Canada.

Hazardous Products Act
Chapter H-3
Consumer and Corporate Affairs, Health Canada

This act prohibits the advertising, sale, and importation of hazardous materials. Products designed for human use (household, garden, or personal use) must be shown to pose no danger to the health or safety of the public due to design or contents. Under this legislation the WHMIS was developed to ensure the protection of workers from the adverse effects of hazardous materials.

Migratory Birds Convention Act
Chapter M-7
Environment Canada

This legislation was put in place for the protection of migratory birds and their environment in Canada and the United States. It prohibits the deposition of substances harmful to migratory birds or their habitats.

Pest Control Products Act
Chapter P-9
Pest Management Regulatory Agency (PMRA), Health Canada

This act regulates the manufacture, importation, sale, and use of products to control pests and organic functions of plants and animals with the intent to ensure the safety, merit, and value of the products used in Canada. Manufacturers, importers, exporters, or distributors of a pest control product must comply with restrictions on the formulation, composition, packaging, labeling, product use, and contaminants defined in this act.

Transportation of Dangerous Goods Act
Chapter T-19
Transport Canada

This act regulates the transportation of dangerous goods within Canada. Safety procedures defined in the law must be adhered to before any shipping of hazardous substances can occur.

THE REGULATION OF CHEMICALS IN CANADA

To ensure the health, safety, and life of humans and the environment, all chemical products must undergo a review process and meet all criteria outlined by the relevant regulatory laws prior to their use in Canada. The primary federal departments responsible for establishing and upholding the regulatory process are listed in Table 25.1. In some cases, regulation of a substance may be covered by more than one law, requiring the input of several regulatory departments.

For example, regulation of pesticides occurs primarily under the Pest Control Act, which is enforced by the Pest Management Regulatory Agency of Health Canada. However, establishment of permissible maximum residue limits of pesticides in food is legislated under the Food and Drug Act, whereas environmental protection against these substances is covered by the Canadian Environmental Protection Act, the Fisheries Act, and the Migratory Birds Convention Act. Therefore, during the course of product registration, experts from Health Canada, Agriculture and Agri-Food Canada, Environment Canada, and Natural Resources Canada may be consulted prior to granting approval. In addition, individual provinces and municipalities may also regulate use of pesticides within their own jurisdiction and may even prohibit the use of a substance which has been approved by federal authority. They may not, however, use a substance which has not been approved by federal authority.

The Regulatory Process of Chemical Products

While the process for product approval is similar in many ways among the different regulatory bodies, major differences exist dependent on a product's uses, effects, and human or environmental exposures (be

TABLE 25.1 Major Federal Regulatory Bodies in Canada

Environment Canada
Fisheries and Oceans
Health Canada
Pest Management Regulatory Agency (Health Canada)

they intentional or not). The following is a brief outline of the regulatory process beginning with the requirements for submission, the review process, and postmarketing surveillance. Where they exist, differences have been delineated.

Product Submission

When submitting a product for review, the petitioner must supply the regulatory body with information which includes product specifications (product recipe with chemical and trade names, the amount of each ingredient contained, and details on packaging), product labeling information, justification of functionality, levels of use, effectiveness, and practicality, and the scientific data required for the evaluation of the product with respect to possible adverse effects on human and environmental health.

Product Review

The data submitted by the petitioner is subjected to review by experts from the responsible regulatory agency. In some cases, where required, a single submission may undergo review by more than one government bureau. It is imperative that any deficiencies in information requested by the reviewer be supplied by the petitioner. Once all the data for a submission have been reviewed, it is recommended for either advancement or rejection. In the case of pharmaceutical products, once approval has been granted, the petitioner is notified in a Notice of Compliance. In the case of pesticides, the intent of approval is published in Part I of the Canada Gazette for public scrutiny to which interested parties have 60 days to voice their opinions and/or objections to the proposal. In addition, the PMRA publishes their own ''Proposed Regulatory Decision Documents'' which are mailed to the appropriate individuals or interest groups and to which a 60-day reply period applies. Comments received from the public are reviewed and may result in alterations to the submission and subsequent reassessment. Announcement of final approval is published in the Canada Gazette (Part II) and thereafter becomes effective for a period of 5 years, after which time the petitioner must reapply for approval.

Postmarketing Surveillance

In Canada, physicians are required to report adverse drug effects to Health Canada. Based on this feedback, a product may be monitored and, should potential human health hazards of a product be identified, Health Canada in conjunction with the manufacturer would then take the appropriate action to rectify any problems which may, if warranted, include the removal of the product from the market. Similarly, for food additives or residues, violation of the Food and Drugs Act for these substances can result in the removal of those affected food products from outlets, the seizure of stocks, and the rejection of imports or prosecution. With pesticides, even once registration has been granted, the PMRA continues to monitor these substances and if precipitated by health and safety concerns, the compound will undergo special review and reevaluation of all available studies/data on the active ingredient and microcontaminants. If warranted, registration of a pesticide may be canceled or suspended.

Protection against Toxic Substances

General Environment

Management of Toxic Substances by the Federal Government

Recently, Environment Canada established ''The Federal Toxic Substances Management Policy,'' which provides the government with a strategy for handling toxic substances both domestically and internationally. After consultation with industry, nongovernment organizations, provinces, territories, municipalities, and other federal government departments, this policy was formulated and adopted by all federal departments and activities involving the management of toxic substances. The principal objectives of this policy are (i) to eliminate toxic substances resulting from human activity which are persistent and bioaccumulate within the environment and (ii) to manage other toxic substances of concern throughout their entire life cycles in order to prevent or minimize their release into the environment.

Access to Health and Safety Information

Although active ingredients of substances must be disclosed in the labeling information, under the Access to Information Law (Chapter A-1 of the *Canadian Statutes*), any formulary information need not be disclosed because it is considered confidential business information. Therefore, any information supplied to the government for regulatory purposes by a petitioner must be kept confidential if it would result in financial, commercial, or scientific interference to that party. Information resulting from government research regarding environmental or product testing may be released if the testing was carried out by, or on behalf of, the government institution, unless the testing was done as a service to a person, group, or organization for a fee. However, proprietary information may be disclosed in the

interest of the health and safety of humans and the environment and if such disclosure outweighs the financial loss, gain, or prejudice of the third party.

Work Environment

Under the auspices of the Hazardous Products Act, WHMIS was developed in 1988 to provide information about hazardous materials in the workplace. This system is overseen by both federal and provincial governments and requires suppliers of hazardous materials to supply adequate labeling information to ensure the safe handling of products and a Material Safety Data Sheet (MSDS) containing information as required by the Controlled Products Regulations and the Ingredient Disclosure List (both issued under the Hazardous Products Act) as a condition of the sale and importation of that product. WHMIS also requires that all workers who work with or near a hazardous substance be informed of its potential hazards and trained to work safely with chemicals.

Provincial legislation also plays a role in regulating worker exposure to toxic substances. For example, in Ontario the Occupational Health and Safety Act allows a toxic substance to be ''designated'' and its use in the workplace to be either prohibited or strictly controlled. Designation is reserved for substances known to be particularly hazardous, and currently there are 11 such designated substances. This act also allows exposure to biological and chemical agents in the workplace air to be controlled via the adoption of threshold limit values.

ORGANIZATIONS

Federal Government

Health Canada

Health Canada has five branches and is represented in five Canadian regions: Atlantic, Quebec, Ontario, Manitoba/Saskatchewan, and Pacific West.

Health Protection Branch

Several activities of the Health Protection Branch are closely linked to toxicology. This branch is responsible for programs that ensure the safety of the food supply, pharmaceuticals and cosmetics, medical or radiation-emitting devices, and the environment. It is also expected to protect Canadians from hazardous consumer products and materials in the workplace and technology. It carries out regulatory and field inspections, has surveillance responsibilities, and investigates disease outbreaks and product hazards. To carry out this large mandate the Health Protection Branch is organized into several directorates.

The role of the Environmental Health Directorate is to assess and manage health risks at work and at home, in the natural and technological environments. This directorate is divided into five bureaus: Chemical Hazard, Product Safety, Medical Device, Radiation Protection, and Tobacco Control.

The Bureau of Chemical Hazard is primarily concerned with the effects of chemicals and biological agents in the environment on human health (e.g., hazard identification and risk quantification relating to chemicals and microorganisms in air, soil, drinking water, and water for recreational uses). This bureau manages health risks through the introduction of regulations, standards, and guidelines. It is organized into four divisions: Environmental and Occupational Toxicology, Environmental Substances, Monitoring and Criteria, and Bioregional Health Effects. Its programs currently include five major project areas: air quality, water quality, new chemical substances and biotechnology products, environmental contaminants, and bioregional health effects (e.g., Great Lakes Basins, St. Lawrence River region, and the Arctic). These activities are mandated by the Canadian Environmental Protection Act, the Canadian Environmental Assessment Act, the Department of Health Act, and agreements such as the Great Lakes Water Quality Agreement, the Canada-Ontario agreement, and the Canada/US Clean Air Act Accord.

Product Safety is concerned with the prevention of injury and death caused by failure of consumer products. It is also responsible for the safety of all consumer and workplace chemical products that do not fall under other legislation. The WHMIS is one of the major programs that product safety administers.

Radiation Protection is concerned with radiation risks to humans, including those from medical and industrial X-ray equipment, lasers, ultraviolet radiation from the sun, microwave ovens, airport noise, and power lines and radon in homes. It also manages the Occupational Dosimetry Service and National Dose Registry.

There are three other directorates within the Health Protection Branch (Food, Drug, and Laboratory and Centre for Disease Control). Some of their activities are also concerned with toxicological research and toxicity testing.

Environment Canada

Environment Canada's objective is to foster a national capacity for sustainable development in cooperation with other governments, departments of govern-

ment, and private sectors that will result in a safe and healthy environment. The Environmental Protection Service Program is responsible for development of strategies for pollution prevention, controlling pollution from existing sources, and assisting in the remediation of polluted sites.

The National Water Research Institute maintains research facilities at the Canada Centre for Inland Waters (867 Lakeshore Rd., Burlington, ON L7R 4A6), which also houses research laboratories of other organizations and departments that are concerned with environmental research and development of the Great Lakes.

Environment Canada also maintains research laboratories at the Bedford Institute of Oceanography (Department of Fisheries and Oceans, Dartmouth, NS), which conduct chemical, toxicological, and microbiological analyses to support the department's environmental protection programs.

Department of Fisheries and Oceans

This department has research facilities throughout Canada and is organized along disciplinary lines into biological sciences, physical and chemical sciences, and hydrography. The physical and chemical sciences also cover toxicology and contaminants science relating to both marine and freshwater environments.

Pacific Region

Institute of Ocean Sciences
J. C. Davis
9860 West Saanich Rd.
Sidney, BC V8L 4B2

Its chemical oceanographic research is directed toward determining the source, distribution, and trends of concentrations of organochlorines, hydrocarbons, and organometallics in marine and freshwater environments to better understand how these pollutants are cycled within marine and freshwater systems.

Central and Arctic Region

Freshwater Institute (regional headquarters for Ontario, the prairie provinces, and the Northwest Territories)
J. Cooley
501 University Crescent
Winnipeg, MN R3T 2N6

It is the major Canadian center for freshwater and Arctic fisheries research, including marine mammals and fish habitat. Its toxicological research includes acidification, radionuleotides, and heavy metal pollution and toxic chemicals.

The Great Lakes Laboratory for Fisheries and Aquatic Sciences (GLLFAS) at the Bayfield Institute
867 Lakeshore Rd.
Box 5050
Burlington, ON L7A 1A6

It is designated as a center of disciplinary expertise for the study of freshwater fisheries contaminants and toxicology. It is involved in ecotoxicology and ''acid rain'' studies as well as studies concerning the impacts of dioxins discharged into the aquatic environment from Canadian pulp mills.

Quebec Region

Maurice Lamontane Institute
850 Route de la Mer
Box 1000
Mont-Joli, QC G5H 3Z4

It is active in investigating pollution of the St. Lawrence river system.

Scotia-Fundy Region

St. Andrews Biological Station
W. Watson-Wright
Brandy Cove Rd.
St. Andrew, NB, E0G 1X1

One of its three primary functions is to study the impacts of human activities on aquatic ecosystems, including the identification of hazards and the effects of pollutants (including acid rain) on fish species and their environments.

Newfoundland Region

Northwest Atlantic Fisheries Centre
L. W. Coady
P.O. Box 5667
St. John's, NF A1C 5X1

Research is focused on major groundfish, marine mammals, and freshwater and anadromous species in the Newfoundland-Labrador area. One aspect of the study is concerned with toxicology/contaminants (hydrocarbons and pesticides).

Provincial Governments

Ontario

Ministry of Agriculture, Food and Rural Affairs

The Agricultural and Food Laboratory Services Centre provides research, testing, and monitoring services that ensure the safety and quality of Ontario's food supply. Analytical services are provided primarily to

food, agricultural products, and environmental samples collected by food inspectors and livestock and crop specialists from the ministry.

The Pesticide Residue and Trace Contaminants Laboratory provides analytical services to support investigation of problems caused by the use and misuse of pesticides, trace metals, drugs, and other selected industrial and agricultural chemicals. It also provides a fee-for-service directly to farmers and food processors to assist in management decisions.

Ministry of the Environment and Energy

Two of its branches have significant toxicologically related activities. The Hazardous Contaminants Branch is involved in risk identification, assessment, and management of environmental contaminants as well as providing expert advice on environmental toxicology, the level of hazardous substances, environmental fate, and biotechnology issues to client groups and other Ministry of the Environment and Energy branches. The Laboratory Services Branch (Toronto Central Laboratory, 125 Resources Rd., Etobicoke, ON M9P 3V6) provides analytical support for the ministry's environmental assessment and regulatory programs. It also acts as a reference center for environmental analyses, research and development for methodology, and participates in research concerning interaction of atmospheric and aquatic pollutants with the environment and their effects on human health.

Ministry of Health

The Public Health Branch has the Environmental Health and Toxicology Unit and the Food Safety/Water Quality Unit concerned with human health aspects of toxic chemicals present in food or the environment.

Ministry of Labour

The Occupational Health Laboratory Service (101 Resources Rd., Weston, ON M9P 3T1) of the Occupational Health and Safety Branch conducts research on health and safety and for developing policy, legislation, and regulations to ensure the health and safety of workers. Its Regulation Development Unit is responsible for developing regulations for toxic substances, including designated substance regulations made under the Occupational Health and Safety Act. The Health and Safety Studies Unit conducts occupational health and safety research studies and provides consultation concerning the effect of occupational and environmental exposure to chemical and biological agents on human health.

Ministry of the Solicitor General and Correctional Services

The laboratories of the Centre of Forensic Sciences (25 Grosvenor Street, Toronto, ON M7A 2G8) provide scientific examination, analysis, evaluation, and interpretation of materials for law enforcement officers, crown attorneys, lawyers, coroners, pathologists, and other investigative agencies. The toxicology section is involved primarily with analyses in medicolegal and criminal investigations in connection with drugs, alcohol, and poison ingestion. This section is also responsible for supervising the alcohol breath testing program in Ontario.

Alberta

Alberta Environmental Centre

This is the province's major facility for applied environmental research and technology development; it supports the mandate of the government for environmental protection. There are six research and two support service programs (including Air, Water, and Waste Management, Environmental Chemistry, Environmental Toxicology, and Pest Management). Some of the toxicologically relevant programs include development of nonchemical pesticides for controlling plant and animal pests; study the effects of environmental pollutants on birds, fish, water, and soil as well as on domestic and wild animals; and inhalation toxicology of hydrogen sulfide and sour gas, including effects on reproduction.

British Columbia

Pacific Environmental Science Centre—Aquatic Toxicology Section
2645 Dollarton Highway
North Vancouver, BC V7H 1V2

A joint program between the B.C. Ministry of Environment, Lands and Parks and Environment Canada has been established to investigate the toxicity of industrial effluents, commercial products, and samples of water and soil.

Saskatchewan

Saskatchewan Research Council
15 Innovation Blvd.
Saskatoon, SK S7N 2X8

The Analytical Services Laboratory of the Research and Technical Services Branch provides analyses for radioisotopes and a wide range of pesticides and toxic organic chemicals to assist in environmental monitoring.

The Environmental Technologies Division provides research services in support of ecosystems. The air quality section has conducted research projects concerning stack emission testing, spray drift, indoor air quality, and environmental monitoring of hazardous waste sites. The water quality section is concerned with the development of methodologies to produce safe drinking water for rural Saskatchewan. Areas of con-

cern include naturally produced organics, chemical contaminants, and pathogenic microbes. In addition, it participates in an international project dealing with the development of aquatic plant bioassays for the assessment of toxicity of industrial wastes.

Nongovernment

Canadian Centre for Occupational Health and Safety (CCOHS)
250 Main Street East, Hamilton, ON L8N 1H6
customer service: 1-800-668-4284
E-mail: custserv@ccohs.ca
Web: http://www.ccohs.ca

CCOHS is the national information resource in occupational health and safety, created by an act of Parliament in 1978 to promote the fundamental right of Canadians to a healthy and safe work environment. This is a corporation governed by a council with representatives from employers, workers, and both the federal and provincial governments; it reports to the Minister of Labour, Government of Canada. It offers two levels of services—a free confidential telephone/mail inquiries service and a series of products on a variety of occupational health and safety topics, presented in both print and electronic format. The latter is provided by a comprehensive computerized information service (CCINFO), delivered through a compact disc (CD-ROM) and an online system, CCINFOWeb (see Web Sites for details). It offers intensive courses pertaining to health and safety training as well as resources retrieval via the Internet.

Canadian Network of Toxicology Centres (CNTC)
Bovey Administration Bldg.
Gordon St., University of Guelph
Guelph, ON N1G 2W1

CNTC is a network of collaborating institutions which includes participants from academia, government, and industry. It was formed in 1988 by the signing of a memorandum by three existing centers: the Centre for Toxicology at Guelph, the Toxicology Centre at the University of Saskatchewan, and the Centre Interuniversitaire de Recherche en Toxicologie de l'Universite de Montreal et de l'Universite du Quebec a Montreal. The network conducts environmentally and human health-related research, emphasizing the risks associated with the use and exposure to chemical agents and metals. An essential element of the CNTC approach is the development of methods that accurately measure hazards and reliably predict risks. The CNTC receives significant funding from the Canadian Government.

Scientific Societies

Canadian Association of Poison Control Centers
Secretary Treasurer: P. Gaudreault
Hospital Sainte-Justine
3175 Cote Sainte-Catherine
Montreal, QC H3T 1C5

Canadian Society of Forensic Science
Suite 215
2660 Southvale Crescent
Ottawa, ON K1B 4W5

Society of Toxicology of Canada
Executive Director, G.Krip
P.O. Box 517
Beaconfield, QC H9W 5V1

This is a society of approximately 500 members from academia, government and industry. It holds its annual meeting and scientific symposium in December, normally in Montreal.

TOXICOLOGY EDUCATION AND SCHOOLS

Several Canadian universities offer programs in toxicology at graduate (MSc and PhD) and/or undergraduate levels. In addition, many schools offer postgraduate diploma programs in toxicology composed of coursework only, whereas others offer programs which although are not toxicology per se emphasize toxicology in their multidisciplinary programs. These schools are listed below with the program offered, subdisciplines, and a contact person for each school.

Graduate Programs in Toxicology

British Columbia

University of British Columbia
MSc and PhD in Toxicology
Subdisciplines: Biomedical and wildlife toxicology
Dr. G. D. Bellward
Division of Pharmacology and Toxicology
Faculty of Pharmaceutical Sciences
2146 East Mall
Vancouver, BC V6T 1Z3
Phone: 604-822-4103
Fax: 604-822-3035

Simon Fraser University
MSc in Environmental Toxicology
Subdisciplines: Environmental, biochemical, and ecotoxicology
Dr. F. Law
Environmental Toxicology Program

Department of Biological Sciences
Burnaby, BC V5A 1S6
Phone: 604-291-4285
Fax: 604-291-3496
E-mail: f_law@sfu.ca

Newfoundland

Memorial University of Newfoundland
MSc in Toxicology
Subdisciplines: Biochemical, clinical, environmental, and reproductive toxicology
Dr. Bruce B. Virgo
Centre for Toxicology
Health Sciences Centre
St. John's, NF A1B 3X9
Phone: 709-737-7903
Fax: 709-737-7044

Ontario

University of Guelph
MSc and PhD in Toxicology
Subdisciplines: Nutritional, chemical, wildlife, environmental, and biomedical toxicology
Dr. N. Bunce
Department of Chemistry and Biochemistry
University of Guelph
Guelph, ON N1G 2W1
Phone: 519-824-4120, ext. 3962
Fax: 519-766-1499
E-mail: bunce@chembio.uoguelph.ca

Queen's University
MSc and PhD in Pharmacology and Toxicology
Subdiscipline: Biomedical toxicology
Dr. Thomas E. Massey
Department of Pharmacology and Toxicology
Kingston, ON K7L 3N6
Phone: 613-545-6115
Fax: 613-545-6412
E-mail: phardept@queensu.ca

University of Toronto
MSc and PhD in Toxicology
Subdisciplines: Biomedical and environmental toxicology
Dr. A. V. Rao, Chair
Collaborative Program in Toxicology
33 Willcocks St. #1016
Toronto, ON M5S 3E8
Phone: 416-978-7077
Fax: 416-978-3884

University of Western Ontario
MSc and PhD in Pharmacology and Toxicology
MSc in Toxicology
Subdisciplines: Pharmacology, molecular, nutritional, and environmental toxicology
Dr. J. R. Bend
Department of Pharmacology and Toxicology
Medical Sciences Building
Rm 275
London, ON N6A 5C1
Phone: 519-661-3312
Fax: 519-661-4051
E-mail: jbend@julian.uwo.ca

Saskatchewan

University of Saskatchewan
MSc and PhD in Toxicology
Subdisciplines: Pharmacology, environmental, biochemical, clinical, and nutritional toxicology
Dr. C. S. Sisodia
Coordinator, Academic Programs in Toxicology
1301 W.C.V.M., 52 Campus Drive
Saskatoon, SK S7N 5B4
Phone: 306-966-7371
Fax: 306-966-7376

Graduate Diploma Programs and Courses in Toxicology

British Columbia

Simon Fraser University
Diploma in Environmental Toxicology
Subdisciplines: Environmental, biochemical, and ecotoxicology
Dr. F. Law
Environmental Toxicology Program
Department of Biological Sciences
Burnaby, BC V5A 1S6
Phone: 604-291-4285
Fax: 604-291-3496
E-mail: f_law@sfu.ca

Quebec

Université de Montréal
Diploma in Toxicology
Subdisciplines: Human health and environmental quality
Dr. Claude Viau
2910 Edouard-Montpetit, app. 1
P.O. Box 6128, Succ. Centre-ville
Montréal, QC H3C 3J7
Phone: 514-343-6134
Fax: 514-343-2200

Saskatchewan

University of Saskatchewan
Diploma in Toxicology
Subdisciplines: Analytical, nutritional, environmental, and medical toxicology
Dr. C. S. Sisodia

Coordinator, Academic Programs in Toxicology
1301 W.C.V.M., 52 Campus Dr.
Saskatoon, SK S7N 5B4
Phone: 306-966-7371
Fax: 306-966-7376

Graduate Programs with Research Areas in Toxicology

Nova Scotia

Dalhousie University
MSc in Pharmacology; MSc in Biology; MES in Environmental Toxicology
Subdisciplines: Environmental toxicology, pharmacology, and biology
Dr. R. P. Côté
School for Resource and Environmental Studies
1312 Robie St.
Halifax, NS B3H 3E2
Phone: 902-494-3632
Fax: 902-494-3728
E-mail: SRES@ac.dal.ca

Ontario

Trent University
MSc and PhD in Watershed Ecosystems
Subdiscipline: Environmental toxicology
Dr. Chris D. Metcalfe
Environmental and Resource Studies
Peterborough, ON K9J 7B8
Phone: 705-748-1272
Fax: 705-748-1569
E-mail: cmetcalfe@trentu.ca

University of Waterloo
MSc and PhD in Biology
Subdiscipline: Environmental toxicology
Dr. W. D. Taylor
Department of Biology
Waterloo, ON N2L 3G1
Phone: 519-888-4567, ext. 2556
Fax: 519-746-0614
E-mail: wdtaylor@sciborg.uwaterloo.ca

Quebec

Université Laval
MSc and PhD in Experimental Medicine
Subdisciplines: Pharmacology and toxicology
Dr. Bao-Linh Dinh
Faculty of Medicine
Sainte-Foy, QC G1K 7P4
Phone: 418-656-5533
Fax: 418-656-2189

McGill University
MSc and PhD in Pharmacology
Subdisciplines: Reproductive and chemical toxicology
Chairman, Graduate Training Committee
Pharmacology and Therapeutics
McIntyre Medical Sciences Building
3655 Drummond Street
Montréal, QC H3G 1Y6

Université de Montréal
MSc, PhD as per participating departments
Subdisciplines: Industrial, environmental, and ecotoxicology
P.O. Box 6128
Succursale Centre-ville
Montréal, QC H3C 3J7
Participating departments:
- Occupational and Environmental Health
  Dr. Claude Viau
  Phone: 514-343-6134
- Community Health: Environmental Toxicology
  Dr. Claude Viau
  Phone: 514-343-6134
- Pharmacology
  Dr. Mahmoud Sharkawi
  Phone: 514-343-6338
- Nutrition
  Dr. Emile Lévy
  Phone: 514-345-4626
- Biological Sciences
  Dr. Raymond McNeil
  Phone: 514-343-6878

Université du Québec á Montrèal
Dr. Bertin Trottier
TOXEN—Department of Biological Sciences
P.O. Box 8888, Succ. Centre-ville
Montréal, QC H3C 3P8
Phone: 514-987-7026
Fax: 514-987-4647

Undergraduate Programs in Toxicology

British Columbia

Simon Fraser University
BSc in Environmental Sciences
Subdisciplines: Environmental, biochemical, and ecotoxicology
Dr. F. Law
Environmental Toxicology Program
Department of Biological Sciences
Burnaby, BC V5A 1S6
Phone: 604-291-4285
Fax: 604-291-3496
E-mail: f_law@sfu.ca

Ontario

University of Guelph
BSc (Hons) Toxicology; BSc (Hons) Biomedical Toxicology; BSc (Hons) Environmental Toxicology
Subdisciplines: Nutritional, chemical, wildlife, environmental, and biomedical toxicology
Dr. N. Bunce
Department of Chemistry and Biochemistry
University of Guelph
Guelph, ON N1G 2W1
Phone: 519-824-4120, ext. 3962
Fax: 519-766-1499
E-mail: bunce@chembio.uoguelph.ca

Queen's University
BSc (Hons) Pharmacology and Toxicology
Subdisciplines: Environmental and life sciences
Dr. Thomas E. Massey
Department of Pharmacology and Toxicology
Kingston, ON K7L 3N6.
Phone: 613-545-6115
Fax: 613-545-6412
E-mail: phardept@qucdn.queensu.ca

Trent University
BSc
Subdiscipline: Environmental science
Dr. Chris D. Metcalfe
Environmental and Resource Studies
Peterborough, ON K9J 7B8
Phone: 705-748-1272
Fax: 705-748-1569
E-mail: cmetcalfe@trentu.ca

University of Western Ontario
BSc (Hons)
Subdisciplines: Pharmacology, toxicology, and environmental science
Dr. J. R. Bend
Department of Pharmacology and Toxicology
Medical Sciences Building
Rm 275
London, ON N6A 5C1
Phone: 519-661-3312
Fax: 519-661-4051
E-mail: jbend@julian.uwo.ca

Quebec

University de Montréal
Certificate in Eco-Industrial Toxicology
Subdisciplines: Industrial and environmental toxicology
Mrs. Elisabeth Lalague
Faculté de l'éducation permanente
P.O. Box 6128, Succ. Centre-ville
Montréal, QC H3C 3J7
Phone: 514-343-6982

University du Ouébec à Montréal
BSc
Subdisciplines: Biochemistry, biology, and chemistry
Dr. Bertin Trottier
TOXEN
P.O. Box 8888, Succ. Centre-ville
Montréal, QC H3C 3P8
Phone: 514-987-7026
Fax: 514-987-4647

TOXICOLOGY TESTING LABORATORIES AND ENVIRONMENTAL CONSULTING SERVICES

Only company activities that are related to toxicology are listed.

Aquatic Toxicology Research Centre—Lakehead University Centre for Analytical Services
C. Nelson
Phone: 807-343-8793

Provides acute toxicity testing using rainbow trout and daphnia. SCC-Canadian Association for Environmental Analytical Laboratories (CAEAL) accredited. Chronic toxicology facilities are also available.

BC Research Inc.
Dr. J. Hill
3650 Westbrook Mall
Vancouver, BC V6S 2L2

An aquatic toxicology group that conducts acute toxicity bioassays, chronic sublethal toxicity evaluation, sediment toxicity, and genotoxicity testing as well as OECD 28-d biodegradation test and bioaccumulation test on salmonids. Evaluations are conducted on industrial and municipal discharges, effluent and receiving waters, as well as chemical reagents used by industry. Some of the tests are accredited by CAEAL.

Beak Consultants Ltd.
D. G. Wilson
14 Abacus Road
Brampton, ON L6T 5B7

A member of CANORA Consortium of 26 Canadian companies providing environmental services on large infrastructure projects in Southeast Asia. If offers a wide range of specialized environmental services and products, including aquatic, marine, and terrestrial toxicology, environmental risk assessment, and modeling. It provides portable innovative environmental

monitoring and biodetection products for screening the levels of environmental contamination and toxicological impact.

Bechtel Canada Inc.
P. Complin
12 Concorde Place
Toronto, On M3C 3R8

Provides a range of environmental and waste management services, including environmental assessment, waste cleanup, pollution control, and regulatory compliance.

B. H. Levelton Associates Ltd.
12791 Clarke Place
Richmond, BC V6V 2H9

This company's major areas of business are materials engineering technology, air pollution and emission control, wastewater treatment, environmental impact assessment and audit, and environmental testing and analysis.

Bio-Research Laboratories Ltd.
Senneville, Quebec

An independent contract laboratory engaged in a wide range of toxicity testing, both *in vivo* and *in vitro*. This fully GLP compliant facility provides services to pharmaceutical, chemical, and biotechnology industries.

Bonnell Environmental Consulting
872 Molfa Cresent
Ottawa, ON K2C OP3
E-mail: tauceti@magi.com

Offers consulting services and research support in ecotoxicology and environmental quality assessment with specialization in biological investigation of contaminated sites.

Bovar Environmental Services
N. Stein
1313 44th Ave., N.E.
Calgary, AB T2E 6L5

Offers services including environmental audits, air quality monitoring, site remediation, hazardous waste management, emissions testing, environmental impact assessments, and training programs.

Brown Meddings Elemental Research Inc.
R. Brown
309-267 West Esplanade
North Vancouver, BC V7M 1A5

Specializes in research and analytical services related to heavy metals. Advanced methodology is available for the determination of heavy metals in water, soil, and air pollution particulates and plant and animal tissues.

Canora (Asia) Inc.
G. Glazier
1700 Varsity Estates Drive, NW
Calgary, AB T3B 2W9

A Canadian corporation formed to provide environmental, engineering, equipment, and contracting services to clients in Southeast Asia. It is a consortium of 26 Canadian companies. Some of the services related to the environmental toxicology area include hazardous waste, environmental audits and environmental impact assessment, water and air quality preservation, and wastewater treatment.

Cantox Inc.
I. Munro
2233 Argentia Road Suite 308
Mississauga, ON L5N 2X7

A consulting firm specializing in safety and regulatory issues related to products and processes that may adversely affect humans and the environment. Expertise is available in the areas of human and aquatic toxicology, fate and modeling of chemicals in the environment, environmental and human health risk assessments, and risk communication. The company is organized into six departments: Health Sciences, Environmental Sciences, Canadian Environmental Protection Act Services, Pharmaceutical and Healthcare, Scientific Communication, and Regulatory Services.

Environmental Sciences Centre—Economic Innovation and Technology Council of Manitoba
E. Sorba
Phone: 204-945-4193

Concerned with identifying and solving environmental and occupational health problems and provides services in water quality testing, environmental monitoring, occupational hygiene, hazardous waste analysis, pesticides and PCB analyses, bioassays, and laboratory audits.

Environ-RISQUE Inc.
Cameron Sherry
78, Lucerne, Bureau 3
Pointe Claire, Quebec H9R 2V2

An environmental consulting firm which is concerned with occupational health and safety and environmental issues (air pollution, hazardous waste, industrial hygiene, occupational health, and safety monitoring). It has certified industrial hygienists and health and safety

specialists on staff. They are experienced in conducting health and safety/environmental audits and industrial hygiene surveys.

EnviroTest Laboratories
9936-67th Avenue
Edmonton, AB T6E OP5

Conducts toxicological testing involving industrial effluent discharges, toxicity identification evaluations using short-term toxicity tests, and toxicity reduction evaluations including identification of factors that are successful in removing the toxicants. They are able to differentiate between toxicants that originate from the petrochemical industry, the pulp and paper industry, and the wood preservation industry (industry-specific responsibility and liability).

EVS Environment Consultants
G. Vigers
195 Pemberton Avenue
North Vancouver, BC V7P 2R4
E-mail: evs_consultant@mindlink.bc.ca

Services industrial sectors with regard to hazardous waste, monitoring, oil spill control, resource management, water and wastewater. Services and products that pertain to toxicology include ecotoxicology and toxicity testing, water and sediment pollution, soil pollution, contaminant fate and effects, environmental impact assessment, and risk assessment.

General Testing Laboratories
P. Tayler
1001 East Pander Street
Vancouver, BC V6A 1W2

A division of SGS Canada, Inc. It provides a wide range of analytical services including trace metal and environmental analyses.

Global Tox International Consultants Inc.
C. G. Rousseaux
301 Metcalfe Street
Ottawa ON K2P 1R9
Phone: 613-237-3812

Provides services in human and environmental toxicology and pathology with emphasis on hazard identification, exposure modeling, and quantitative risk assessment as well as communications. It offers complete pathology with aquatic and mammalian species in support of product development and regulatory compliance. Other services includes reviews of science documents, permit applications, workplace exposure assessment, and preparation of MSDSs.

Green-Eclipse Incorporated
B. M. Small
2269 Conc. 4, R.R.#1
Goodwood, ON L0C 1AO

Specializes in indoor air quality as related to human health and promotes Envirodesic buildings, products, and services. This company has expertise in the areas of low-pollution design, toxicology, medicine, indoor air quality, pollutant testing, chemistry, and engineering.

Klohn–Crippen Consultants Ltd.
D. Sellers
600-510 Burrard Street
Vancouver, BC V6C 3A8

Provides a wide range of engineering services to industries related to waste management, mining, agriculture, electric power generation, and construction as well as to government (water supply and environmental studies). The toxicologically relevant environmental services provided include environmental liability assessment, industrial toxicology, human and ecological risk analysis, contaminant fate and transport modeling, and wastewater characterization and treatment. It has expertise in monitoring workers for occupational exposure to arsenic.

Nova Scotia Innovation Corporation
(InNOVAcorp)
M. L. Robicheau

Offers analytical and environmental chemistry services including analysis of heavy metals, organic halogens, PCBs, and other organic and inorganic pollutants in various samples (e.g., waste oils, transformer oils, soils, sediments, drinking water, and process effluents). It also offers indoor air quality monitoring service including testing for asbestos fibers and formaldehyde. The analytical chemistry group supports its forensic service branch in providing analytical data on contamination of industrial process waters and characterization of hydrocarbon fuels, metals, fabrics, and alcoholic beverages.

Ocean Ltd.
J. Bobbitt
31 Temperance Street
St. John's, NF A1C 3J3
E-mail: ocean@terra.ninet.nf.ca

In addition to its expertise in physical oceanography, meteorology, and air/sea interaction studies, this company provides service in fish histopathology and toxicology.

Ontario Hydro International Inc.
Environmental Coordinator: D. A. Hempel
A14H15-700 University Avenue
Toronto, ON M5G 1X6

The international representative of Ontario Hydro established to assist clients in sustainable energy development with environmentally superior technologies. Some of the toxicologically related services include chemical analysis, decontamination systems, effluent bioassays, emission testing, hazardous material, management and services, PCB treatment/disposal, disposal of radioactive materials, and toxicity analysis.

Pollutech EnviroQuatics Ltd.
Point Edward, ON

A biological laboratory of Pollutech Environmental Ltd., it offers services in aquatic toxicity testing, including acute toxicity (rainbow trout and Daphnia compliance testing), chronic toxicity, and development, growth, and reproductive cycles of fish. In addition to several species of fish, bacteria, algae, and invertebrates are used as test organisms. Test samples include industrial wastes from municipal facilities, sludges, and industrial wastewater. Sediment toxicity bioassays using multitest species are integrated with benthic macro invertebrate and specific sediment chemical analysis to examine lethal and sublethal effects as well as chemical accumulation. This laboratory has full accreditation from CAEAL.

Prairie Biological Research Ltd.
4290-91A Street, Block C
Edmonton, Alberta T6E 5V2
A subsidiary, ACCRA Bioanalytical Labs., is located in Burnaby, BC

A biotechnological and testing laboratory which provides services in the areas of microbiology and toxicology with applications in the cleanup of environmental contamination; monitoring of food, water, and indoor air quality; in evaluating product safety; and providing risk assessment analysis. They also conduct tests for identification of pathogenic microorganisms in various environmental samples and perform toxicity, mutagenicity, and carcinogenicity screening tests for product development, hazard identification, evaluation of environmental cleanups; services related to assessment of occupational and environmental exposure to toxic contaminants are also available. Other products and new technologies include the development of indigenous microbial cultures for cleanup of contaminated soil and water. Some of the specific analytical tests used are accredited by the CAEAL and Agriculture Canada.

Technitrol Eco Inc.
M. Bienvenue
121 Boul. Hymus
Point-Claire, QC T9R 1E6

The product of a merger between Technitrol Canada Ltee/Ltd. and Eco-Research Inc., it specializes in biological control, physics, chemistry, and mechanics. Some of the available services include chemical analysis, emission testing, PCB treatment/disposal, testing of toxic substances with aquatic species, and water and air pollution control. Technitrol Eco Inc., in conjunction with Groupe Sante Medisys (Eco.Med), also provides services in industrial hygiene and occupational health. It also provides analytical and environmental services under Les Laboratories Eco. CNFS Inc. (a merger with SNC-Lavalin Inc.).

POISON CONTROL CENTERS

The following list represents current contact information for poison control centers across Canada as provided by the Canadian Association of Poison Control Centres in 1996 (J. Courtemanche).

Alberta

Poison and Drug Information Service
Foothills General Hospital
1403-29th Street, NW
Calgary, AB T2N 2T9
Phone: 1-800-332-1414 or 403-270-1414
Fax: 403-670-1472

British Columbia

BC Drug and Poison Information Centre
St. Paul's Hospital
1081 Burrard Street
Vancouver, BC V6Z 1Y6
Phone: 1-800-567-8911 or 604-682-5050
Fax: 604-631-5262

Manitoba

Provincial Poison Information Centre
Children's Hospital Health Sciences Centre
840 Sherbrooke Street
Winnipeg, MB R3A 1S1
Phone: 204-787-2591 (emergency inquiries), 204-787-2444 (general inquires)
Fax: 204-787-4807

New Brunswick

Moncton
Poison Control Centre
The Moncton Hospital

135 McBeth Avenue
Moncton, NB E1C 6Z8
Phone: 506-857-5555 (emergency inquires), 506-857-5353 (general inquires)
Fax: 506-857-5360

Saint John
Saint John Regional Hospital
Emergency Department
P.O. Box 2100
Saint John, NB E2L 4L2
Phone: 506-648-6222
Fax: 506-648-6901

Newfoundland and Labrador

The Dr. Charles A. Janeway Child Health Centre
Emergency Department
710 Janeway Place
St. John's, NF A1A 1R8
Phone: 709-722-1110

Northwest Territories

Stanton Yellowknife Hospital
Emergency Department
P.O. Box 10
Yellowknife, NT X1A 2N1
Phone: 403-920-4111
Fax: 403-920-2805

Nova Scotia

Poison Control Centre
The Izaak Walton Killam Children's Hospital
P.O. Box 3070
Halifax, NS B3J 3G9
Phone: 902-428-8161, 1-800-565-8161 (toll-free from P.E.I.)
Fax: 902-428-3213

Ontario

Ottawa
Ontario Regional Poison Information Centre
Children's Hospital of Eastern Ontario
401 Smyth Road
Ottawa, ON K1H 8L1
Phone: 1-800-267-1373, 613-737-1100 (emergency inquires), 613-737-2320 (general inquiries)
Fax: 613-738-4862

Toronto
Ontario Regional Poison Information Centre
The Hospital for Sick Children
555 University Avenue
Toronto, On M5G 1X8
Phone: 1-800-268-9017, 416-598-5900
Fax: 416-813-7489

Prince Edward Island

See Nova Scotia for address.
Phone: 1-800-565-8161 (toll-free)

Quebec

Centre antipoison du Quebec
Hospitalier de l'Universite Laval
2705 boul. Laurier
Sainte-Foy, PQ G1V 4G2
Phone: 1-800-463-5060, 418-656-8090
Fax: 418-654-2747

Saskatchewan

Regina
Regina General Hospital
Emergency Department
1440 14th Ave.
Regina, SK S4P 0W5
Phone: 1-800-667-4545, 306-359-4545
Fax: 306-359-4357

Saskatoon
Royal University Hospital
Emergency Department
Saskatoon, SK
Phone: 306-966-1010
Fax: 306-966-1011

Yukon Territory

Whitehorse General Hospital
Emergency Department
5 Hospital Road
Whitehorse, YT Y1A 3H7
Phone: 403-667-8726
Fax: 403-667-2471

Acknowledgments

The authors thank the following individuals for their invaluable assistance in the preparation of this document: Dr. Brian Belliveau, Dr. Peter Grosser, Ms. Allison Pink, and Mr. John Salminen.

References

CAPCO Note: Workplace Hazardous Materials Information System (WHMIS)—Phase II (1990). Agriculture Canada.

Drugs Directorate Guidelines (1990). Health Protection Branch, Health and Welfare Canada.

Government Proposal for the Pest Management Regulatory System (1994).

Lauer, B. H. (1987). Control of food additives in Canada and its implication on protection of public health. *Environ. Health Rev.,* 104–111

Registration Handbook (1994). [For pest control products under the Pest Control Products Act and Regulations]

Toxic Substances Management Policy (1995). Government of Canada, Environment Canada.

China

S. LI AND D. Y. ZHU

BOOKS

Feng, Y. P., and Chen, J. Y. (Eds.) (1986)
Adverse Effect on Toxic Chemicals on Human Reproduction
Sichuan Scientific and Technological Publishing Societies Press
ISBN 13298-69

This book is an extensive presentation of harmful effects of chemical substances on reproduction of humans. It contains six chapters. The chapter subjects include sensitivity of chemical substances on reproduction, relationship between chemicals and reproductive functions of humans, research methods related to studying adverse effects of chemical substances on reproductive functions, similarity of research for humans and for laboratory animals, and effects of different chemicals on reproduction in humans and animals. This book is aimed at health care personnel and occupational toxicologists.

Ji, Y. J. (Ed.) (1991)
Handbook on Practical Toxicology
China Environment Science Publishing Societies Press
ISBN 7-80010-679/K-011

This publication is targeted for occupational doctors, hygienists, toxicologists, and manager of health care. The topics include toxic effects of common and new toxic substances, pesticides, drugs, additives, and cosmetics; toxicology diagnosis of poisoning; treatment; hygienic standards; and recommendations. This book contains five chapters, including a general introduction, toxicological methods, practical toxicology, clinical signs of poisoning, and management for toxic substances.

Jiang, Q. G. (Ed.) (1995)
An English–Chinese Dictionary of Toxicology
Chemistry Industry Publishing House
ISBN 7-5025-1526-7

This English–Chinese dictionary covers (i) definitions and explanations of toxicology-related terms, (ii) toxicity information on common chemicals, and (iii) data on important enzyme inducers and inhibitors. It is a useful reference for toxicology professionals as well as for people working in related areas.

Jiang, Q. G. (Ed.) (1995)
Basic Toxicology
Chemistry Industry Publishing Societies Press
ISSN 7-5025-0822-8/TQ.474

This book covers three parts: (i) basic theories of toxicology, (ii) hepatic toxicology and chemical carcinogens, and (iii) extrapolation issues, designs for toxicological experiments, and risk assessment of chemical substances. This book is a useful reference for teaching; it is also for advanced studies in the field of toxicology.

Li, S. L. (Ed.) (1989)
Toxicology and Analysis on Toxic Substances
People's Health Publishing Societies Press
ISBN 7-117-00739/R.746

The subjects of the chapters in this book deal with general concepts, how organisms are exposed to toxic chemicals, mechanism of poisoning, survey and inference of acute poisoning, analytical methods for toxic substances, physical and chemical properties of chemicals, toxicological effects, clinical signs, principles of qualitative and quantitative analyses, and emergency treatment. The book also gives 50 cases of acute poisoning caused by toxic substances. This book is written for medical students and teachers, occupational doctors, toxicologists, and hygienists.

Li, S. Q. (Ed.) (1987)
Basic Principles and Methods of Hygienic Toxicology
Sichuan Scientific and Technological Publishing Societies Press
ISBN 7-5364-0367-4/R.66

This book contains 33 chapters. It is the most extensive presentation on toxicology and is also teaching reference for toxicologists and hygienists.

Qiao, Z., and Zhou, J. L. (Eds.) (1984)
Basic Toxicology
Y. X. Sun Medical College Publishing Societies Press

This is a compilation for advanced studies of toxicology. The topics cover kinetic and metabolism of toxic

substances, mechanism of toxic effects, their effect factors, effect on impairment and repair of genetic substances, mutagenicity and carcinogenicity of toxic chemicals, and major toxicological methods. This book contains 16 sections; it is targeted for Chinese toxicologists.

Wan, B. J. (Ed.) (1991)
Hygienic Toxicology
Liaoning Scientific and Technological Publishing Societies Press
ISBN 7-5381-1433-5/R.232

This book comprises eight chapters. Subjects include biological transport and transformation of chemical substances, toxicity and toxic effect, dose–response relationship and its influencing factors, experimental basics for animals in toxicological research, evaluation for common and special chemical substances, risk assessment of chemical substances and limit of exposure, and toxicological test methods. This book is written for teachers and students of preventive medicine and medical university faculty. It is a reference for teaching.

Wang, Y. L., and Gong, B. Q. (Eds.) (1994)
Modern Labour Hygiene
People's Health Publishing Societies Press
ISBN 7-117-02048-2/R.2049

This book deals with the general introduction of industrial dust and pneumosilicosis, physical factors of occupational cancer, evaluation of harmful occupational factors on special groups of persons, and labor hygiene. This book is written for persons who are responsible for teaching and researching occupational medicine aspects.

Xia, Y. X. (Ed.) (1991)
Toxicity of Toxic Chemical Substances
Shanghai Scientific and Technological Document Publishing Societies Press
ISBN 7-80513-873-7/0.64

This book contains 34 chapters; it introduces separately properties of 3000 kinds of chemical substances which belong to 29 groups, their toxicity and effects on human health, as well as diagnosis, treatment, and prevention for poisoning. This book gives more detailed information on the toxicity of common chemical substances used in industries and in agriculture. This book is not a student textbook, but it helps medical professionals, especially occupational doctors and toxicologists, to design and conduct proper medical examinations. It is also a handbook for managers in the field of health care.

Yuan, B. S., and Liang, C. K. (Eds.) (1995)
Mutagenicity, Carcinogenicity and Teratogenicity of Environmental Pollutants
Lanzhou University Publishing Societies Press
ISBN 7-311-00863-8/R-19

This book comprises six chapters. The subjects of the chapters deal with the mechanisms of mutagenicity, carcinogenicity, and teratogenicity of environmental pollutants; some major test methods; physical and chemical properties; sources of pollution levels in environment; and characterization of toxicity.

Zhang, D. R. (Ed.) (1984)
Handbook on Metal Toxicology
Sichuan Scientific and Technological Publishing Societies Press
BN 13248-38

This book includes two sections: general introduction and separated description. The titles include physical and chemical properties of toxic substances (including 30 kinds of toxic metals and more than 100 metal compounds), sample collection and analytical methods, criteria and hygienic evaluation, epidemiological methods for assessing the toxic effects of metals mutagenicity and carcinogenicity, and diagnosis and treatment for metal poisoning. This book reviews the relationship between toxic chemicals and human health.

Zhu, P. L. (Ed.) (1987)
Animal Toxicology
Shanghai Scientific and Technological Publishing Societies Press
ISBN 7-5323-0347-0/Q.4

This is a first monograph related to animal toxicology. It contains two parts. Subjects of the first part deal with the research subjects of animal toxicology; its general principles and conceptions; toxicological kinetics; toxicological assessment; residuals of toxic substances in edible animal organs; and diagnosis, treatment, and prevention for animal poisoning. The second part introduces the sources of toxic substances, their metabolism, mechanism of poisoning, clinical signs, pathological changes, etc. This monograph is written for teachers, university students, researchers interested preventive medicine, and veterinary surgeons and professional in charge of quarantine.

JOURNALS

Biomedical and Environmental Sciences
ISSN 0893-3985

C. M. Chen (Ed.). Published under the auspices of the Chinese Academy of Preventive Medicine, 27 Nan Wei Road, Beijing, 100050.

Biomedical and Environmental Sciences, an international journal with special emphasis on scientific findings in China, publishes articles dealing with the biologic and toxic effects of environmental pollutants on man and other forms of life. The effects may be measured with pharmacological, biochemical, pathological, and immunological techniques. The journal also publishes reports dealing with the entry, transport, and fate of natural and anthropogenic chemicals in the biosphere and their impact on human health and well-being.

Chinese Journal of Industrial Hygiene and Occupational Diseases (1983–)
ISSN 1001-9391
Domestic Periodical Register CN-12-1094/R

B. Q. Gong (Ed.). Sponsored by the Chinese Preventive Medical Association. Edited and published by Tianjin Institute of Labour Hygiene and Occupational Diseases.

This journal is intended for personnel responsible for labor hygiene and occupational health. It frequently publishes articles and reviews concerned with toxicological issues of chemical substances.

Chinese Journal of Industrial Medicine (1988–, bimonthly)
ISSN 1002-2214
CN-21-1267/R

F. S. He and Z. D. Zhao (Eds.). Sponsored by Labour Hygiene & Occupational Diseases Society, Chinese Preventive Medical Association. Published by Shen Yang Institute of Labour Hygiene & Occupational Diseases, Editorial Board of the *Chinese Journal of Industrial Medicine*, 18 South 11 W. Road, Tie Xi District, Shen Yang, 110024.

This journal is for professionals in occupational medicine and labor safety and for managers in charge of labor hygiene and occupational diseases.

Chinese Journal of Pharmacology and Toxicology (1986–, quarterly)
ISSN 1000-3002
CN-11-1155/R

K. T. Rong (Ed.). Sponsored by the Chinese Pharmacological Society. Undertaken by Academy of Military Medical Sciences, 27 Taiping Road, Beijing, 100850. Edited and published by Editorial Office of Chinese Pharmacology and Toxicology, 27 Taiping Road, Beijing, 100850.

This journal is intended mainly for pharmacologists, toxicologists, hygienists, and occupational doctors. Series of this journal contain reviews, articles, and press and new briefs concerning toxicology and pharmacology.

Chinese Journal of Preventive Medicine (1953–, bimonthly)
ISSN 0253-9624
CN-11-2816

Y. D. Chen (Ed.). Chinese Medical Association, 42 Dongsi Xidajie, Beijing, 100710.

This periodical is one of the important Chinese medical series published by the Chinese Medical Association. This journal is intended for preventive medical professionals. It contains the most extensive presentations on preventive medicine, and toxicology is one of the topics of this journal. Every major article has an English abstract.

Industrial Health and Occupational Diseases (1973–, bimonthly)
ISSN 1000-7164
CN-21-1147/R

M. R. Xu (Ed.). An Shan Institute of Industrial Health, 29 129-Park, An Shan, Liaoning, 114001. Sponsored by An Shan Institute of Industrial Health, An Shan Iron & Steel Corp. at An Shan, Liaoning. Edited by Editorial Board of Industrial Health and Occupational Diseases.

This is a professional periodical for persons interested in occupational health and labor safety; it also is intended for managers in business and industry. Toxicological issues are one of the topics covered in this journal.

Journal of Environment and Health (1984–, bimonthly)
ISSN 1001-5914
CN-12-1095

S. X. Dong (Ed.). Published by the Editorial Board of the *Journal of Environmental & Health*, 76 Tian Shan She Street, Hedong District, Tianjin, 300011.

This is professional periodical for persons responsible for and interested in environmental health and environmental protection as well as teachers at medical universities. The topics include review, survey, and research; technology and methods; special information; short reports; training courses; and press reviews.

Journal of Health Toxicology (1987–, quarterly)
ISSN 1002-3127
CN-2413/G2

S. J. Liu (Ed.). Sponsored by the Chinese Preventive Medical Association, edited by the editorial board, and published by the editorial department (Beijing Institute of Labour Hygiene and Occupational Diseases). Chaowai, Dong de Qiao Bei, Beijing, 100020.

This journal is an important periodical of toxicology in China. It belongs to the series published by the Chinese Preventive Medicine Association. The topics of this journal include industrial toxicology, environmental toxicology, health criteria of chemical substances risk assessment for chemicals, and toxicological test methods. This journal is intended mainly for toxicologists, hygienists, and occupational doctors. It is also a useful reference for teaching and training. The language of the journal is Chinese with abstracts in English.

Journal of Hygiene Research (bimonthly)
ISSN 1000-8020
CN 11-2816

J. S. Chen (Ed.). Published under the auspices of the Institute of Nutrition and Food Hygiene, Chinese Academy of Preventive Medicine, 29 Nan Wei Road, Beijing, 100050.

The major topics of this journal include reviews and articles on labor hygiene, environmental health and monitoring, occupational medicine, nutrition and food hygiene, and health statistics. Toxicology is one aspect of this journal. This journal is intended for medical professionals of sanitary antiepidemic stations, teachers and students of medical universities, and researchers of hygienic institutes. Some articles have English abstracts.

Journal of Preventive Medicine of Chinese People's Liberation Army (1983–, bimonthly)
ISSN 1001-5248
CN-12-1198/R

Z. F. Gu (Ed.). Sponsored and published by the Preventive Medicine Center, People's Liberation Army. Edited by the editorial board of *Journal of Preventive Medicine PLA,* The Preventive Medicine Center, PLA, 1 Da Li Road, Tian Jin, 300050.

This is a special journal for military preventive medicine. Topics cover health criteria research and review, experimental technology, and survey and experiment in field preventive medicine for military purpose. It includes some toxicological issues.

SOCIETIES

Chinese Preventive Medicine Society (CPMS)
The Committee of Hygienic Toxicology is housed in CPMS. Professor Q. G. Jiang is the chairman of the Committee of Hygienic Toxicology.

Chinese Society of Pharmacology (CSP)
The Committee of Toxicology is housed in CSP.

Chinese Society of Toxicology (CST)
Professor D. C. Wu is the current president of CST. The society consists of following Committees:

Committee of Chemical and Molecular Toxicology
Committee of Military Toxicology
Committee of Management Toxicology
Committee of Genetic Toxicology
Committee of Industrial Toxicology
Committee of Agricultural Toxicology
Committee of Inhaled Toxicology
Committee of Radiation Toxicology
Committee of Reproduction Toxicology
Committee of Drug Dependence Toxicology
Committee of Behavior Toxicology
Committee of Clinic Toxicology

EDUCATION/SCHOOLS

Department of Industrial Toxicology
Institute of Occupational Medicine
Chinese Academy of Preventive Medicine
29 Nan Wei Road
Beijing, 100050, China

Department of Hygiene Toxicology Beijing Medical University
Xue Yuan Road
Beijing, 100083, China

Department of Environmental Toxicology
Institute of Environmental Health and Engineering
Chinese Academy of Preventive Medicine
29 Nan Wei Road
Beijing, 100050, China

Department of Environmental Toxicology
Institute of Environmental Health Monitoring CAPM
7 Pan Jia Yuan Nan Li
Beijing, 100021, China

Department of Industrial Toxicology
Beijing Institute of Labor Hygiene and Occupational Diseases
Dong Da Qiao
Beijing, 100020, China

Institute of Pharmacology and Toxicology
Tai Ping Road
Beijing, 1000850, China

Laborator of Industrial Hygiene
Ministry of Public Health, PR of China
2 Xin Kang Street
Beijing, 100288, China

Department of Toxicology
Beijing Institute of Chemical Industry Occupational Diseases
Beijing, 100093, China

Division of Hygiene Toxicology
Department of Public Health
Tianjing Medical College
Ba Li Zhuang
Tianjin, 300020, China

Department of Occupational Health
Shanghai Medical University
138 Yi Xue Yuan Road
Shanghai, 200032, China

Department of Toxicology
Shanghai Institute of Labor Hygiene and Occupational Diseases
261 Bei Jing Xi Road
Shanghai, 200003, China

National Evaluation Centre for the Toxicology of Fertility Regulating Drugs
Shanghai, 200032, China

Department of Special Toxicology
Second Military Medical University
Shanghai, 200433, China

Research Unit of Genotoxicology
University of Medical Sciences
74 Zhong Shan Er Road
Guang Zhou, 510089, China

Department of Toxicology
China Medical University
92 Bei Er Road
Shen Yang, 110001, China

Environmental Medical Laboratory
Hunan Medical University
22 Bei Zhan Road
Changsha Hunan, 410078, China

Department of Environmental Toxicology
Tongji Medical University
13 Hang Kong Road
Wuhan, 430030, China

Guangxi Prevention and Treatment Institute of Occupational Diseases
73 He Di Road
Nanning, 530021, China

Toxicology Program
Shanghai Medical University
138 Yi-Xue-Yuan Road, Box 206
Shanghai, 200032, China

REGULATION AND HEALTH STANDARDS

The information in this section is reprinted in part with permission from Li, S. (1992). Regulations and health standards in the management of risks in the Chinese chemical manufacturing industry. In *Risk Management of Chemicals* (M. L. Richardson, Ed.). Royal Society of Chemistry, Cambridge, UK.

The constantly increasing quantity and variety of chemicals produced globally and an increasing awareness that chemicals have the potential to adversely affect human health and the environment require the development of proper and adequate measures to control and test chemicals. Therefore, the problems of safe use of chemicals against deleterious effects of potentially toxic chemicals have been dealt with by all countries. The enactment and promulgation of national regulations and standards for chemicals are one of the most important requirements for chemical safety.

The People's Republic of China's government pays great attention to the program for environmental protection, including the safe use of chemicals. In accordance with Article II of the Constitution of the People's Republic of China, the State protects the environment and natural resources and prevents and eliminates pollution and other hazards to the public. The Environmental Protection Law adopted in 1979 stipulates active prevention and control measures to obviate noxious substances from factories, mines, businesses, and urban life, including waste gases, wastewater, waste residues, dust, garbage, radioactive material, etc., in addition to noise, vibration, and offending odors from pollution and damage to the environment (Article 16). It stresses that highly effective low-toxicity and low-residue agricultural pesticides must be developed (Article 21). It points out that the amount of permissible harmful gases and dust in the working environment must conform with the standards for industrial hygiene specified by Chinese law (Article 22) and registration and control of toxic chemicals must be strictly adhered with. Highly toxic substances must be securely contained to prevent leakage during storage and transportation (Article 24).

Maximum Allowable Concentration

In order to ensure human health, to prevent contamination from chemicals, in 1956 the Chinese government promulgated the ''Health Standard for Industry and Enterprise Design,'' which has been revised in 1961 and 1979. The maximum allowable concentration (MAC) of 111 harmful chemicals in the atmospheres

of factories has been specified in this document (TJ 36-79); additional associated material gives the MACs of toxic chemicals in the workplace atmosphere. The 35 MACs of chemicals that are ambient air pollutants and the 53 MACs of substances harmful to surface water have been prescribed.

Occupational Health Standard Subcommittee, China National Technical Committee of Health Standards (1990). *Maximum Allowable Concentrations for Chemical Substances and Permissible Exposure Limits for Physical Agents at the Workplace (1979–1989).*

Sanitary Standard for Lead and its Inorganic Compounds in the Atmosphere, GB 7355-87

In recent years, MACs of chemicals in soil have been established in China; for example:

Hygiene Standard for Arsenic in Soil, GB 8915-88
Hygiene Standard for Copper in Soil, GB 11728-89

For health purposes, the Ministry of Public Health enacted the ''Health Standards for Drinking Water'' in 1956. In 1985, the standards were revised and reviewed; the new edition takes into account achievements in environmental medicine and practical experience. It contains a list of exposure limits for the 15 toxic chemicals addressed in 1985. This standard plays a unique role in helping to provide safe water for people all over the country as well as preventing the spread of waterborne diseases. Promoted by the International Drinking Water Campaign (International Drinking Water Supply and Sanitation Decade 1981–1991, WHO), rural water supplies in China were improved on the basis of this standard.

Hygiene Standards for Drinking Water, GB 5749-85
Hygiene Standard for Beryllium in Drinking Water Sources, GB 8161-87

Provisional Law of the People's Republic of China on Food Hygiene

The Provisional Law of the People's Republic of China on Food Hygiene was adopted in 1982. The major aims were to ensure good food hygiene, to prevent the contamination of foods and the presence of factors that are harmful to human health, to guarantee the physical health of the people, and to strengthen the physique of the whole population. This law provided for the prohibition of the production and handling of foods containing toxic or harmful substances or that have been contaminated by toxic or harmful substances, which could be deleterious to human health. The production, handling, and use of food additives must meet the hygienic standards and regulations governing the use of food additives.

Hygiene Standards for Cosmetics (GB 7916-87)

In recent years, the production and use of cosmetics has been increased. The Ministry of Public Health and the Ministry of Light Industry have promulgated national regulations for the control and evaluation of the safe use for human health for cosmetics. This document includes a list of substances banned for use in cosmetics, allowable application rates, limited use conditions, required explanations for labels, and allowable concentrations for preservatives in cosmetics.

Classification of Health Hazard Levels from Occupational Exposure to Toxic Substances (GB 5044-85)

This standard is used for the classification of health hazards resulting from occupational exposure to toxic substances. It is a basic standard in the scientific management for labor protection.

Definition

Toxic substances to which the labor forces may be occupationally exposed include substances present in raw materials, final products, semi-final products, intermediate products, by-products, and impurities that could enter the human body during preparation via the respiratory tract, skin, and oral route and cause hazards to health.

Principles

The classification of health hazards resulting from occupational exposure is carried out according to the following six criteria: acute toxicity, adverse effects resulting from acute intoxication, adverse effects during chronic intoxication, consequences of chronic intoxication, carcinogenicity, and MAC.

The principle of the classification is to carry out comprehensive comparisons and overall assessments; the classification is subject to the results of the assessment by the majority of the six criteria. However, for certain toxic substances, classification could be made according to the major hazardous criteria, such as acute toxicity, chronic toxicity, or carcinogenicity.

Basis

Acute Toxicity. The LC_{50} lowest value was obtained after inhalation or LD_{50} after skin and oral exposure in animals was used to assess the acute toxicity.

Observations from Acute Intoxication. This is a qualitative criterion that includes the frequency and

outcome of acute intoxication and is further divided into four levels, i.e., often, sometimes, rare, and never.

Evidence during Chronic Intoxication. In principle, this is assessed by the incidence rate for chronic intoxication for highly exposed workers. If the incidence rate for chronic intoxication is not available, the incidence rate of intoxication symptoms or signs can be used.

Outcome of Chronic Intoxication. After the cessation of exposure, the outcome is divided into four levels, i.e., progressive, non-curable, curable, and spontaneous recovery. Using the results from animal experiments the outcome was also assessed according to the characteristics of lesions (progressive, non-reversible, or reversible) and the pathological-physiological characteristics of the target organs (repair, regeneration, or functional conservation).

Carcinogenicity. According to the International Agency for Research on Cancer (IARC) publications or other well-accepted carcinogenicity data, this is divided into human carcinogens, suspected human carcinogens, animal carcinogens, and noncarcinogens.

Maximum Allowable Concentration. This is assessed according to the Hygienic Standards, i.e., MAC for Toxic Substances in the atmosphere of the workplace.

The degree of health hazard resulting from occupational exposure to toxic substances is classified as extreme hazard, high hazard, medium hazard, and slight hazard.

Classification for Different Professions

According to this classification standard (GB 5044-85), the health hazards resulting from occupational exposure to 56 common toxic substances in China were classified.

The health effects of the same toxic substances used in professions were assessed according to their atmosphere concentrations in the workshop, incidence of poisoning, and duration of exposure. If the atmosphere concentration in the workshop often exceeds the MAC of the Hygiene Standard, but the incidence of poisoning or symptoms is less than the corresponding value for this classification standard, the classification could be lowered by one order of magnitude.

When workers are exposed to a number of toxic substances, it was classified according to the health effects resulting from the most hazardous toxic substance.

Health Protection Zone Standards for Industrial Premises, Part 1 (GB 11654-11666-89)

Guidelines

A standard is used to determine the health protection zone between industrial premises and residential areas in order to protect human health and the environmental quality of the atmosphere in residential areas.

This standard is used when building new industrial premises and for reconstruction projects in plains and slightly hilly areas. The existing relevant industrial factories should conform to this standard. In complex topographical areas the establishment of health protection zones would be made in accordance with a comprehensive environmental quality evaluation assessment. The authority responsible for industrial premises should discuss and determine the requirements for adequate public health and environmental assessment.

The industrialist should adopt effectively the progressive economic and rational production technologies and equipment requirements for controlling environmental aspects, and management and maintenance must be strengthened in order to accomplish these requirements. In addition, the irregular emissions of wastes must be decreased to a minimum. The concentrations of environmental pollutants from chimneys must comply with the State Standards.

In order to determine a health protection zone the following factors should be considered: wind direction, wind speed, and topographic position, etc., in order to reduce the level of atmospheric pollution in residential areas to the lowest practical value.

Terminology

Health Protection Zone means the minimal distance between the boundary of the factory, producing harmful emissions and the boundary of the residential area.

Standard Content

The Health Protection Zone standards for various types of industrial operations are determined using average wind speeds in the local area over the past 5 years and the specific levels of production of the relevant plants.

To establish a Health Protection Zone Standard (GB 8195-87) for oil refineries, the scale of production of the industrial plants and the concentration of sulfur in the raw oil are considered in addition to average wind speeds in the local area over the past 5 years and the specific levels of production of the relevant plants.

Chinese Academy of Preventive Medicine (CAPM)

In order to implement the Chinese national health policy of ''Put prevention first'' and to raise the efficiency in public health practice, including environmental protection, the Chinese State Council approved the establishment, within the Ministry of Public Health, of the Chinese Academy of Preventive Medicine (CAPM) in 1983. The five basic tasks of CAPM are summarized as follows:

To carry out fundamental and applied research on preventive medicine and coordinate preventive medicine research programs throughout the country

To provide technical assistance to the provincial health institutions and train public health professionals for the provinces

To engage in surveillance, monitoring, and supervision of health and epidemic prevention and to produce quarantine programs

To develop the scientific basis for establishing regulations, criteria, and appropriate public health priorities and policies

To collect, retrieve, analyze, review, and exchange information on preventive medicine

Currently, within CAPM, there are eight institutes:

Institute of Parasitic Diseases
Institute of Virology
Institute of Epidemiology and Microbiology
Institute of Occupational Medicine
Institute of Nutrition and Food Hygiene
Institute of Environmental Hygiene and Engineering
Institute of Environmental Health Monitoring
Institute of Food Safety Control and Inspection

Except for the Institute of Parasitic Diseases, which is located in Shanghai, all of the institutes are in Beijing.

CAPM is the research center, technical assistance center, and training center in the field of preventive medicine in China; its activities play a significant role in environmental medicine and occupational medicine.

National Committee for Health Standards

In order to improve the authority and scientific level of the standard of health, the National Committee for Health Standards (NCHS) was established under the Ministry of Public Health in 1981. It is a scientific and technical committee. The basic tasks of NCHS are to evaluate the health criteria for harmful substances and to make proposals and suggestions for the guidelines, policies, research plans, and programs for national health standards and regulations. NCHS consists of experts, including hygienists, toxicologists, chemists, physicians, and engineers. NCHS includes the following subcommittees:

Occupational Health Standard Subcommittee
Environmental Health Standard Subcommittee
Food Hygiene Standard Subcommittee
Diagnostic Criteria of Occupational Diseases Subcommittee
Radiation Hygiene and Protection Subcommittee
Diagnostic Criteria of Radioactive Diseases Subcommittee
Diagnostic Criteria of Infectious Diseases and Disinfection
Subcommittee
Diagnostic Criteria of Endemic Diseases Subcommittee

The NCHS's major requirement is the provision of adequate health standards. The second is to take into consideration the most feasible and cost-effective methods for improving health standards. Full use must be made of technical and advanced scientific achievements from abroad, the employment of past experience from experimental work and field observations, and the study of existing standards issued by the same developed countries.

Under the Ministry of Public Health there are sanitary antiepidemic stations including a reasonably complete system of public health in China, which was established in the 1950s at provincial and municipal levels. According to the 1990 Chinese medical statistical data, the total number of sanitary antiepidemic stations is 3618 at various levels. In addition to the above there are institutes of labor hygiene and occupational disease in many provinces and cities. Investigation and monitoring of the adverse effects of toxic chemicals on humans to supervise and control the implementation of relevant health standards, and to prevent chemical poisoning due to potentially toxic chemicals, are the major tasks of sanitary antiepidemic stations and institutes of labor hygiene and occupational disease.

National Environmental Protection Agency

The National Environmental Protection Agency (EPA) was established at the end of the 1970s. In recent years, certain environmental quality standards have been promulgated by the Chinese EPA, including:

Ambient Air Quality Standard (GB 3095-82)
Surface Water Quality Standard (GB 3838-88)

Comprehensive Emission Standards for Pollutants from Industrial Premises (GB 8978-88)

These standards play an important role in environmental protection programs in China.

There is also an EPA system at provincial and municipal levels. It consists of regional EPAs, institutes of environmental protection, and the environmental monitoring stations. These organizations also have a significant function in the control of the safe use of toxic chemicals and reduction in potentially toxic chemicals in the environment.

A general introduction on pesticides, environmental pollution, and human health in China, and relevant information concerning risk assessment of chemicals in the environment in China, is included in the following publications:

Li, S. (1988). An epidemiological approach for the risk assessment of chemicals causing human cancer and other disorders. In *Risk Assessment of Chemicals in the Environment* (M. L. Richardson, Ed.), pp. 207–221. Royal Society of Chemistry, London.

Li, S. (1991). Pesticides, environmental pollution and human health in China. In *Chemistry, Agriculture and the Environment* (M. L. Richardson, Ed.), pp. 389–409. Royal Society of Chemistry, Cambridge, UK.

Egypt

LAILA A. M. ABD EL-MEGID AND EL-SAYED M. SALEM

BOOKS

Abdel-Aziz, M. A. (1978)
Man and Environment
Arab League Educational, Cultural, and Scientific Organization in cooperation with UNEP, Cairo

Abdel-Aziz, M. A.
Environmental Education: A Source Book for Environmental Education for Higher Institutes and Universities
Cairo University, Faculty of Science, Cairo
ISBN 977-7191-11-1

Summary of contents: Man and environmental requirements, ecosystem deterioration due to man's activities, environmental resources and pollution in the Arab world, environmental adverse effects in relation to agricultural development, problems of city pollution and urban communities, and legislation concerned with protection of the environment from the toxic effects of pollutants and the natural imbalance.

Abd El-Megid, L. A. (1999)
Postgraduate Clear Clinical Toxicology
Alexandria Univ. Press, Alexandria

Abd El-Megid, L. A., and Salem, E. M. (1999)
Protocol Manual for the Management of Common Acute Poisoning
Alexandria Univ. Press, Alexandria

Abd El-Megid, L. A., and Salem, E. M. (1999)
Compilation in Forensic Medicine and Toxicology: Part 1, Forensic Medicine; Part 2, Toxicology (Clinical, Environmental, Experimental, Genetic, Occupational)
Alexandria Univ. Press, Alexandria

Contains scientific papers written by Egyptian and Arab scientists during the past 40 years.

Abd El-Megid, L. A., Salem, E. M., and Metwally, H. (1997)
Forensic Medicine and Toxicology. Museum Specimens Comments, Question, and Problem Solving
Alexandria Univ. Press, Alexandria

El Dakhakhney, A. A. (1983)
Final Report on Air Pollution in Alexandria
Academy of Scientific Research and Technology, Cairo

El-Husseiny, K. M. (1993)
Essentials of Toxicology
Assiut Univ. Press, Assiut

El-Sebaie, A. K. (1966)
Chemistry and Toxicology of Pesticides
Dar El-Maaref Press, Cairo

Targeted for postgraduate students. It deals with pest control measures; formulation and application of pesticides; evaluation of pesticidal efficiency; structure and mode of action of pesticides; classification of insecticides, plant origin insecticides, organochlorine insecticides, organophosphorous ester insecticides, carbamates and oxime carbamates, mineral oils, and fumigants, mechanism of pest resistance, integrated pest management, and rationalization of the use of pesticides; synergism, potentiation, and antagonism of pesticide combinations; and structure and mode of action of fungicides, herbicides, rodenticides, and molluscicides. Principles for safe use of pesticides.

El-Sebaie, A. K., Ibrahim, M., Shaker, N., and Saber, N. (1987)
Principles in Pesticide Use and Pest Control
El-Shenhaby Center Press, Alexandria

El-Shishtawi, M. (1995)
Days of Health and Illness
El-Akida Press, Oman

El-Zayat, M. A., *et al.* (1984)
Pollution from Industrial Plants in Alexandria
El-Marwa Press, Alexandria

Gamal El-Din, A. A. (1994)
Basics of Forensic Medicine and Toxicology
Cairo Univ. Press, Cairo

Hefnawi, M. S., and El-Hawari, S. S. (1995)
GLC and HPLC
Cairo Univ. Press, Cairo

Concerned with the techniques and methods of analyzing and detecting toxins by gas liquid chromatography and high-performance liquid chromatography.

Hendi, Z. (1993)
Pest Control
Ain Shams Univ. Press, Cairo.

Ibrahim, M., Shaker, N., Abd El-Ghany, M., and Saber, N. (1988)
Pest Control
El-Shenhaby Center Press, Alexandria

Salem, E. M. (1994)
Compilation in Environmental Studies
Medical Research Institute Press, Alexandria

Contains more than 35,000 scientific papers concerning pollutants, pollution, toxins, toxicants, poisoning, etc. All of these papers are written by Egyptian and Arab scientists who shared in the different symposia, conferences, seminars, and workshops which were held in Egypt during the past 30 years. All these papers were published either in the Egyptian or foreign scientific journals. Offered as a printed book (600 pages) or on computer diskettes.
P.O. Box 525
Manshia-21111, Alexandria, Egypt
e-mail: Prof_Salem@Hotmail

Wagih, I. M. (1994)
Essentials of Toxicology
Mansoura Univ. Press, Mansoura

PROCEEDINGS

Dewidar, M. L. (Ed.) (1973)
Proceedings of the First Scientific Conference on Environmental Pollution, May 8–10, 1973
Alexandria Univ. Press, Alexandria

Summary of contents: Water pollution and the impact of pollutants on the toxic effects to humans; air pollution problems, monitoring programs, toxic effect; and food contamination with pesticide residues and other toxicants.

El-Samara, G. H. (Ed.)
Proceedings of the Arab Symposium on Pollution

Summary of contents: Air and water pollutants, pesticide pollution by industrial wastes, biomagnification, and biodegradation—hazards to nontarget organisms; pollution by radioisotopes and radiation and their adverse effects on humans and environment.

There are also proceedings on conferences, congresses, symposia, and workshops that have been published in the *Compilation of Environmental Studies* by Dr. E. M. Salem (e-mail: Salem@dataxprs.com.eg).

Egyptian Proceedings in English

Proceedings of the International Conference on Environmental Hazards of Agrochemicals in Developing Countries
Alexandria University, November 8–12, 1983 (2 vols.)

Proceedings of the International Egyptian–German Seminar on Environment Protection from Hazards of Pesticides
Alexandria University, March 24–29, 1979

Proceedings of the International Symposium on Hazards of Pesticides to the Environment and Human Health
Alexandria University, November 1–3, 1978
Alexandria University in collaboration with USEPA
(J. Environ. Sci. Health **15B**(6), 611–1236, 1980)

Proceedings of the 2nd International Congress of Legal Medicine, Toxicology and Forensic Sciences
Cairo, December 13–16, 1994

Proceedings of the 3rd Congress of Toxicology in Developing Countries Together for Immune and Environmental Welfare
Cairo, November 19–23, 1995
Prof. Dr. Samih Mansour, Professor of Pesticide Chemistry (Ed.)., National Research Center, Dokki, Cairo, Egypt.

Proceedings of the UC/AID–University of Alexandria, ARE, Seminar/Workshop in Pesticide Management March 5–10 (1977)
Alexandria Univ. Press, Alexandria.

Proceedings of USA–Egyptian Seminar on Environmental Management
Cairo University, March 1982

JOURNALS

Many of the Egyptian scientific journals related to the different Egyptian faculties of agriculture, medicine, pharmacy, science, veterinary medicine, etc. publish scientific papers and research concerning topics such as toxins, toxicants, toxicity of chemicals, poisoning, and toxicology.

Ain Shams Medical Journal (1949–)
Ain Shams Faculty of Medicine, Ain Shams Univ. Press, Abassia, Cairo

Ain Shams Science Bulletin (1954–)
Ain Shams Faculty of Science, Abassia, Cairo

Al-Azhar Agriculture Research Bulletin (1963–)
Al-Azhar Faculty of Agriculture, Al-Azhar University

Al-Azhar Dental Journal (1985–)
Al-Azhar Faculty of Dental Medicine, Al-Azhar University, Nasr City, Cairo

Al-Azhar Medical Journal (1951–)
Al-Azhar Faculty of Medicine, Al-Azhar Univ. Press

Alexandria Dental Journal (1980–)

Alexandria Engineering Journal (1961–)
Faculty of Engineering

Alexandria Journal of Agriculture Research (1952–)

Alexandria Journal of Communication in Science and Developmental Research (1963–)

Alexandria Journal of Pediatrics (1987–)
Alexandria Faculty of Medicine, El-Shatby Children's Hospital, Alexandria

Alexandria Journal of Veterinary Science (1985–)

Alexandria Medical Journal (1958–)
Alexandria Medical Association, 4 Giosue Carducci Street, Alexandria

Alexandria Science Exchange (1979–)

Alexandria University Journal of Veterinary Medicine (1985–)

Assiut Medical Journal (1973–)

Assiut Veterinary Medical Journal (1968–)

Benha Medical Journal (1983–)

Benha Veterinary Medical Research Journal (1990–)

Benha Veterinary Medicine Journal (1990–)

Bulletin of Alexandria Faculty of Medicine (1964–)
Alexandria Faculty of Medicine

Bulletin of Faculty of Pharmacy (1961–)
Cairo University

Bulletin of Faculty of Science (1958–)
Alexandria University

Bulletin of Faculty of Science (1983–)
Assiut University

Bulletin of Faculty of Science (1973–)
Mansoura University

Bulletin of Faculty of Science (1978–)
Zagazig University

Bulletin High Institute of Public Health (1970–)
High Institute of Public Health, El-Hadara, Alexandria

Bulletin National Research Center (1975–)
Cairo

Bulletin National Institute of Oceanography and Fisheries (1974–)
Academy of Scientific Research and Technology

Bulletin of Nutrition Institute (1980–)

Communications in Science, Development and Research Journal (1957–)
Faculty of Agriculture, Prof. Dr. Balba, Alexandria University

Delta Journal of Science (1976–)
Faculty of Science, Tanta

Egyptian Journal of Chemistry, National Information and Documentation Center
Academy of Scientific Research and Technology, Tahrir Street, Dokky, Giza, Egypt

Egyptian Journal of Community Medicine (1984–)
Egyptian Association of Community Medicine, Giza Square, Amin Building, Flat 32, Giza, Egypt

Egyptian Journal of Occupational Medicine (1969–)
Cairo Univ. Press, Cairo

Egyptian Journal of Pharmacology (1970–)
National Commitee of Pharmacology, Academy of Scientific Research and Technology, Cairo

Egyptian Journal of Veterinary Sciences (1963–)
Faculty of Veterinary Medicine, Cairo University

El-Minia Medical Bulletin (1990–)
El-Minia Faculty of Medicine

Journal of the Egyptian Medical Association (1917–)
Egyptian Medical Association, 42 Kasr El-Aini Street, Cairo

Journal of Egyptian Public Health Association (1925–)
Shousha Bldg. Block (A), App. 116, 26 Juli Street, Cairo

Journal of Egyptian Society of Toxicology (1984–)
Egyptian Society of Toxicology, Faculty of Pharmacy, Cairo University

Journal of the Medical Research Institute (1979–)

Mansoura Journal of Forensic Medicine and Clinical Toxicology (1992–)
Department of Forensic Medicine and Toxicology, Mansoura Faculty of Medicine, University of Mansoura, Mansoura

Mansoura Journal of Pharmaceutical Sciences (1980–)
Faculty of Pharmacy, University of Mansoura, Mansoura

New Egyptian Journal of Medicine (1986–)
Medical Information and Publishing Centre (MIPC), Egyptian Junior Medical Doctors Association (EJMDA), 27 El-Dokki Street, App. 5, Giza

Tanta Medical Journal (1976–)
Faculty of Medicine, Tanta University, Tanta
Alexandria University
Alexandria, Egypt

ORGANIZATIONS

Ain Shams Poison Control Center
Faculty of Medicine, Ain Shams University
Abbasia, Cairo, Egypt
Director: Prof. Dr. Asem Badawi
Professor of Clinical Toxicology

In addition to the clinical care services offered to patients suffering acute poisoning, there is a data bank containing data on toxins, toxic substances and materials, toxicity of drugs, etc. Founded in 1981.

Alexandria Poison Center
Faculty of Medicine, Alexandria University
Director: Prof. Dr. Laila A.M. Abdelmegid
Professor of Clinical Toxicology
P.O. Box 525
Manshia-21111
Alexandria, Egypt
Phone: 0203-4822244
E-mail: Prof_Salem@Hotmail

In addition to the clinical care services offered to patients suffering acute poisoning, there is a data bank containing data on toxins, toxic substances and materials, toxicity of drugs, etc. Founded in 1979, it gives information for doctors, pharmacists, and the public.

Cairo Poison Center
Faculty of Medicine, Cairo University
Giza, Cairo, Egypt
Director: Prof. Dr. Abobakr M.

Founded in 1991. Not yet functioning.

The Egyptian Society of Toxicology
President: Prof. Dr. Essam Galal
Faculty of Medicine, Cairo University
Giza, Cairo, Egypt

National Committee of Toxicology
Affiliated with the Egyptian Academy of Scientific Research and Technology
Cairo, Egypt

Activities started in 1982; member of IUTOX.

SCOPE National Committee in Egypt
In collaboration with MAB National Committee
International Toxicology Officer of the Committee: Dr. A. H. El-Sebaie
Faculty of Agriculture

EDUCATION/SCHOOLS

All Egyptian medical and pharmacy faculties provide courses in medical toxicology either undergraduate courses in the fourth academic year or postgraduate courses as partial fullfilment of the requirements for the master or doctoral degrees (MSc and MD).

Faculty of Medicine, Ain Shams University
Abbasia, Cairo, Egypt

Faculty of Pharmacy, Ain Shams University
Abbasia, Cairo, Egypt

Faculty of Medicine (Boys), Al-Azhar University
Cairo, Egypt

Faculty of Medicine (Girls), Al-Azhar University
Cairo, Egypt

Faculty of Pharmacy, Al-Azhar University
Cairo, Egypt

Faculty of Medicine, Alexandria University
Alexandria, Egypt

Faculty of Pharmacy, Alexandria University
Alexandria, Egypt

Faculty of Medicine, Assiut University
Assiut, Egypt

Faculty of Pharmacy, Assiut University
Assiut, Egypt

Faculty of Medicine, Benha University
Benha, Egypt

Faculty of Pharmacy, Benha University
Benha, Egypt

Faculty of Medicine, Cairo University
Cairo, Egypt

Faculty of Pharmacy, Cairo University
Cairo, Egypt

Faculty of Medicine, El-Menia University
El-Menia, Egypt

Faculty of Pharmacy, El-Menia University
El-Menia, Egypt

Faculty of Pharmacy, El-Menoufia University
El-Menoufia, Egypt

Faculty of Medicine, El-Menoufia University
El-Menoufia, Egypt

Faculty of Medicine, Sohag University
Sohag, Egypt

Faculty of Pharmacy, Sohag University
Sohag, Egypt

Faculty of Medicine, Tanta University
Tanta, Egypt

Faculty of Pharmacy, Tanta University
Tanta, Egypt

Also, faculties of agriculture and science in the Egyptian universities teach toxicology in their different academic departments as

Academy of Science and Technology

Pesticide Division, Faculty of Agriculture, Ain Shams University
Cairo, Egypt

Pesticide Division, Faculty of Agriculture, Alexandria University
Alexandria, Egypt

Pesticide Division, Faculty of Agriculture, Assiut University
Assiut, Egypt

Pesticide Division, Faculty of Agriculture, Cairo University
Cairo, Egypt

Pesticide Division, Faculty of Agriculture, Tanta University
Tanta, Egypt

LIBRARIES

Many libraries contain textbooks and periodicals that are concerned with toxicology.

Alexandria University Central Library
El-Shatby
Alexandria, Egypt

American Cultural Center
El-Pharana Street
Alexandria, Egypt

British Council Library
El-Batalsa Street
Alexandria, Egypt

Data Bank
c/o Prof. Dr. Salem, UNARC
P.O. Box 525
Manshia-21111
Alexandria, Egypt

High Institute of Public Health
El-Hadara, Alexandria, Egypt

Institute of Graduate Studies and Research Library
El-Hadara, Alexandria, Egypt

Medical Research Institute Library
El-Hadara, Alexandria, Egypt

National Research Center
Dokki, Cairo, Egypt

World Health Organization
EMRO, Alexandria, Egypt

RESEARCH LABORATORIES

Alexandria Poison Center
P.O. Box 525
Manshia-21111
Alexandria, Egypt

High Institute of Public Health
El-Hadara, Alexandria, Egypt

Institute of Graduate Studies and Research
Alexandria, Egypt

Ministry of Justice, Department of Forensic Medicine and Toxicology
Alexandria, Egypt

National Institute of Oceonography and Fisheries, Qait Bay
Alexandria, Egypt

Finland

HANNU KOMULAINEN

BOOKS

Santalahti, P., Oroza, V., Laakia, R., Koivusalo, M., and Hemminki, E. (Eds.) (1991)
Auto, terveys, ympäristö (*Car, Health, Environment*)
Gaudeamus, Helsinki
ISBN 951-662-530-4

A multidiscipline analysis by university scientists on traffic and the use of cars in modern society. The book reviews popular level health effects of exhaust fumes and fuels and environmental effects of traffic and the maintenance of roads.

Advisory Committee on Chemicals (1994)
Chemicals Control in Finland
Advisory Committee on Chemicals, Helsinki
ISBN 952-9597-29-0

Describes in brief control of chemicals and the related legislation in Finland (in English).

Salminen, S., and von Wright, A. (Eds.) (1985)
Elintarvikelisäaineet, käyttö ja turvallisuus (*Food Additives, Their Application and Safety*)
Weilin & Göös, Espoo
ISBN 951-35-3247-X

Review on food additives intended for university students interested in food chemistry, food toxicology, toxicology, and medicine. The subjects deal with the characterization, exposure, kinetics, mutagenicity, carcinogenicity, and allergenic properties of food additives. The structure–activity relationships, toxicity, and risk evaluation of these compounds have also been addressed.

Louekari, K., Salminen, S., and von Wright, A. (Eds.) (1995)
Elintarvikkeiden turvallisuus (*Safety of Food*)
Otatieto Oy, Helsinki
ISBN 951-672-193-1

A textbook for students of nutrition and food industry and a handbook for authorities monitoring food safety. The subjects include food additives, food contaminants, interactions between nutrients and contaminants, natural toxins in food, pesticide residues, and monitoring of food safety.

Pyötsiä, J. (1992)
Euroopan yhteisöjen kemikaalilainsäädäntö ja Suomi (*Legislation of European Union on Chemicals*)
Kemian Keskusliitto, Helsinki
ISBN 952-9597-15-0

A book on legislation in the European Union (EU) in the trade and use of chemicals in Finland. Describes the structure of the EU legislation, and it contains lists of pertinent directives and other regulations and how they are to be interpreted. Aimed at the chemical industry and chemical control authorities but may also be used as a reference material for teaching.

Koulu, M., Tuomisto, J., and Paasonen, M. K. (Eds.) (1996)
Farmakologia ja toksikologia (*Pharmacology and Toxicology*), 5th ed.
Kustannusosakeyhtiö Medicina, Kuopio
ISBN 951-97316-0-1

This textbook is the first comprehensive presentation of pharmacology in the Finnish language aimed especially at students of medicine and pharmacists. It contains basics of toxicology as separate sections; altogether there are 120 pages including principles of toxicology, organ toxicity, mutagenicity, carcinogenicity, teratogenicity, and evaluation of toxicity. Toxicity of drugs, alcohols, solvents, carbon monoxide, metals, and pesticides have been dealt with in more detail in separate chapters, as has occupational toxicology.

Aitio, A., Luotamo, M., and Kiilunen, M. (Eds.) (1995)
Kemikaalialtistumisen biomonitorointi (*Biological Monitoring of Chemical Exposure*)
Institute of Occupational Health, Helsinki
ISBN 951-802–077-9

A handbook on biological monitoring of industrial chemicals. Describes general principles of biological monitoring and contains monitoring methods for 60 chemicals or groups of chemicals. Each entry includes a short description of the chemical, its synonyms, use and exposure, occupational TLVs, short summary on

toxicokinetics and harmful effects, recommendations on sampling and the frequency of biomonitoring, sources of error, methods for analyses, range of normal values, and interpretation of the results. Contains a short English summary on each agent. The same text is available as a file on TURVA-CD-ROM and is planned to be updated yearly.

Pyötsiä, J. (1996)
Kemikaalilaki. Opas valmistajille ja käyttäjille (*Legislation on Chemicals in Finland*), 3rd ed.
Kemianteollisuus ry, Helsinki
ISBN 952-9597-31-2

Contains the current national legislation on chemicals, the Chemical Act, and the regulations based on it.

Nikunen, E., Miettinen, V., and Tulonen, T. (Eds.) (1986)
Kemikaalien myrkyllisyys vesieliöille (*Toxicity of Chemicals to Aquatic Organisms*)
Ministry of the Environment, Helsinki

An extensive compilation of toxic responses observed in various species of aquatic organisms. The number of listed compounds exceeds 1000.

Nikunen, E., Leinonen, R., and Kultamaa, A. (1990)
Kemikaalien ympäristöominaisuuksia (*Environmental Properties of Chemicals*) Research Report 91
Ministry of the Environment and VAPK-Publishing, Helsinki
ISBN 951-37-0315-0, ISSN 0784-8129

The report contains environmental information on more than 1700 substances based on scientific papers and other material accessible to environmental authorities. The substances are clean natural substances, industrial chemicals, or commercially marketed product compounds. The main content is data on toxicity to different species, especially to aquatic species, and persistance and accumulation in the environment. The same information is in Finnish and English. The updated version is available in electronic form in the database Ympäristötietojärjestelmä.

Riihimäki, V., Jauhiainen, M., and Laamanen, I. (1993)
Kemikaaliturvallisuuden tiedonlähteet (*Information Resources on Chemical Safety*)
Institute of Occupational Health, Helsinki: Reviews 127

A short compilation of information resources in toxicology. The booklet describes what kind of information is available on chemicals, how the information has been produced, and how it should be interpreted. It also provides advice, where the information is available, on how to start the search in practice. The most important Finnish and foreign data banks, expert organizations, books, monographs, journals, and other sources of information have been listed and a short description of the contents is included.

Neuvonen, P. J., Himberg, J.-J., Iisalo, E., Mattila, M., and Ylitalo, P. (Eds.) (1994)
Kliininen farmakologia (*Clinical Pharmacology*)
Kandidaattikustannus Oy, Helsinki
ISBN 951-8951-09-08

The first Finnish textbook in clinical pharmacology also containing clinical toxicology. The most common acute poisonings of drugs and their treatments have been described as well as poisoning with ethanol, carbon monoxide, solvents, cyanide, and some pesticides. Poisoning with toxic plants, mushrooms, and animal poisons have also been addressed.

Pyötsiä, J., Penttilä, P.-L., Salminen, S., and Palmunen, T. (Eds.) (1988)
Kotiympäristön kemialliset vaarat (*The Chemical Dangers of the Home Environment*), 2nd ed.
Weilin & Göös, Espoo
ISBN 951-35-4514-8

This book deals with the poisons and chemicals used at home. The book is intended for laypeople, especially families with children and allergic persons. The contents of some of the short chapters include general toxicology (mechanisms of carcinogenicity and hypersensitivity, toxicity testing of chemicals, and first aid for poisoning). The topics include poisons and chemicals used in the home, contaminants of ambient air, water as a source of chemicals, food additives, pesticides residues in food, toxic chemicals borne in food preparation, natural poisons in food, purity of provisions, and dangers of toys. The book also gives a list of major important ingredients in chemicals used in the home environment.

Pelkonen, O., and Ruskoaho, H. (Eds.) (1995)
Lääketieteellinen farmakologia ja toksikologia
Kustannus Oy Duodecim, Helsinki
ISBN 951-8917-57-4

A textbook in pharmacology and toxicology for medical, dental, and pharmacy students. The book contains sections of general pharmacology, systematic pharmacology, and toxicology. The emphasis is on mechanisms of action of drugs. The section of toxicology (110 pages) covers general principles of toxicology, organ-specific toxicity, clinical toxicology, occupational toxicology, environmental toxicology, and evaluation of toxicity and risk assessment.

Laboratoriokemikaalien käyttöturvallisuustiedotteita (*Safety Data Sheets*) (1993)
Pro SL Oy, Turku

A compilation of safety data sheets provided by the manufacturers of chemicals and reviewed by the Occupational Safety and Health Division, Ministry of Labour. The chemicals are in alphabetical order and each entry contains information on classification of the chemical, safety instructions, components hazardous to health, physical–chemical properties, health risks, precautions in handling, and instructions for storage and disposal. Two volumes comprise altogether over 2000 pages. Available also as an electronic database.

Tuomisto, J. (1992)
Myrkynvihreä maailma (*This Our Poisonous World*)
Recallmed Oy, Helsinki
ISBN 951-9221-52-2

Essays from the view of risk assessment on topics of general and environmental toxicology. A compilation of invited lectures of one of the pioneer toxicologist in Finland. The representative topics include crisis in toxicology, new challenges of environmental toxicology, environmental cancer, health risks of energy production, and environmental research; science or polemic opinions.

Kinos, M., Mustonen, H., Paatela, A., Pohjalainen, T., and Vilska, J. (Eds.) (1992)
Myrkytystieto (*Clinical Toxicology*)
Kandidaattikustannus Oy, Helsinki
ISBN 951-8951-05-5

Clinical aspects to poisoning caused by drugs, mushrooms, chemicals, toxic plants, worms, snakes, and bees. General principles in treatment of acute poisonings.

Lähteenmäki, P., Nuutinen, T., and Parkkinen, P. (1996)
Ravintomme lisäineet (*Food Additives*)
Academica Kustannus Oy, Helsinki
ISBN 952-5046-01-X

A handbook on food additives for consumers; useful information also for professionals in nutrition and food safety control. Lists food additives and describes their sources and harmful health effects shown or suspected as well as control of food additives in Finland. Offers a key to interpret specifications in food products by presenting the food additives by their E-codes.

Mukula, J., and Salonen, J. (1990)
Rikkakasvien kemiallinen torjunta, Herbisidit ja niiden käyttö (*Herbicides and Their Use*), No. 81
Kasvinsuojeluseuran julkaisuja, Jokioinen

This booklet instructs on the use of herbicides, delineates the mechanisms of their action, and summarizes the characteristics of the most common herbicides used in Finland.

Nevalainen, T., Jaakkola, U.-M., Kohila, T., and Pudas, J. (Eds.) (1996)
Rottia Tutkijoita Tuloksia (*Rats Researchers Results*)
FinLAS ry, Helsinki
ISBN 952-90-7313-5

A textbook on laboratory animal science. Contains current national legislation on laboratory animals, planning of animal experiments, breeding, maintenance of animals and animal facilities, anesthesia and analgesia, laboratory animals by species, transgenic animals, and ethical issues in animal experiments.

Santti, R., and Tenovuo, R. (1988)
Terveys ja ympäristö (*Health and Environment*)
WSOY SHKS, Helsinki
ISBN 951-0-15013-4

A textbook for nurses on environmental medicine and health. The topics include chemical contamination of the environment, air pollution, impurities in water and food, noise, radiation, environmental diseases and accidents, and the organizations involved in the control of environmental health issues.

Hurme, M., Laakkonen, O., Kangas, J., Riihimäki, V., Liesivuori, J., and Härkönen, H. (1984)
Torjunta-aineet (*Pesticides*)
Publications Office, Institute of Occupational Health, Vantaa
ISBN 951-801-436-1

A booklet on the proper use and dangers of pesticides in Finland. The book emphasizes the occupational health aspects, especially toxicology, but there is also information on the legislation, chemistry, and proper use of more than 200 pesticide compounds. The book is targeted especially at persons who are responsible for the occupational health aspects of pesticides.

Paasivirta, J., and Rytsä, E. (1987)
Torjunta—ainekemia (*Chemistry of Pesticides*), 3rd ed.
Tekijät ja Otakustantamo, Helsinki
ISBN 951-672-009-9

A textbook on pesticides and pesticide chemistry for graduate students in science and agriculture and a handbook for those who work with pesticides. Contains thorough information on pesticides, including synthesis, chemical formulae, chemical properties, use, and toxicity. The current legislation on pesticides is also explained.

Kalliokoski, P., Pfäffli, P., Riihimäki, V., Starck, J., Vaaranen, V., and Helminen, P. (Eds.) (1992)
Työhygienia—työolot ja niiden parantaminen (*Occupational Hygiene—Better Working Environment*)

Institute of Occupational Health, Helsinki
ISBN 951-801-940-1

Contains information on occupational exposure to various chemicals and physical factors and presents ways to reduce the associated health risks.

Sorsa, M., Anttila, A., Hemminki, K., and Vainio, H. (Eds.) (1992)
Työperäinen syöpä, syyt ja torjunta (*Occupational Cancer, Causes and Prevention*)
Institute of Occupational Health, Helsinki
ISBN 951-801-891-X

This book reviews development of cancer, occupational exposures, and chemicals causing cancer, and recommended preventive measures to reduce the cancer by industrial chemicals. The occupations prone to high risk of cancer and the exposures considered carcinogenic to man have been listed.

Antti-Poika, M. (Ed.) (1993)
Työperäiset sairaudet (*Occupational Diseases*)
Institute of Occupational Health, Helsinki
ISBN 951-801-945-2

A handbook and textbook on occupational diseases aimed principally at medical doctors interested in occupational medicine. The contents have been grouped by diseases. The symptoms, clinical findings, and diagnostic features of the diseases are followed by a detailed description of harmful effects of single chemicals. Exposure, kinetics, pathogenesis, clinical signs, treatment, prognosis, and prevention of the diseases have been considered. The book also contains several case reports of occupational diseases.

Wahlström, E., Reinikainen, T., and Hallanaro, E.-L. (Eds.) (1992)
Ympäristön tila Suomessa (*Finnish Environment*)
Vesi- ja ympäristöhallitus, ympäristötietokeskus and Gaudeamus, Helsinki
ISBN 951-662-523-1

The book describes comprehensively the current condition of the environment in Finland from several aspects. It provides basic information on energy production, agriculture, industry, traffic, waste disposal, and typical environmental problems and contaminants in Finland and their contribution to health and effect on the environment. The view is not only national but also includes a global and European perspective, particularly with contributions from other Scandinavian and Baltic countries to the contamination load in Finland.

Seppänen, H. (1994)
Ympäristönsuojelutekniikan perusteet (*Principles of Environmental Protection*), 2nd ed.
Otatieto, Helsinki
ISBN 951-672-134-6

A textbook on environmental protection for university students containing useful information on pollution emissions in Finland; also for toxicologists and ecotoxicologists. The topics include natural resources in Finland; emissions from industry, agriculture, forestry, and traffic; pollution of the environment and its health consequences; protection of water and air; and legislation of environmental issues in Finland.

Mussalo-Rauhamaa, H., and Jaakkola, J. J. K. (Eds.) (1993)
Ympäristöterveyden käsikirja (*A Handbook on Environmental Health*)
Kustannus Oy Duodecim, Helsinki
ISBN 951-8917-34-5

This book provides an introduction to assessment of environmental health problems and delineates the most relevant environmental health issues, including health effects of indoor and outdoor air pollution, impurities in food and drinking water, ionizing and nonionizing radiation, noise, and psychic effects of environmental catastrophes and accidents. Legislation and regulatory authorities related to environmental health issues have also been briefly described. Suitable as a textbook for university students on these issues.

SERIES OF MONOGRAPHS

Most governmental organizations and research institutes have one or more series of monographs which contain reports, reviews, and nationally relevant research data on their mandate. These series have not been listed here.

Työterveyslaitos (Ed.) (1990–1992)
Altisteet työssä (*Occupational Exposure in Finland*)
Finnish Institute of Occupational Health, Finnish Work Environment Fund, Helsinki
ISSN 0787-5940

Thirty-three separate monographs and their summary (No. 34) on occupational exposure of Finnish workers between 1980 and 1985. The series is based on a large research project of the Finnish Institute of Occupational Health on occupational exposure and biological monitoring. Each monograph contains data on a single or a group of related chemicals and includes physical–chemical properties, health effects and occupational diseases, threshold limits, use, exposure, and recommendations. A summary in Swedish is provided.

JOURNALS

ALARA (*Radiation Safety*)
Finnish Centre for Radiation and Nuclear Safety, Helsinki
ISSN 1235-1970

An information forum from the Finnish Centre for Radiation and Nuclear Safety for the professionals who use radiation and radioactive materials. Contains articles on health and environmental risks of radiation and nuclear power with a summary in English, facts on radioisotopes, and information on the national regulations on radioactive agents and nuclear power. Informs on study reports and publications of the institute. Four issues per year.

Duodecim (*Finnish Medical Journal Duodecim*)
The Medical Society Duodecim, Helsinki
ISSN 0012-7183

This is the oldest Finnish medical serial publication, founded in 1885. It is intended for medical professionals, especially physicians. Therefore, the primary purpose is to provide postgraduate scientific and vocational training for physicians. The journal publishes original articles, reviews, and case reports in all specialties of clinical medicine as well as articles of general interest on biomedicine and public health. Six special issues are normally published each year; 24 issues are published annually. Toxicology is among the topics covered in this journal's articles.

Kansanterveys (*Information Journal of National Public Health Institute*)
National Public Health Institute, Helsinki
ISSN 1236-973X

An information journal of the National Public Health Institute for professionals working in the public and environmental health care system from local government to ministries and other governmental institutes. Views of the institute on important current topics and short notes on the ongoing research in the institute in 10 yearly issues. Each issue summarizes the current situation of infectious diseases in Finland. The articles can also be accessed via the Internet (http://www.ktl.fi).

Kasvinsuojelulehti (*Plant Protection*)
Kasvinsuojeluseura, Jokioinen
ISSN 0355-0400

Most of the articles of this journal are devoted to plant diseases and their protection, but some of them contain information on the use and risks of pesticides. The decisions of the Plant Production Inspection Centre on the marketing of pesticides are provided in this journal. Four issues per year.

Kemia—Kemi (*Finnish Chemistry*)
Kemian Kustannus Oy, Helsinki
ISSN 0355-1628

This periodical is published once a month; 10 separate issues per year for Finnish chemists. Although widely read by leaders of industry, technical and scientific management, and purchasing managers, this journal is not a scientific journal, but a trade magazine that covers and reviews the news and developments in the field of the international and Finnish chemical trades and industry. As a closely related field, toxicology is also one of the topics of the periodical and the journal contains articles on analysis methods of chemicals.

Scandinavian Journal of Work, Environment and Health
Institute of Occupational Health in Finland, Helsinki in cooperation with National Institute of Occupational Health (Denmark), National Institute of Occupational Health (Norway), and National Institute for Working Life (Sweden)
ISSN 0355-3140

The Journal publishes original papers and review articles concerning occupational health and the work environment in the fields of medicine, toxicology, epidemiology, industrial hygiene, safety, ergonomics, sociology, psychology, and physiology. Six issues per year. The papers are indexed in leading index services.

Suomen lääkärilehti (*Finnish Medical Journal*)
Finnish Medical Association, Helsinki
ISSN 0039-5560

The Finnish Medical Association is a professional organization of physicians. The aim of the journal is to serve as an information medium for the association and its members in vocational questions and support the postgraduate training of physicians. The journal publishes articles mostly on diagnostics, treatment, and rehabilitation and articles concerning the practical work of physicians. Toxicology is not one of the main issues, but it is frequently dealt with, especially in the form of drug toxicity. The journal is published in 36 issues each year. Some of the issues are partly devoted to special subjects.

TABU (drug information from the National Agency for Medicines)
National Agency for Medicines, Helsinki
ISSN 1236-7427

Concentrates on problems of regulatory affairs of medicinal products. Contains the newest information on

side effects of drugs. Five issues per year. Summaries in English and Swedish.

Työ ja ihminen (studies from the Institute of Occupational Health)
Finnish Institute of Occupational Health, Helsinki
ISSN 0783-4098

Publishes scientific articles on occupational health research and is a forum for discussion of the science of occupational health with Swedish and English summaries. The periodical is aimed at all researchers and experts in this field in Finland and four issues are published each year.

Työ ja ihminen (study reports from the Institute of Occupational Health)
Finnish Institute of Occupational Health, Helsinki
ISSN 1237-6175
ISBN 951-802-122-8

This series publishes single large study reports on occupational health research as a supplement to *Työ ja ihminen* journal.

Työterveiset (news from the Institute of Occupational Health)
Finnish Institute of Occupational Health, Helsinki
ISBN 0359-1255

This journal reviews briefly the most topical work of the Institute of Occupational Health and informs on the courses to be organized and the books and other material produced by the institute. The target groups are other professionals keeping up to date with what is going on in the institute. Four issues per year.

Työterveyslaitos, Katsauksia (reviews, Finnish Institute of Occupational Health)
Finnish Institute of Occupational Health, Helsinki
ISSN 0357-4296

This series publishes summary reports and statistics related to regulatory duties of the Finnish Institute of Occupational Health as separate monographs. Examples of topics are statistics on workers handling occupational chemicals considered to cause cancer (ASA register) and occupational diseases in Finland. Data are published on a yearly basis. Some of the reports are also available on TURVA CD-ROM.

Työterveyslääkäri (*Occupational Medicine*)
Suomen Teollisuuslääketieteen yhdistys, Helsinki
ISSN 0780-2218

This journal is aimed at medical doctors and other professionals specializing in occupational health care. The topics cover different aspects of occupational health care, including effects of various occupational exposures to health of workers. Four issues per year.

Työ, terveys, turvallisuus (*Work, Health, Safety*)
Finnish Institute of Occupational Health, Helsinki
ISSN 0041-4816

A journal for all individuals interested in occupational health and safety. It is intended for persons responsible for occupational safety and health, government authorities, health care personnel, and interested workers. The topics cover all fields of occupational safety and health. The journal is published 15 times per year.

Ympäristö ja Terveys (*Environment and Health*)
Ympäristö-ja terveysalan tekniset, Kuntien terveystarkastajat, Ympäristösuojeluviranhaltijat, Helsinki
ISSN 0358-3333

A professional periodical for persons responsible for and interested in environmental and occupational health, as well as the hygiene of food in Finland. The readers are mainly state and communal authorities and persons responsible for environment and occupational protection in industry. The journal frequently publishes special issues, which occasionally cover toxicological issues. Ministries and governmental offices may publish official announcements in the journal. Ten issues every year.

DATA BANKS

KETU (Finnish Register of Chemical Products)
Ministry of Social Affairs and Health
Occupational Safety and Health Division
P.O. Box 536
FIN-33010 Tampere, Finland
Phone: (0)3-2608 111
Fax: (0)3-2608 511

KETU contains data on approximately 84,000 industrial chemical products and compounds registered in Finland. The data are based on information submitted by the manufacturers and importers according to the Chemical Act in the context of registration of the product. It contains information on classification of the chemical, safety instructions, components hazardous to health, physical–chemical properties, health risks, precautions in handling and instructions for storage and disposal, etc. The safety data sheets are based on the same information. Since some data may be confidential, access is restricted to authorities responsible for chemical control in consultation with the maintainer of the register, Ministry of Labour.

Laboratoriokemikaalien käyttöturvallisuustiedotteita (Safety Data Sheets)

Oy Tamro Ab
KEMIA
Rajatorpantie 41 B
FIN-01640 Vantaa, Finland
Phone: (0)9-8520 3802
Fax: (0)9-8520 1717

A Windows-based database of safety data sheets on chemicals in electronic form. Updated regularly.

LEO
Finnish Institute of Occupational Health
Information Service Centre
Topeliuksenkatu 41 a A
FIN-00250 Helsinki, Finland
Phone: (0)9-47 471

LEO is a reference list of all publications concerning occupational safety and health published since 1978 in Finland. The list contains more than 29,000 computerized references and it increases by about 1600 every year. The file contains all references from the institute's own journals, *Työ, terveys, Turvallisuus, Työ ja Ihminen*, and *Työterveiset*, and the *African Newsletter* on occupational health and safety and from the *Scandinavian Journal on Work, Environment* and *Health*. LEO also contains abstracts of some of those journals and complete articles of the *Työterveiset* journal. The major part of the material is published in Finnish, with only a small amount of English or Swedish. LEO is also on TURVA CD-ROM. It can be reached via Internet (home pages of the Information Service Centre) and by phone; the current charge for its use is FIM 1400 per year.

Linda
Automation Unit of Finnish Research Libraries
P.O. Box 26
FIN-00014 University of Helsinki, Finland
Phone: (0)9-70 851
Fax: (0)9-7539 514
Web: http://www.linda.helsinki.fi

A database of literature of 22 Finnish university libraries (over 200 library units) containing over 2.5 million references on books (since 1939), journals (since 1970), and series of monographs and reports, including toxicology, available at Finnish university libraries. It expands by 200,000 new references per year. Linda can be reached at university libraries all over the country and its use is free for students and university employees. It is available via a charge to other users through various networks.

Nordic Ecotoxicological and Toxicological Laboratories
Finnish Institute of Occupational Health
Topeliuksenkatu 41aA
FIN-00250 Helsinki, Finland
Phone: (0)9-47 471

A directory and a manual database on institutes and laboratories active in ecotoxicological and toxicological research in Scandinavia including laboratories in Finland launched by Nordic Co-ordination Group for the Development of Test Methods for Toxicology and Ecotoxicology (NORD-UTTE). Contains information on research topics, methods available, and services on a contract basis for industry.

Poison Control Center
Helsinki University Central Hospital
Department of Clinical Pharmacology
Stenbäckinkatu 11
FIN-00290 Helsinki, Finland
Phone: (0)9-4711
Fax: (0)9-4714 702

Information on poisoning by drugs, toxins, technochemical products, plants, and mushrooms for general public and hospitals open 24 hours a day. The center uses card indexes, accumulated during the past 30 years, and the databases POISINDEX, Tomes Plus, and Drugdex. The information is available on request by phone.

TORJUNTA-AINEREKISTERI (A register on pesticides)
Plant Production Inspection Centre (KTTK)
Pesticide Division
P.O. Box 42
FIN-00501 Helsinki, Finland
Phone: (0)9-134 211
Fax: (0)9-1342 1499

A register of about 300 pesticides in use in Finland. The file contains basic information on each pesticide, including health and environmental effects. The register is primarily intended for authorities responsible for pesticide control.

TURVA-CD
Oy EDITA AB
Kustannustoiminta
PL 700
FIN-00043 Helsinki, Finland
Phone: (0)9-56 601
Fax: (0)9-5660 380

A data bank containing 32 data files on health care and social and occupational health issues from 12 Finnish research (ALKO, TTL, and STUK), governmental (STM, OPM, TM, STAKES, KELA, TTK, and Tilastokeskus) or other organizations (TSR and Painatuskeskus) on a CD-ROM. The files contain various data

maintained by the organizations, including reference files of the libraries. For toxicologists the most relevant files are the register on carcinogenic chemicals (ASA), results of biomonitoring, causes of death, occupational diseases, and safety instructions on chemicals.

TYKI
Finnish Institute of Occupational Health
Information Service Centre
Topeliuksenkatu 41 a A
FIN-00250 Helsinki, Finland
Phone: (0)9-47 471

A data bank of the Information Center of the Finnish Institute of Occupational Health containing bibliographic data on all books, journals, series of monographs, reports, and standards available in the library since 1983. Altogether, there are over 23,000 references, many of them in English, Swedish, or German. The Information Service Centre publishes a list of the most recent material six times per year. TYKI is on TURVA CD-ROM and can be reached via Internet with a charge via the LEO data bank.

YMPÄRISTÖTERVEYDENHUOLLON TEKSTITIETOKANTA (Data bank on documents of environmental health authorities)
Ministry of Social Affairs and Health
P.O. Box 197
FIN-00531 Helsinki, Finland
Phone: (0)9-1601
Fax: (0)9-1604 492

This data bank collects statements and written opinions according to the mandate of the Ministry of Social Affairs and Health on various issues of public and environmental health as a text file. The contents include legislation, living, food, chemical control, radon, biocides, drinking water, pesticides, product control, and environmental health. The main users are municipal authorities, but it may contain useful information on single topics for experts in toxicology. Currently, its use is on a contract basis.

YMPÄRISTÖTIETOJÄRJESTELMÄ (A database on the Finnish Environment)
Finnish Environment Agency (SYKE) and the Ministry of Environment
P.O. Box 140
FIN-00251 Helsinki, Finland
Phone: (0)9-69 511
Fax: (0)9-6951 381

A database of over 50 separate registers on the Finnish environment maintained by the Finnish Environment Agency (SYKE). The registers cover air and water quality, monitoring data from the environment, prevention of contamination, natural resources, and information resources. The most relevant registers for toxicologists may be on fallout, environmental release, and ecotoxicity of chemicals, and biocides. The data bank is primarily aimed at regulatory authorities but yearly licenses may be sold on request for other users. The license permits access to some of the registers via networks.

ORGANIZATIONS

Scientific Society

Finnish Society of Toxicology
Hanna Tähti
University of Tampere
Department of Biomedical Sciences
P.O. Box 607
FIN-33101 Tampere, Finland
Phone: (0)3-2156 672
Fax: (0)3-2156 170
Web: http://www.uta.fi/fst

The Finnish Society of Toxicology was founded in 1979. The purpose of the society is to promote the advancement and research of toxicology in Finland. The society has a membership of approximately 350 from practically all fields of toxicology. It organizes a 2-day scientific meeting annually where the presentations and abstracts are usually in English. The society is a member of EUROTOX and IUTOX. It publishes a newsletter which contains information on future activities and events (four or five issues per year). The society has published *Ethical Guidelines* for a toxicologist and maintains the *Register of Finnish Toxicologists.* The statutes of the society, the rules of the register, and the guidelines are printed in the membership directory in Finnish and English.

State Regulatory Agencies

Finnish Environment Agency (Suomen ympäristökeskus, SYKE)
Chemicals Unit
P.O. Box 140
FIN-00251 Helsinki, Finland
Phone: (0)9-403 000
Fax: (0)9-4030 0591
Web: http://www.vyh.fi/syke/syke.html

Environmental effects of chemicals; ecotoxicological risk assessment; testing guidelines (ecotoxicity); publishes a series of monographs.

Ministry of Agriculture and Forestry (MMM)
P.O. Box 232
FIN-00171 Helsinki, Finland
Phone: (0)9-1601
Fax: (0)9-1602 190

Legislative action on control of pesticides.

Ministry of the Environment (YM)
Environmental Protection Department
P.O. Box 399
FIN-00121 Helsinki, Finland
Phone: (0)9-19 911
Fax: (0)9-1991 9716
Web: http://www.vyh.fi/ym/ym.html

Legislative action on the protection of the environment, especially the air and water; effects of chemicals on the environment; ecotoxicological risk assessment.

Ministry of Social Affairs and Health (STM)
P.O. Box 267
FIN-00171 Helsinki, Finland
Phone: (0)9-1601
Fax: (0)9-1604 716

Department for Promotion and Prevention
P.O. Box 197
FIN-00531 Helsinki, Finland
Phone: (0)9-1601
Fax: (0)9-1604 492
Web: http://www.vn.fi/stm/index.htm

Coordination of occupational and environmental health issues including risk assessment of chemicals and pesticides.

Ministry of Labour (TM)
Occupational Safety and Health Division
P.O. Box 536
FIN-33101 Tampere, Finland
Phone: (0)3-2608 111
Fax: (0)3-2608 511

Occupational health protection; prevention of occupational exposure to chemicals.

Ministry of Trade and Industry (KTM)
P.O. Box 239
FIN-00171 Helsinki, Finland
Phone: (0)9-1601
Fax: (0)9-1603 666
Web: http://www.vn.fi

Legislative action on the control of industrial manufacturing of poisonous substances.

National Agency for Medicines (Lääkelaitos)
P.O. Box 55
FIN-00301 Helsinki, Finland
Phone: (0)9-473 341
Fax: (0)9-714 469

Processing of marketing applications of new drugs; national GLP inspections; register on side effects of drugs; information on drugs.

National Consumer Administration (Kuluttajavirasto)
P.O. Box 5
FIN-00531 Helsinki, Finland
Phone: (0)9-77 261
Fax: (0)9-7726 7557

Control of cosmetics; control of consumer products; publishes a series of monographs.

National Food Administration (Elintarvikevirasto, EV)
P.O. Box 5
FIN-00531 Helsinki, Finland
Phone: (0)9-77 261
Fax: (0)9-7726 7666

Daily intakes of contaminants in food; publishes a series of research notes.

National Product Control Agency for Welfare and Health (Tuotevalvontakeskus, STTV)
Chemical Unit
P.O. Box 210
FIN-00531 Helsinki, Finland
Phone: (0)9-3967 270
Fax: (0)9-3967 2797

Chemical control; health risk assessment of new chemicals, existing substances, pesticides, and biocides; testing guidelines (health effects); national authority on GLP; publishes a series of monographs.

Plant Production Inspection Centre (Kasvintuotannon tarkastuskeskus, KTTK)
Pesticide Division
P.O. Box 42
FIN-00501 Helsinki, Finland
Phone: (0)9-134 211
Fax: (0)9-1342 1499
Web: http://www.kttk.fi

Control of pesticides; publishes a series of monographs.

Safety Technology Authority (Turvatekniikan keskus, TUKES)
P.O. Box 123
FIN-00181 Helsinki, Finland
Phone: (0)9-61 671
Fax: (0)9-605 474
Web: http://www.tukes.fi

Control of industrial manufacturing, storage and use of chemicals; gases, and oil products.

Statistics Finland (Tilastokeskus, TK)
FIN-00022 Tilastokeskus, Finland
Phone: (0)9-173 41
Fax: (0)9-1734 2279
Web: http://www.stat.fi

Several different registers concerning Finland.

State-Supported Research Institutions

Agricultural Research Centre of Finland (Maatalouden tutkimuskeskus, MTT)
FIN-31600 Jokioinen, Finland
Phone: (0)3-41 881
Fax: (0)3-418 8222
Web: http://www.mtt.fi

Analyses of heavy metals and pesticide residues in plants, crops, fields, and food; field studies on pesticides; publishes a series of monographs.

Geological Survey on Finland (Geologian tutkimuskeskus, GTK)
Betonimiehenkuja 4
FIN-02150 Espoo, Finland
Phone: (0)9-0205 5020
Fax: (0)9-0205 5012

Statistics, analyses, and research on Finnish soils and water; information on purity of groundwater; publishes a series of monographs.

Finnish Centre for Radiation and Nuclear Safety (Säteilyturvakeskus, STUK)
P.O. Box 14
FIN-00881 Helsinki, Finland
Phone: (0)9-759 881
Fax: (0)9-7598 8500

Control and monitoring on radioactive substances, nuclear power plants, and radioactive waste disposal; monitoring of equipment for radiation therapy; research on health effects of radiation; publishes a series of monographs.

Finnish Institute of Occupational Health (Työterveyslaitos, TTL)
Topeliuksenkatu 41 a A
FIN-00250 Helsinki, Finland
Phone: (0)9-47 471
Fax: (0)9-2414 634
Web: http://www.occuphealth.fi

Occupational health monitoring and research on health effects of industrial chemicals and occupational exposures; publishes a series of monographs.

The Finnish Meteorological Institute (Ilmatieteen laitos, IL)
P.O. Box 503
FIN-00101 Helsinki, Finland
Phone: (0)9-19 291
Fax: (0)9-179 581, 90-1929 203
Web: http://www.fmi.fi

Statistics, analyses, and information on outdoor air quality in Finland; publishes a series of monographs.

National Public Health Institute (Kansanterveyslaitos, KTL)
Mannerheiminti 166
FIN-00300 Helsinki, Finland
Phone: (0)9-47 441
Fax: (0)9-4744 8408
Web: http://www.ktl.fi

Division of Environmental Health
P.O. Box 95
FIN-70701 Kuopio, Finland
Phone: (0)17-201 211
Fax: (0)17-201 265

Research and risk assessment on environmental pollutants in drinking water, indoor and outdoor air, and soil; the WHO collaborating center on emergency preparedness and responses (FINNPREP); publishes a series of monographs.

National Research and Development Centre for Welfare and Health (STAKES)
P.O. Box 220
FIN-00531 Helsinki, Finland
Phone: (0)9-39 671
Fax: (0)9-761 307
Web: http://www.stakes.fi

An expert institute in social and health issues; maintains the Cancer Register of Finland; publishes a series of monographs.

National Veterinary and Food Research Institute (Eläinlääkintä-ja elintarvikelaitos, EELA)
P.O. Box 368 (Hämeentie 57)
FIN-00231 Helsinki, Finland
Phone: (0)9-393 101
Fax: (0)9-3931 811

Poisonous chemicals in food and animals; publishes a series of monographs.

Technical Research Center of Finland (Valtion teknillinen tutkimuskeskus, VTT)
Biotechnology and Food Research
Biologinkuja 1
FIN-02044 VTT, Finland
Phone: (0)9-4561

Fax: (0)9-4552 103
Web: http://www.vtt.fi

Analysis of poisonous chemicals from food and environment; publishes a series of monographs.

POISON CONTROL CENTERS

National Veterinary and Food Research Institute (EELA)
P.O. Box 368 (Hämeentie 57)
FIN-00231 Helsinki, Finland
Phone: (0)9-393 101
Fax: (0)9-3931 811

Identification of cause and first-aid information on poisonings in animals.

Poison Information Centre (Myrkytystietokeskus)
Helsinki University Hospital
Department of Clinical Pharmacology
Stenbäckinkatu 11
FIN-00290 Helsinki, Finland
Phone: (0)9-4711
Fax: (0)9-4714 702

The Poison Control Center provides services especially for the treatment of ambulatory and acute poisonings on a 24-hour basis for hospitals and the general public. The center also distributes general information on poisonings and their treatment.

EDUCATION/SCHOOLS

Department of Pharmacology and Toxicology
University of Kuopio
P.O. Box 1627
FIN-70211 Kuopio, Finland
Phone: (0)17-162 211
Fax: (0)17-162 424

The Department of Pharmacology and Toxicology has graduate programs in toxicology for the students of medicine, dentistry, pharmacy, and environmental hygiene and a 40-credit postgraduate training program in toxicology for postgraduate students. The department gives training in close cooperation with the National Public Health Institute, which is located close to the University of Kuopio.

OTHER GRADUATE PROGRAMS IN TOXICOLOGY OR ECOTOXICOLOGY

Department of Applied Chemistry and Microbiology, Food Chemistry, Nutrition
University of Helsinki
P.O. Box 27
FIN-00014 University of Helsinki, Finland
Phone: (0)9-70 851
Fax: (0)9-7085 212

Department of Biochemistry and Biotechnology
University of Kuopio
P.O. Box 1627
FIN-70211 Kuopio, Finland
Phone: (0)17-162 211
Fax: (0)17-2811 510

Department of Biological and Environmental Science
University of Jyväskylä
P.O. Box 35
FIN-40351 Jyväskylä, Finland
Phone: (0)14-601 211
Fax: (0)14-602 329

Department of Biology
Åbo Akademi
Tykistökatu 6
FIN-20520 Turku, Finland
Phone: (0)2-2654 311
Fax: (0)2-2654 748

Department of Biology
University of Joensuu
P.O. Box 111
FIN-80101 Joensuu, Finland
Phone: (0)13-1511
Fax: (0)13-1513 590

Department of Biosciences
Division of Animal Physiology
University of Helsinki
P.O. Box 17
FIN-00014 University of Helsinki, Finland
Phone: (0)9-1911
Fax: (0)9-1917 301

Department of Biosciences
Division of Genetics
University of Helsinki
P.O. Box 56
FIN-00014 University of Helsinki, Finland
Phone: (0)9-70 851
Fax: (0)9-7085 9079

Department of Botany
University of Oulu
P.O. Box 333
FIN-90571 Oulu, Finland
Phone: (0)8-5531 011
Fax: (0)8-5531 500

Department of Cell Biology
University of Jyväskylä

P.O. Box 35
FIN-40351 Jyväskylä, Finland
Phone: (0)14-601 211
Fax: (0)14-602 221

Department of Chemistry
University of Helsinki
P.O. Box 55
FIN-00014 University of Helsinki, Finland
Phone: (0)9-1911
Fax: (0)9-1914 0466

Department of Chemistry
University of Jyväskylä
P.O. Box 35
FIN-40351 Jyväskylä, Finland
Phone: (0)14-601 211
Fax: (0)14-602 501

Department of Clinical Pharmacology
University of Helsinki
Paasikivenkatu 4
FIN-00250 Helsinki, Finland
Phone: (0)9-4711
Fax: (0)9-4714 039

Department of Ecology and Systematics
Division of Environmental Biology
University of Helsinki
P.O. Box 7
FIN-00014 University of Helsinki, Finland
Phone: (0)9-1911
Fax: (0)9-1918 656

Department of Ecology and Systematics
Division of Population Biology
University of Helsinki
P.O. Box 17
FIN-00014 University of Helsinki, Finland
Phone: (0)9-1911
Fax: (0)9-1917 492

Department of Environmental Sciences
Department of Ecology and Environmental Science
University of Kuopio
P.O. Box 1627
FIN-70211 Kuopio, Finland
Phone: (0)17-162 211
Fax: (0)17-163 230

Department of Pharmacology
University of Turku
FIN-20014 Turun yliopisto, Finland
Phone: (0)2-33 351
Fax: (0)2-3337 216

Department of Pharmacology and Toxicology
University of Helsinki
P.O. Box 8
00014 University of Helsinki, Finland
Phone: (0)9-1911
Fax: (0)9-1918 288

Department of Pharmacology and Toxicology
University of Oulu
Kajaanintie 52 D
FIN-90220 Oulu, Finland
Phone: (0)8-5375 011
Fax: (0)8-330 687

Department of Pharmacy
University of Helsinki
P.O. Box 56
FIN-00014 University of Helsinki, Finland
Phone: (0)9-70 851
Fax: (0)9-7085 9138

Faculty of Medicine
Medical School

Department of Pharmacology
University of Tampere
P.O. Box 607
FIN-33101 Tampere, Finland
Phone: (0)3-2156 111
Fax: (0)3-2156 170

Helsinki University of Technology
Otakari 1
FIN-02150 Espoo, Finland
Phone: (0)9-4511

Tampere University of Technology
P.O. Box 527
FIN-33101 Tampere, Finland
Phone: (0)3-3652 111
Fax: (0)3-3652 170

University of Helsinki
Faculty of Veterinary Medicine
P.O. Box 57 (Hämeentie 57)
FIN-00014 University of Helsinki, Finland
Phone: (0)9-70 851
Fax: (0)9-7084 9799

RESEARCH LABORATORIES IN INDUSTRY

Leiras (a pharmaceutical company)
Research Laboratories
P.O. Box 415
FIN-20101 Turku, Finland

Phone: (0)2-33 321
Fax: (0)2-3332 337

Orion Corporation (a pharmaceutical company)
ORION-FARMOS
Research and Development
P.O. Box 65
FIN-02101 Espoo, Finland
Phone: (0)9-4291
Fax: (0)9-4293 600

LIBRARIES

Agricultural Library
University of Helsinki
P.O. Box 27
FIN-00014 University of Helsinki, Finland
Phone: (0)9-70 851

Finnish Institute of Occupational Health Information Service Centre
Topeliuksenkatu 41 a A
FIN-00250 Helsinki, Finland
Phone: (0)9-47 471
Fax: (0)9-4747 490

Jyväskylä University Library
P.O. Box 35
FIN-40351 Jyväskylä, Finland
Phone: (0)14-601 211
Fax: (0)14-603 371

Library of the Medical Faculty of Oulu
Kajaanintie 52 A
FIN-90220 Oulu, Finland
Phone: (0)8-5375 011
Fax: (0)8-5375 153

Library of the Medical Faculty of Tampere
P.O. Box 607
FIN-33101 Tampere, Finland
Phone: (0)3-2156 111
Fax: (0)3-2157 072

Library of the Medical Faculty of Turku
Kiinanmyllynkatu 8-10
FIN-20520 Turku, Finland
Phone: (0)2-33 371
Fax: (0)2-3338 413

Library of the University of Kuopio
Savilahdentie 9
FIN-70210 Kuopio, Finland
Phone: (0)17-162 211
Fax: (0)17-163 410

National Library of Health Sciences
University of Helsinki
Haartmaninkatu 4
FIN-00290 Helsinki, Finland
Phone: (0)9-43 461
Fax: (0)9-2410 385

National Library of Health Sciences
Theoretical Department
P.O. Box 21
FIN-00014 University of Helsinki, Finland
Phone: (0)9-43 461
Fax: (0)9-2410 385

National Public Health Institute
Library and Information Service
Mannerheimintie 166
FIN-00300 Helsinki, Finland
Phone: (0)9-47 441
Fax: (0)9-4744 494

Research Center Neulanen, Library
P.O. Box 88
FIN-70701 Kuopio, Finland
Phone: (0)17-201 211
Fax: (0)17-201 265

CONTRACT LABORATORIES

Finnish Environment Agency (SYKE)
Impacts Research Division
P.O. Box 140
FIN-00251 Helsinki, Finland
Phone: (0)9-403 000
Fax: (0)9-4030 0390

Ecotoxicity tests; soil respiration, and biological tests.

Finnish Institute of Occupational Health (TTL)
Topeliuksenkatu 41 A
FIN-00250 Helsinki, Finland
Phone: (0)9-47 471
Fax: (0)9-2414 634

Mutagenicity tests *in vitro* and *in vivo;* analysis of heavy metals and organic solvents in blood and urine; occupational biomonitoring of industrial chemicals; searches of toxicological literature; hazard assessment on occupational exposures.

The Finnish Pulp and Paper Research Institute
KCL Ekolab
P.O. Box 70
FIN-02151 Espoo, Finland

Phone: (0)9-43 711
Fax: (0)9-464 305

Ecotoxicity tests on algae, Daphnia, and fish (acute and physiology); Microtox; biodegradation; bioaccumulation.

Kuopio Regional Institute of Occupational Health (KATTL)
P.O.B. 95
FIN-70701 Kuopio, Finland
Phone: (0)17-201 211
Fax: (0)17-201 265

Biological monitoring of occupational chemicals; IgG and IgE measurements; analytical services; microbiological analysis of indoor aerosols.

National Public Health Institute (KTL/YTOR)
Division of Environmental Health
P.O. Box 95
FIN-70701 Kuopio, Finland
Phone: (0)17-201 211
Fax: (0)17-201 265

Analysis of TCDD, chlorophenols, and other organochlorine compounds in soil, water, and biological samples; analysis of pesticides; microbiological analysis of indoor aerosols; mutagenicity testing *in vitro* and *in vivo;* toxicity testing in animals with chemicals complying with GLP requirements.

Technical Research Center of Finland (VTT)
Biotechnology and Food Research
Biologinkuja 1
FIN-02044 VTT, Finland
Phone: (0)9-4561
Fax: (0)9-4552 103

Mutagenicity tests *in vitro:* analysis of food contaminants, pesticides, polyorganic materials, metals, tobacco smoke, and toxic monomers.

University of Jyväskylä
Department of Biological and Environmental Science
P.O. Box 35
FIN-40351 Jyväskylä, Finland
Phone: (0)14-601 211
Fax: (0)14-602 321

Ecotoxicity tests; photobacter toxicity, algal toxicity, and Daphnia toxicity tests; acute and subacute toxicity tests in fish; fish growth test.

University of Jyväskylä
Department of Chemistry, Section of Organic Chemistry
P.O. Box 35
FIN-40351 Jyväskylä, Finland
Phone: (0)14-601 211
Fax: (0)14-602 501

Analytical services, especially for polychlorinated aromatic compounds (PAHs) and PAH in environmental samples and pulp and paper mill effluents.

University of Jyväskylä
Institute of Environmental Research
P.O. Box 35
FIN-40350 Jyväskylä, Finland
Phone: (0)14-601 211
Fax: (0)14-603 831

Chemical analyses of organic and inorganic pollutants in air, water, soil, and food; ecotoxicity tests with Daphnia and earthworm; enchytraied and collembolan tests.

France

JACQUES DESCOTES

BOOKS

Baud, F. (1995)
Réanimation des Intoxications Aiguës (*Resuscitation of Acute Poisonings*) Masson, Paris

The state-of-the-art management of severe acute poisonings in man is addressed.

Baud, F., Barriot, P., and Riou, B. (1992)
Les Antidotes (*Antidotes*)
Masson, Paris

The pharmacological properties and therapeutic uses of antidotes are reviewed and discussed.

Bismuth, Ch., and Dally, S. (1994)
Cas Cliniques en Toxicologie (*Case Report Studies in Toxicology*)
Flammarion, Paris

Selected case reports of human poisonings are presented and commented on for students.

Cezard, C., and Haguenoer, J. M. (1992)
Toxicologie du Plomb Chez l'Homme (*Toxicology of Lead in Man*)
Lavoisier, Paris

The toxic effects of lead in man are reviewed.

Creppy, E., Castegnaro, M., and Dirheimer, G. (1993)
Ochratoxicose Humaine et ses Pathologies (*Human Ochratoxicosis and Its Pathologies*)
John Libbey Eurotext-INSERM, Paris

Papers of a meeting on ochratoxicosis held in Bordeaux, July 4–6, 1993, are presented.

Daniel, V., and Barriot, P. (1993)
Les Intoxications Aiguës (*Acute Poisonings*)
Arnette, Paris

Clinical features, diagnosis, and management of main acute poisonings are presented from the perspective of clinical toxicology.

Descotes, J. (1990)
Introduction à l'Immunotoxicologie (*Introduction to Immunotoxicology*)
Lacassagne, Lyon

The basic principles of immunotoxicology are described.

Descotes, J., Testud, F., and Frantz, P. (1992)
Les Urgences en Toxicologie (*Emergencies in Toxicology*)
Maloine, Paris

The clinical features, diagnosis, and managements of poisonings are presented from the perspective of poison control.

Hachet, J. C. (1992)
Dictionnaire de Toxicologie Clinique (*Dictionary of Clinical Toxicology*)
Masson, Paris

The clinical toxicity of many medicinal and chemical products is briefly summarized.

Roujas, F., and Sorkine, M. (1990)
Intoxications Aiguës (*Acute Poisonings*)
Masson, Paris

The clinical features, diagnosis, and management of the most frequent acute poisonings are presented.

Testud, F. (1997)
Pathologie Toxique en Milieu de Travail (*Toxic Effects at the Workplace*)
ESKA, Lyon

The toxic effects of the occupational chemicals are extensively reviewed.

JOURNALS

Human and Experimental Toxicology
Journal affiliated with the French Society of Toxicology
Stockton Press, Houndmills, Basingstoke, Hampshire RG21 6XS, UK

Contains abstracts of meetings of the French Society of Toxicology.

Sciences et Techniques de l'Animal de Laboratoire (*Sciences and Techniques of Laboratory Animals*)
Journal of the French Society of Animal Experimentation

Contains reviews and original papers concerning laboratory animals, including toxicological aspects.

Toxicorama
Journal of the French Society of Analytical Toxicology

POISON CONTROL CENTERS

(List published by the French Ministry of Health, March 13, 1993.)

Angers
Hôpital
49033 Angers Cedex 01
Phone: +33 (0) 241-48-21-21
Fax: +33 (0) 241-35-55-07

Bozdeaux
Hôpital Pellegin-Tzipode
Pl. Amélie Raba-Léon
33076 Bordeaux Cedex
Phone: +33 (0) 556-96-40-80
Fax: +33 (0) 556-79-60-96

Lille
Centre Hospitalier Régional
5 avenue Oscar Lambret
59037 Lille Cedex
Phone: +33 (0) 220-54-55-56
Fax: +33 (0) 220-44-56-28

Lyon
Hôpital Edouard Herriot
5 place d'Arsonval
69437 Lyon Cedex 08
Phone: +33 (0) 472-11-69-11
Fax: +33 (0) 472-11-69-85

Marseille
Hôpital Salvator
249 Bd Sainte Marguerite
13274 Marseille Cedex 9
Phone: +33 (0) 491-75-25-25
Fax: +33 (0) 491-74-41-68

Nancy
Hôpital Central
29 avenue M[al] de Lattre de Tassigny
54035 Nancy Cedex,
Phone: +33 (0) 383-85-26-26
Fax: +33 (0) 383-85-26-15

Paris
Hôpital Fernand Widal
200 rue du Faubourg Saint-Denis
75475 Paris Cedex 10
Phone: +33 (0) 140-37-04-04
Fax: +33 (0) 140-05-41-93

Rennes
Hôpital Pontchaillou
rue Henri Le Guilloux
35000 Rennes
Phone: +33 (0) 299-59-22-22
Fax: +33 (0) 299-28-42-30

Strasbourg
Hôpital Universitaires
1 place de l'Hôpital
67000 Strasbourg
Phone: +33 (0) 388-37-37-37
Fax: +33 (0) 388-16-13-88

Toulouse
Hôpital Purpan
place du Docteur Blayac
31059 Toulouse Cedex
Phone: +33 (0) 561-49-33-33
Fax: +33 (0) 561-77-25-72

ORGANIZATIONS

Governmental Organizations and National Institutes

Agence Française du Médicament (French Medicine Evaluation Agency)
Ministère du Travail et des Affaires Sociales
143–145 boulevard Anatole France
92300 Saint-Denis

Centre National de la Recherche Scientifique (National Centre for Scientific Research)
3 rue Michel-Ange
74794 Paris Cedex 16

Institut National de l'Environment Industriel et des Risques (National Institute for Industrial Environment and Risks)
Parc Technologique ALATA
BP No. 2
60550 Verneuil-en-Halatte

Institut National de Law Recherche Agronomique (National Institute for Agronomical Research)
145 rue de l'Université
75341 Paris Cedex 07

Institut National de la Santé et de la Recherche Médicale (National Institute for Health and Medical Research)
101 rue de Tolbiac
75645 Paris Cedex 13

Institut National Recherche et Sécurité (National Institute for Research and Safety)
30 rue Olivier Noyer
75680 Paris Cedex 14 and,
Avenue de Bourgogne, B.P. 27
54501 Vandoeuvre-les-Nancy Cedex

Sous-Direction de la Veille Sanitaire (Subdirectorate for Health Surveillance)
Direction Générale de la Santé
Ministère du Travail et des Affaires Sociales
1 place de Fontenoy
75350 Paris 07 SP

NATIONAL COMMITTEES

Commission d'Autorisation de la Mise sur le Marché des Médicaments(Committee for Medicines Approval)

National committee at the French Medicine Evaluation Agency which approves new pharmaceutical products.

Commission d'Etude de la Toxicité des Produits Antiparasitaires à Usage Agricole et Produits Assimilés, des Matières Fertilisantes et Supports de Culture (Committee for the Study of Toxicity of Pesticides and Related Products)

National committee in the Ministry of Agriculture which evaluates the toxicity of products and approves pesticides and related products.

Commission d'Evaluation de l'Ecotoxicité des Substances Chimiques (Committee for the Evaluation of the Ecotoxicity of Chemical Substances)

National committee in the Ministry of the Environment which evaluates the ecotoxicity of chemical substances.

Commission Nationale de Pharmacovigilance (National Committee for Pharmacovigilance)

National committee in the French Medicine Evaluation Agency which evaluates postmarketing adverse effects of medicines.

Commission Nationale de Toxicovigilance (National Committee for Toxicovigilance)

National committee in the Subdirectorate for Health Surveillance which evaluates the toxic effects of nonpharmaceutical chemicals in man.

Conseil Supérieur d'Hygiène Publique de France (High Council for Public Hygiene)

National committee in the Subdirectorate for Health Surveillance which evaluates the toxic effects of environmental chemicals, radiations, and the quality of food and water, from the perspective of human health.

NATIONAL SOCIETIES

Association des Biologistes Cliniciens pour les Animaux de Laboratoire (Association of Clinical Biologists for Laboratory Animals)
Centre de Recherche Pfizer
route des Industries, B.P. 159
37401 Amboise Cedex

Association Française de Tératologie (French Association of Teratology)
Laboratoire d'Embryologie
Faculté de Médecine Saint-Antoine
27 rue de Chaligny
75012 Paris

Association pour la Recherche en Toxicologie (Association for Research in Toxicology)
18 rue de la Procession
75015 Paris

Association des Techniciens de Toxicologie Expérimentale (Association of Technicians in Experimental Toxicology)
Centre de Recherche Pfizer
route des Industries, B.P. 159
37401 Amboise Cedex

Association Toxicologie CNAM (Association Toxicology at CNAM)
70 rue du Hameau des Joncherettes
91120 Palaiseau

Société d'Ecotoxicologie Fondamentale et Appliquée (Society of Fundamental and Applied Ecotoxicology)
Centre des Sciences de l'Environnement
1 rue des Récollets, B.P. 4025
57040 Metz Cedex 1

Société d'Française d'Expérimentation Animale (French Society of Animal Experimentation)
28 rue Saint Dominique
75007 Paris

Société de Pharmaco-Toxicologie Cellulaire (Society of Cellular Pharmacology and Toxicology)
15 rue de l'Ecole de Médecine
75006 Paris

Société de Toxicologie Clinique (Society of Clinical Toxicology)
Hôpital Fernand Widal
200 rue du Faubourg Saint-Denis
75010 Paris

Société Française des Anatomo-Pathologistes Toxicologues (French Society of Toxicologic Pathologists)
Laboratoires MSD-Chibret, B.P. 134
63023 Riom Cedex

Société Française de Médecine du Travail (French Society of Occupational Medicine)
40 rue de Seine
75007 Paris

Société Française de Santé Publique (French Society of Public Health)
B.P. 7
54501 Vandoeuvre-les-Nancy

Société Française de Toxicologie (French Society of Toxicology)
Hôpital Fernand Widal
200 rue du Faubourg Saint-Denis
75010 Paris

Société Française de Toxicologie Analytique (French Society of Analytical Toxicology)
Laboratoire de Biochimie, CHU, B.P. 577
86021 Poitiers Cedex

Société Française de Toxicologie Génétique (French Society of Genetic Toxicology)
Institut Pasteur de Paris
28 rue du Dr Roux
75724 Paris Cedex 15

OTHER INSTITUTIONS

Contract Laboratories

ADME Bioanalyses SA
Parc Haute Technologie
Sophia-Antipolis
694 anvenue du Dr M. Donat
06250 Mougins

Bio-Inova Eurolab
Garabel No. 2
48-52 rue de la Gare
78370 Plaisir

Biotrial SA
Rue Jean-Louis Bertrand
Technopole Atalante Villejean
35000 Rennes

Centre International de Toxicologie
B.P. 563
Miserey
27005 Evreux Cedex

CERB
Chemin de Montifault
18800 Baugy

Chrysalis, Preclinical Operations Europe (formerly Pharmakon Europe)
B.P. 118
69593 L'Arbresle Cedex

Phoenix International Pharmacology (Formerly I.T.E.M. Labo)
93 avenue de Fontainebleau
94276 le Kremlin-Bicêtre Cedex

Germany

REGINE KAHL AND HERBERT DESEL

BOOKS

General

Wolf, H. U. (Ed.) (1992)
Hagers Handbuch der Pharmazeutischen Praxis, Band 3: Gifte (*Hager's Textbook of Pharmaceutical Practice, Vol. 3: Poisons*), 5th ed.
Springer-Verlag, Berlin
ISBN 3-540-52633-1

Data on the properties, signs, and therapy of intoxication and regulation of toxic substances, listed in alphabetical order and comprising both generic names and product trade names, are given in a condensed form.

Student Textbooks

Textbooks on Toxicology

Dekant, W., and Vamvakas, S. (1994)
Toxikologie für Chemiker und Biologen (*Toxicology for Chemists and Biologists*)
Spektrum Akademischer Verlag, Heidelberg
ISBN 3-86025-218-6

Eisenbrand, G., and Metzler, M. (1994)
Toxikologie für Chemiker (*Toxicology for Chemists*)
Thieme Verlag, Stuttgart
ISBN 3-13-127001-2

Greim, H., and Deml, E. (1996)
Toxikologie (*Toxicology*)
VCH Verlagsgesellschaft, Weinheim
ISBN 3-527-28483-4

Three textbooks designed for students of chemistry and biology and in part also for students of medicine. The focus is on general toxicology, toxicological mechanisms, German law regulating treatment of hazardous substances, and less amply on the actions of specific compounds. In addition, basic anatomical and pathophysiological information is provided.

Marquardt, H., and Schäfer, S. (Eds.) (1997)
Lehrbuch der Toxikologie (*Textbook of Toxicology*)
Spektrum Akademischer Verlag, Heidelberg
ISBN 3-8274-0271-9

A comprehensive multiauthor textbook covering most aspects of toxicology in 1004 pages. Contains sections on general toxicology, organ toxicology, the most important groups of toxic substances, specific fields of toxicology, toxicological methodology, and risk assessment.

Textbooks on Pharmacology and Toxicology

Estler, C. J. (Ed.) (1994)
Pharmakologie und Toxikologie. Lehrbuch für Mediziner, Veterinärmediziner, Pharmazeuten und Naturwissenschaftler (*Pharmacology and Toxicology Textbook for Physicians, Veterinary Surgeons, Pharmacists, and Natural Scientists*), 4th ed.
Schattauer Verlag, Stuttgart
ISBN 3-7945-1645-1

A multiauthor book with 22 chapters, one of which covers toxicology in a brief but systematic manner.

Forth, W., Henschler, D., Rummel, W., and Starke, K. (Eds.) (1996)
Allgemeine und spezielle Pharmakologie und Toxikologie (*General and Special Pharmacology and Toxicology*), 7th ed.
Spektrum, Heidelberg
ISBN 3-8274-0088-0

A comprehensive general textbook covering the theoretical basis as well as the clinical aspects of pharmacology, with an extensive chapter on toxicology. Each chapter was written by an expert and starts with the pathophysiological basis.

Kuschinsky, G., and Lüllmann, H. (1993)
Kurzes Lehrbuch der Pharmakologie und Toxikologie (*Short Textbook of Pharmacology and Toxicology*), 13th ed.
Georg Thieme Verlag, Stuttgart
ISBN 3-13-368513-9

This concise textbook focuses mainly on pharmacology and briefly discusses the main issues of toxicology.

Mutschler, E. (1996)
Arzneimittelwirkungen. Lehrbuch der Pharmakologie und Toxikologie (*Effects of Drugs. Textbook of Pharmacology and Toxicology*), 7th ed.

Wissenschaftliche Verlagsgesellschaft, Stuttgart
ISBN 3-8047-1377-7

This general textbook for students of medicine, pharmacy, and the life sciences contains three major sections (general pharmacology, special pharmacology, and toxicology). For the nonmedical reader, a brief introduction to anatomy, physiology, and pathophysiology precedes each chapter.

Carcinogenesis and Mutagenesis

Roth, L. (1988)
Krebserzeugende Stoffe (*Carcinogenic Substances*), 2nd ed.
Wissenschaftliche Verlagsgesellschaft, Stuttgart
ISBN 3-8047-0948-6

This book aims at improving safety in the handling of carcinogenic compounds at the workplace. A list of established and suspected carcinogens is provided together with a detailed profile of the individual carcinogens (physicochemical properties, toxicological data, safety regulations, and recommendations for safe handling). The book also lists the pertinent regulations for making and handling carcinogens.

Analytical and Clinical Toxicology

Ludewig, R., and Lohs, K. (1991)
Akute Vergiftungen (*Acute Intoxications*), 8th ed.
Gustav Fischer Verlag, Jena
ISBN 3-334-00095-8

A valuable guide for the clinical management of intoxications and a comprehensive index to many uncommon substances and products. Substances are grouped by chemical or application aspects. Each entry comprises toxicokinetic and toxicodynamic data and the symptoms and therapy of intoxication.

Moeschlin, S. (1986)
Klinik und Therapie der Vergiftungen (*Clinical Symptoms and Therapy of Intoxications*), 7th ed.
Georg Thieme Verlag, Stuttgart
ISBN 3-13-378407-2

A standard reference book for the management of poisonings by drugs and other chemicals.

Pfleger, K., Maurer, H., and Weber, A. (1992)
Mass Spectral and GC Data of Drugs, Poisons, Pesticides, Pollutants and Their Metabolites I/II/III
VCH Verlagsgesellschaft, Weinheim
ISBN 3-527-26989-4

Reference to mass spectra of more than 4000 substances, most of them important in intoxications.

Wirth, W., and Gloxhuber, C. (1994)
Toxikologie (*Toxicology*), 5th ed.
Georg Thieme Verlag, Stuttgart
ISBN 3-13-421105-X

Following a shorter section on general toxicology, the main section is divided into the toxicology (chemistry, exposure, symptoms and mechanisms of acute and chronic intoxication, and therapy) of inorganic compounds, organic compounds, plant poisons, and animal poisons.

V. Mühlendahl, K. E., Oberdisse, U., and Bunjes, R. (1995)
Vergiftungen im Kindesalter (*Intoxications in Childhood*), 3rd ed.
Enke, Stuttgart
ISBN 3-432-91413-X

Experience of more than 20 years of poison information is processed in this standard book for diagnosis and treatment of intoxications. The main focus is on intoxications in childhood, but useful hints for intoxications in adults are also included for many products.

Environmental Toxicology and Biotoxins

Bresinsky, A., and Besl, H. (1985)
Giftpilze (*Poisonous Fungi*)
Wissenschaftliche Verlagsgesellschaft, Stuttgart
ISBN 3-8047-0680-0

Contains information on intoxication syndromes and more detailed information on the identification of poisonous fungi.

Frohne, D., and Pfänder, H. J. (1997)
Giftpflanzen (*Poisonous Plants*), 4th ed.
Wissenschaftliche Verlagsgesellschaft, Stuttgart
ISBN 3-8047-1466-8

In this handbook many plants with toxic ingredients are presented with photographs, as are comprehensive descriptions of their experimental and clinical toxicology.

Habermehl, G. (1985)
Mitteleuropäische Giftpflanzen und Ihre Wirkstoffe (*Poisonous Plants of Central Europe and Their Active Principles*)
Springer-Verlag, Berlin
ISBN 3-540-15084-6

A book describing the botany of the most common plants and fungi, the chemical nature of their toxins, and the symptoms and treatment of the poisoning.

Habermehl, G. (1994)
Gift-Tiere und ihre Waffen (*Poisonous Animals and Their Weapons*), 5th ed.

Springer-Verlag, Berlin
ISBN 3-540-56897-2

This book represents a systematic introduction to the taxonomy of poisonous molluscs, arthropods, fish, amphibia, and reptilia, describing briefly the animals and the chemistry of the toxins as well as the symptoms and treatment of the intoxication.

Korte, F. (Ed.) (1992)
Ökologische Chemie (*Ecological Chemistry*), 3rd ed.
Georg Thieme Verlag, Stuttgart
ISBN 3-13-586703-X

This book provides in a concise from the principles and strategies of the ecological evaluation of chemicals.

Lindner, E. (1990)
Toxikologie der Nahrungsmittel (*Toxicology of Food*), 4th ed.
Georg Thieme Verlag, Stuttgart
ISBN 3-8047-1575-3

A book about the toxic substances in food that are either constitutive or formed during storage or preparation, as well as about food additives.

Mebs, D. (1992)
Gifttiere (*Poisonous Animals*)
Wissenschaftliche Verlagsgesellschaft, Stuttgart
ISBN 3-8047-1219-3

In this handbook many poisonous animals are presented with photographs, and the toxins as well as the symptoms and therapy of the intoxication are described.

Merian, E. (Ed.) (1991)
Metals and Their Compounds in the Environment
VCH, Wiley–Weinheim
ISBN 3-527-26521-X (or 0-89573-562-8)

The book is structured into two main sections. The first section contains 16 chapters and discusses general principles and ecological and analytical aspects, whereas the second section contains 27 chapters, each dealing with a specific metal and written by an international expert.

Teuscher, E., and Lindequist, U. (1994)
Biogene Gifte (*Poisons from Biological Sources*), 2nd ed.
Fischer, Stuttgart
ISBN 3-8047-1580-X

This book presents the biology, chemistry, and toxicology of toxins-from all types of biological organisms. Many color pictures and chemical structures are presented.

Looseleaf Books (Irregular Supplementation)

Daunderer, M. (Ed.) (1996)
Klinische Toxikologie (*Clinical Toxicology*)
ecomed, Landsberg
ISBN 3-609-70000-9

A comprehensive data collection on clinical toxicology, structured in three sections: general information, treatment of intoxications, and toxic compounds.

Henschler, D. (Ed.) (1998)
Senatskommission der Deutschen Forschungsgemeinschaft zur Prüfung Gesundheitsschädlicher Arbeitsstoffe (Commission for the Investigation of Health Hazards of Chemical Compounds)
Gesundheitsschädliche Arbeitsstoffe.
Toxikologisch-arbeitsmedizinische Begründungen von MAK-Werten (*Occupational Toxicants. Critical Data Evaluation for MAK Values and Classification of Carcinogens*)
Wiley–VCH, Weinheim, 24. Lieferung
ISSN 0930–1984

The MAK value (Maximale Arbeitsplatzkonzentration = maximum concentration in the workplace) is defined as the maximum permissible concentration of a chemical compound present in the air within a working area which, according to current knowledge, generally does not impair the health of the employee or cause undue annoyance. These values are established by a commission of the Senate of the German Science Foundation and are published annually. The critical data evaluations of newly established values are published as supplementary monographs to this looseleaf book.

Henschler, D., and Lehnert, G. (Eds.) (1996)
Senatskommission der Deutschen Forschungsgemeinschaft zur Prüfung gesundheitsschädlicher Arbeitsstoffe (Commission for the Investigation of Health Hazards of Chemical Compounds in the Work Area)
Biologische Arbeitsstofftoleranz-Werte (BAT-Werte) und Expositionsäquivalente für rebserzeugende Arbeitsstoffe (EKA). Arbeitsmedizinisch-toxikologische Begründungen (*Biological Exposure Values for Occupational Toxicants and Carcinogens. Critical Data Evaluation for BAT and EKA Values*)
Wiley–VCH, Weinheim, 8. Lieferung
ISSN 0930-195-X

The BAT value (Biologischer Arbeitsstofftoleranzwert = biological exposure value) is defined as the maximum permissible quantity of a chemical compound, its metabolites, or any deviation from the norm of biological parameters induced by these substances in exposed humans. The BAT values are established by a commis-

sion of the Senate of the German Science Foundation and are published annually. The ciritical data evaluations of the newly established values are published as supplementary material to this looseleaf book.

Seeger, R., and Neumann, G. (1994)
Giftlexikon (*Encyclopedia of Poisons*)
Deutscher Apotheker Verlag, Stuttgart
ISBN 3-7692-1653-9

An introduction to general principles of intoxication management is followed by monographs on toxic substances containing data on properties, occurrence, analysis, use, toxic actions, mechanism of action, toxicokinetics, and the symptoms, diagnosis, therapy, and prognosis of the intoxication. The collection of monographs is fragmentary.

Wichmann, H.-E., Schlipköter, H.-W., and Fülgraff, G. (1995)
Handbuch der Umweltmedizin (*Textbook of Environmental Medicine*)
ecomed, Landsberg
ISBN 3-609-71180-9

Toxicology is one field of environmental medicine. Consequently, this book contains a section on toxic substances present in the environment. Currently, the book provides chapters on ozone, sulfur dioxide, passive smoking, polycyclic aromatic hydrocarbons, a number of metals, benzol, formaldehyde, pentachlorphenol, polychlorinated biphenyls, tetrachloroethene, herbicides, and nitrite/nitrate.

JOURNALS

Professional journals of toxicology in the Federal Republic of Germany are no longer published in German but have switched to English to gain a wider readership. These journals are listed elsewhere.

There is, however, an important periodical that appears annually in German:

Deutsche Forschungsgemeinschaft (*German Science Foundation*) ***MAK- und BAT-Werte-Liste*** (*List of MAK and BAT values*) (1998)
Wiley–VCH, Weinheim 34. Mitteilung
ISBN 3-527-27584-3

This periodical provides cumulative tables listing the maximum concentrations in the workplace and the biological exposure values for occupational toxicants established by the Commisssion for the Investigation of Health Hazards in the Workplace of the German Science Foundation and also contains classification proposals for carcinogens. These values and classification proposals provide the basis for the legislative process on hazardous substances, which is prepared by the Bundesministerium für Arbeit und Sozialordnung. Each annual issue is accompanied by supplements in leaflet form to two important looseleaf books listed previously.

ORGANIZATIONS

Federal Authorities

Bundesministerium für Umwelt, Naturschutz und Reaktorsicherheit (Federal Ministry of the Environment, Nature Conservation and Nuclear Safety)
Kennedyallee 5
D-53175 Bonn 1
Phone: ++49-228-305-0
Fax: ++49-228-305-3225

Bundesministerium für Umwelt, Naturschutz und Reaktorsicherheit, Außenstelle Berlin
Schiffbauerdamm 15
D-10117 Berlin
Phone: ++49-30-28550-0
Web: http://www.bmu.de

Activities in the fields of and responsibility for protection of human health against hazardous substances; prevention of hazardous incidence in industrial plants; public information on environmental questions; guidelines and strategies of environmental protection; protection of soil, water, and seas; and radiation protection.

Umweltbundesamt (UBA, Federal Environmental Agency)
Bismarckplatz 1
D-14193 Berlin
Phone: ++49-30-8903-0
Fax: ++49-30-8903-2285
Web: http://www.umweltbundesamt.de

The Umweltbundesamt provides support to the Federal Ministry of the Environment, Nature conservation and Nuclear Safety, in particular at a scientific and technical level in the fields of air pollution control, noise abatement, waste and water management, soil protection and environmental chemicals, in particular in the drawing up of statutory and administrative provisions.

As part of the Umweltbundesamt:

Institut für Wasser, Boden und Lufthygiene (Institute for Hygiene of the Water, Soil and Air)
Corrensplatz 1

D-12167 Berlin
Phone: ++49-30-8903-0
Fax: ++49-30-8903-1830
Web: http://www.umweltbundesamt.de/uba-info/d-fach5.htm

The main tasks of the institute include research dealing with inquiries concerning environmental hygiene. The institute was formerly part of the Bundesgesundheitsamt (Federal Health Office) and was incorporated into the Federal Environmental Agency in 1994.

Bundesministerium für Gesundheit (Federal Ministry for Health)
Am Propsthof 78a
D-53121 Bonn
Phone: ++49-228-941-0
Fax: ++49-228-941-4900

Bundesministerium für Gesundheit—Außenstelle Berlin
Mohrenstraße 62
D-10117 Berlin
Phone: ++49-30-20640-0
Web: http://www.bmgesundheit.de

The Bundesministerium für Gesundheit located in Bonn and in Berlin is acting in all fields of health and medicine, e.g., medical drugs, prevention, health insurance, as well as protection of consumers and veterinary medicine.

Institutions with Close Relations to the Bundesministerium für Gesundheit

Bundeszentrale für gesundheitliche Aufklärung (BZgA, Federal Center for Health Education)
Web: http://www.bzgaide

Paul-Ehrlich-Institut, Bundesamt für Sera und Impfstoffe in Frankfurt/M. (PEI, Federal Agency for Sera and Vaccines)
Web: http://www.pei.de

Deutsches Institut für medizinische Dokumentation und Information in Köln (DIMDI, German Institute for Medical Documentation and Information)
Web: http://www.dimdi.de

Robert Koch-Institut, Bundesinstitut für Infektionskrankheiten und nicht-übertragbare Krankheiten in Berlin (RKI, Federal Institute for Infectious and Non-Communicable Diseases)
Web: http://www.rki.de

Bundesinstitut für Arzneimittel und Medizinprodukte in Berlin (BfArM, Federal Institute for Drugs and Medical Devices)

Bundesinstitut für gesundheitlichen Verbraucherschutz und Veterinärmedizin in Berlin (BgVV, Federal Institute for Health Protection of Consumers and Veterinary Medicine)

In the past the Bundesgesundheitsamt (Federal Health Office) was the authority with main responsibility in many toxicological affairs. For political reasons it was split into different institutes in 1994.

Bundesinstitut für gesundheitlichen Verbraucherschutz und Veterinärmedizin (BgVV) (Federal Institute for Health Protection of Consumers and Veterinary Medicine)
Thielallee 88–92
D-14195 Berlin
Phone: ++49-30-8412-4300
Fax: ++49-30-8412-4970
Web: http://www.bgvv.de

Responsibilities of the institute include

- Protection of public health with respect to food, tobacco, cosmetic and other products, pesticides, and chemicals
- Documentation and information about intoxications
- Protection of man from animal-carried diseases
- Registration of drugs for animals and animal protection
- Alternative methods to animal experimentation

Bundesinstitut für Arzneimittel und Medizinprodukte (Federal Institute for Drugs and Medical Products)
Seestrasse 10
D-13353 Berlin 65
Phone: ++49-30-45483-0
Web: http://www.bfarm.de

Authorization and registration of drugs and collection and evaluation of side effects of drugs and medical products

Bundesministerium für Arbeit und Sozialordnung (Federal Ministry of Labour and Social Affairs)
Rochusstrasse 1, Postfach 14 02 80
D-53107 Bonn
Phone: ++49-228-527-0
Telex: 8 86 641
Web: http://www.bma.de

Responsibilities include protection against hazardous substances at the workplace. For this, the ministry is supported by the Bundesanstalt für Arbeitsschutz und Arbeitsmedizin (Federal Institute for Occupational Safety and Health), the Ausschuß für Gefahrstoffe (Committee for Hazardous Substances), and the Se-

natskommission zur Prüfung gesundheitsschädlicher Arbeitsstoffe (Commission for the Investigation of Health Hazards of Chemical Compounds in the Work Area).

Bundesanstalt für Arbeitsschutz und Arbeitsmedizin (BAuA, Federal Institute for Occupational Safety and Health)
Friedrich-Henkel-Weg 1-25
D-44149 Dortmund
Phone: ++49-231-9071-0
Fax: ++49-231-9071-454
Web: http://www.baua.de

The institute takes responsibilities in occupational safety and occupational protection and in the control of chemical, biological, physical, physiological, and psychosocial factors operative in the workplace. Its activities comprise the registration and evaluation of hazardous substances in accordance with the legislation on chemical substances in Germany and in the European Union.

Ausschuß für Gefahrstoffe beim Bundesministerium für Arbeit und Sozialordnung
(AGS, Committee for Hazardous Substances at the Federal Ministry of Labour and Social Affairs)
c/o Bundesanstalt für Arbeitsschutz und Arbeitsmedizin

This committee, consisting of representatives from federal and state agencies, industry, trade unions, and academia, advises the ministry on

- Chemical substances that may exert mutagenic effects, carcinogenic effects, or toxic effects on reproduction in the employees
- Threshold values at the workplace

For this, it has established many subcommittees but also relies in part on the work of the ''MAK-Kommission.''

Senatskommission der Deutschen Forschungsgemeinschaft zur Prüfung gesundheitsschädlicher Arbeitsstoffe (MAK-Kommission, Commission for the Investigation of Health Hazards of Chemical Compounds in the Work Area)
Web: http://www.dfg.de/organisation/gremien/mak.html

In this commission, belonging to the German Science Foundation, scientific experts in the fields of toxicology and occupational health from academia, agencies, and industry establish maximum concentrations in the workplace and biological exposure values for occupational toxicants as well as classifications of carcinogens and define the critical data evaluations on which these values and classifications are based.

Professional Societies

Abteilung Experimentelle Krebsforschung (AEK) der Deutschen Krebsgesellschaft e.V. (Department of Experimental Cancer Research of the German Cancer Society)
c/o Prof. Dr. M. Schwab
Deutsches Krebsforschungszentrum
Im Neuenheimer Feld 280
D-69120 Heidelberg
Phone: ++49-6221-42-3220
Fax: ++49-6221-42-3277

An association of German scientists involved in experimental cancer research.

Sektion Toxikologie der Deutschen Gesellschaft für experimentelle und klinische Pharmakologie und Toxikologie—DGPT (Section of Toxicology of the German Society for Experimental and Clinical Pharmacology and Toxicology)
Prof. Dr. F. Oesch, Chairman
Institut für Toxikologie
Universitat Mainz
Obere Zahlbacher Str. 67
D-55131 Mainz
Phone: ++49-7071-29-2274
Fax: ++49-7071-29-2273
Web: http://www.toxikologie.de

The professional society of German toxicologists. Unlike in most other countries, there is no independent toxicological society in the Federal Republic of Germany.

Research Institutes

Deutsches Krebsforschungszentrum (DKFZ) (German Cancer Research Center)
Im Neuenheimer Feld 280
D-69120 Heidelberg
Phone: ++49-6221-42-0
Fax: ++49-6221-42-2995
Web: http://www.dkfz-heidelberg.de

The DKFZ was founded in 1964 as a nonprofit organization and supraregional research center by the State of Baden–Württemberg. It is mainly funded by the Bundesministerium für Forschung, Bildung, Wissenschaft und Technologie. A new program-oriented organizational structure of the DKFZ was adopted in 1991. Today, multidisciplinary cancer research is

performed by more than 50 divisions and working groups.

Forschungs- und Beratungsinstitut Gefahrstoffe GmbH (FoBiG) (Institute for Research and Consulting on Hazardous Substances)
Werderring 16
D-79098 Freiburg
Phone: ++49-761-386080
Fax: ++49-761-3860820

Institute working on evaluation of the effects of toxic substances in the workplace and in the environment.

Fraunhofer Arbeitsgruppe ''Toxikologie und Umweltmedizin'' (ATU) (Fraunhofer Department ''Toxicology and Environmental Medicine'')
Grindelallee 117
D-20146 Hamburg
Phone: ++49-40-4123-5277
Fax: ++49-40-4123-5316
Web: http://www.fhg.de/german/profile/atu.html

The working group carries out research in analytical and experimental toxicology, evaluation of effects of environmental substances on human health, and scientific support for other institutions in health protection and environmental protection. The ATU is linked with the medical and chemistry departments of the Universität Hamburg.

Fraunhofer-Institut für Toxikologie und Aerosolforschung (ITA) (Fraunhofer Institute of Toxicology and Aerosol Research)
Nikolai-Fuchs-Straße 1
D-30625 Hannover
Phone: ++49-511-5350-0
Fax: ++49-511-5350-155
Telex: 921 280 ita ha d
E-mail: info@ita.fhg.de
Web: http://www.fhg.de/german/profile/ita.html

The Fraunhofer Institute for Toxicology and Aerosol Research ITA works in the field of environmental and health protection. It supports industry in the development of products and technology that involve the lowest possible health risk potential. The main work of the institute is research into the effects and mechanisms of action of foreign substances, particularly after chronic exposure in the low-dose range.

Fraunhofer-Institut für Umweltchemie und Ökotoxikologie (IUCT) (Fraunhofer Institute for Environmental Chemistry and Ecotoxicology)
Auf dem Aberg 1
D-57392 Schmallenberg/Grafschaft
Phone: ++49-2972-302-0
Fax: ++49-2972-302-319
Telex: 841 520 iuct d
E-mail: info@iuct.fhg.de 5948
Web: http://www.fhg.de/german/profile/iuct.html

The Fraunhofer Institute for Environmental Chemistry and Ecotoxicology IUCT focuses on research, development, and monitoring activities with respect to identifying and characterizing chemical substances and products in the environment, including the determination of ecotoxicological effects.

GSF—Forschungszentrum für Umwelt und Gesundheit (GSF—National Research Center for Environment and Health)
Neuberberg—Ingolstädter Landstraße 1
D-85764 Oberschleißheim
Phone: ++49-89-3187-0
Fax: ++49-089-31 87-3322
Web: http://www.gsf.de

A federal research organization founded in 1960 and aimed in particular at environmental and health research. Topics of research are

- Development of concepts for protection and community health care; development of concepts for prevention and therapy
- Mechanisms and risk quantification of the pollutant effects of chemicals and radiation on the environment and health
- Ecological assessment of physical and chemical waste management

The research of the Institute of Toxicology at the GSF is directed toward establishing the scientific basis for assessing the health risks of chemicals to man. To this end, dose–response relationships are investigated, the mechanism of action is analyzed, and systems for toxicity testing are developed.

Institut für Arbeitsphysiologie an der Universität Dortmund (IfADo, Institute for Occupational Physiology at the University of Dortmund)
Ardeystraße 67
D-44139 Dortmund
Phone: ++49-231-1084-0
Fax: ++49-231-1084-308
Web: http://ergonomie.arb-phys.uni-dortmund.de

A research institute funded in part by the Federal Ministry of Labour and Social Affairs and in part by the State of Nordrhein–Westfalen, which carries out toxicological research in its Department of Toxicology and Occupational Medicine.

Medizinisches Institut für Umwelthygiene an der Universität Düsseldorf (Medical Institute of Environmental Hygiene at the University of Düsseldorf)

Auf'm Hennekamp 50
4100 Düsseldorf 1
Phone: ++49-211-3389-0

This institute was founded in 1962 by the Gesellschaft zur Förderung der Lufthygiene und Silikoseforschung (Society for the Promotion of Air Hygiene and Silicosis Research) and is funded in part by the Federal Ministry of the Environment, Nature Conservation and Nuclear Safety and in part by the state of Nordrhein–Westfalen. It is primarily devoted to the study of the health risks posed by volatile and airborne particulate pollutants and comprises Departments of Molecular Toxicology, Neurotoxicology, and Immunotoxicology.

Öko-Institut—Institut für angewandte Ökologie e.V. (Institute of Applied Ecology)
Binzengrün 34A
D-79114 Freiburg
Phone: ++49-761-452950
Fax: ++49-761-475437
Web: http://www.oeko.de

Nonprofit organization mainly concerned with the environmental impact of toxic chemicals and technical processes.

EDUCATION/SCHOOLS

General

Pharmacology and toxicology are established parts of the curriculum in the study of medicine and pharmacy. Students of chemistry take part in a course on toxicology in the beginning of their studies. Toxicological and ecotoxicological topics are also dealt with in the study of biology. Postgraduate work in toxicology aiming at an academic degree can be carried out at all universities with a medical faculty in the departments of toxicology or pharmacology. A few universities have such departments in the faculty of pharmacy or veterinary medicine. The postgraduate work leads to a doctorate in the discipline of the student's basic degree, e.g., medicine, chemistry, pharmacy, biology, and food chemistry. There is no ''doctor of toxicology'' degree, nor is there a degree in toxicology at the graduate level.

Fachtoxikologe/Fachtoxikologin DGPT

The **Deutsche Gesellschaft für experimentelle und klinische Pharmakologie und Toxikologie (DGPT)** has set up a postgraduate program ''Fachtoxikologe/Fachtoxikogin DGPT.'' Scientists working in the field of toxicology or pharmacology in a qualified institution (e.g., university department) for 5 years or more who can document their experience and knowledge in a catalog of toxicological topics can gain the degree ''Fachtoxikologe/Fachtoxikologin DGPT'' after having passed an oral exam. About fifteen 5-day courses on different toxicological topics are organized at least once a year by the institutions involved in this program.

Graduiertenkolleg Toxikologie und Umwelthygiene der Universität Düsseldorf (Graduate School of Toxicology and Environmental Hygiene of the University of Düsseldorf)
c/o Prof. Dr. Regine Kahl
Institut für Toxikologie der Heinrich-Heine-Universität
Universitätsstrasse 1
D-40225 Düsseldorf
Phone: ++49-211-81-13022
Fax: ++49-211-81-13013

The graduate school is a central academic institution of the University of Düsseldorf. It is affiliated with the Faculty of Science and Mathematics and the Faculty of Medicine. It is devoted to the education of junior scientists in the field of actions of harmful substances on humans and the environment by providing both a thesis research project and a 3-year curriculum on the subjects of toxicology and environmental hygiene. The principal research areas are the carcinogenicity, immunotoxicity, neurotoxicity, and ecotoxicity of harmful substances.

UNIVERSITY DEPARTMENTS OF PHARMACOLOGY AND/OR TOXICOLOGY

Aachen

Institut für Pharmakologie und Toxikologie der RWTH
Wendlingweg 2
D-52074 Aachen
Phone: ++49-241-8089120
Fax: ++49-241-8888433

Berlin

Institut für Klinische Pharmakologie
Medizinische Fakultät/Charité an der Humboldt-Universität
Schumannstraße 20/21
D-10117 Berlin
Phone: ++49-30-28025318
Fax: ++49-30-28025153
Web: http://www.charite.de/ch/institute/pharma.html

Institut für Klinische Pharmakologie am Universitätsklinikum Benjamin Franklin
Freie Universität Berlin

Hindenburgdamm 30
D-12200 Berlin
Phone: ++49-30-84452279
Fax: ++49-30-8445-4482
Web: http://www.medizin.fu-berlin.de/copharm

Institut für Pharmakologie der Freien Universität
Klinikum Rudolf Virchow
Thielallee 67-73
D-14195 Berlin
Phone: ++49-30-838-3370

Institut für Pharmakologie und Toxikologie (WE 14)
Fachbereich Veterinärmedizin der Freien Universität Berlin
Koserstraße 20
D-14195 Berlin
Phone: ++49-30-8383214/3221
(Second address: Luisenstr. 56, D-10117 Berlin; Phone: ++49-30-2093-6307; Web: http://www.vetmed.fu-berlin.de)

Institut für Pharmakologie und Toxikologie
Medizinische Fakultät/Charité an der Humboldt-Universität
Dorotheenstr. 94
D-10117 Berlin
Phone: ++49-30-2202411
Fax: ++49-30-2291174
Web: http://www.charite.hu-berlin.de/ch/institute/toxi.html

Institut für Toxikologie und Embryonalpharmakologie der Freien Universität
Fachbereich Humanmedizin
Garystraße 5
D-14195 Berlin
Phone: ++49-30-8383704
Fax: ++49-30-8314091
Web: http://userpage.fu-berlin.de/~harald

Bochum

Institut für Pharmakologie und Toxikologie der Ruhr-Universität Bochum
Universitätsstraße 150
D-44801 Bochum
Phone: ++49-316-3804306
Fax: ++49-316-3804323
Web: http://www.neurop.ruhr-uni-bochum.de/Info-1-Medizin.html

Bonn

Abteilung Pharmakologie und Toxikologie
Pharmazeutisches Institut der Universität Bonn
An der Immenburg 4
D-53121 Bonn
Phone: ++49-228-735212/13
Fax: ++49-228-737929
Web: http://www.rhrz.uni-bonn.de/~unc600

Institut für Pharmakologie und Toxikologie der Universität
Reuterstraße 2B
D-53113 Bonn
Phone: ++49-228-735410/5411
Fax: ++49-228-735404
Web: http://www.meb.uni-bonn.de/institute/insphatox/insphatox.html

Braunschweig

Institut für Pharmakologie und Toxikologie der Technischen Universität
Mendelssohnstraße 1
D-38106 Braunschweig
Phone: ++49-531-3915665
Web: http://www.tu-bs.de/FachBer/fb3.html

Dresden

Institut für Klinische Pharmakologie der Medizinischen Akademie ''Carl Gustav Carus''
Fiedlerstraße 27
D-01069 Dresden
Phone: ++49-351-458-2815
Fax: ++49-351-458-4341
Web: http://www.tu-dresden.de/medf/institut.htm

Institut für Pharmakologie und Toxikologie der Medizinischen Akademie ''Carl Gustav Carus''
Karl-Marx-Str. 3
D-01109 Dresden
Phone: ++49-351-4769444
Fax: ++49-351-4769444
Web: http://www.tu-dresden.de/medf/institut.htm

Düsseldorf

Institut für Pharmakologie der Universität
Universitätsstrasse 1
D-40225 Düsseldorf
Phone: ++49-211-81-12500
Fax: ++49-211-81-14781
Web: http://www.rz.uni-duesseldorf.de/WWW/MedFak/Pharm/institute.html

Institut für Toxikologie der Universität
Universitätsstrasse 1
D-40225 Düsseldorf
Phone: ++49-211-81-13022
Fax: ++49-211-81-13013
Web: http://www.rz.uni-duesseldorf.de/WWW/MedFak/Tox/toxi.html

Erfurt

Institut für Klinische Pharmakologie im Klinikum Erfurt

Nordhäuser Straße 74
D-99089 Erfurt
Phone: ++49-361-7819737
Fax: ++40-361-7819738

Erlangen

Institut für Experimentelle und Klinische Pharmakologie und Toxikologie der Universität Erlangen-Nürnberg
Universitätsstraße 22
D-91054 Erlangen
Phone: ++49-9131-852293
Fax: ++49-9131-85206119
Web: http://www.rrze.uni-erlangen.de/docs/FAU/fakultaet/med/kle/ekpt.html

Essen

Institut für Pharmakologie
Klinikum der Universität Gesamthochschule Essen
Hufelandstraße 55
D-45147 Essen
Phone: ++49-201-723-3460
Fax: ++40-201-723-5968
Web: http://www.uni-essen.de/fb14.html

Frankfurt/M.

Pharmakologisches Institut für Naturwissenschaftler der Johann-Wolfgang-Goethe-Universität
Biozentrum Niederursel
Marie-Curie-Str. 9, Geb. N 260
D-60439 Frankfurt
Phone: ++49-69-798-29366
Web: http://www.uni-frankfurt.de/~garrit/institute/pharmnat.html

Zentrum der Pharmakologie
Klinikum der Johann-Wolfgang-Goethe-Universität
Theodor-Stern-Kai 7
D-60596 Frankfurt
Phone: ++49-69-6301-6950
Web: http://141.2.61.48/zpharm.htm

Freiburg

Pharmakologisches Institut der Universität
Hermann-Herder-Straße 5
D-79104 Freiburg
Phone: ++49-761-2035313
Fax: ++49-761-2035818
Web: http://www.uni-freiburg.de/pharmakol

Garching

Institut für Pharmakologie und Toxikologie der Akademie des Sanitäts- und Gesundheitswesens der Bundeswehr
Ingolstädter Landstraße 100
D-85748 Garching

Gießen

Institut für Pharmakologie und Toxikologie
Fachbereich Veterinärmedizin
Frankfurter Straße 107
D-35392 Gießen
Phone: ++49-731-5024280
Fax: ++49-731-5024299
Web: http://www.uni-giessen.de/fb18/Pharma-Toxi.html

Rudolf-Buchheim-Institut für Pharmakologie
Justus-Liebig-Universität Gießen
Frankfurter Straße 107
D-35392 Gießen
Phone: ++49-641-7024143
Fax: ++49-641-7023781
Web: http://www.med.uni-giessen.de/infoweb/institut/institu2.htm

Göttingen

Zentrum für Pharmakologie und Toxikologie der Georg-August-Universität
Robert-Koch-Straße 40
D-37075 Göttingen
Phone: ++49-551-395301
Fax: ++49-551-399652
Web: http://regulus.pharbp.med.uni-goettingen.de

Greifswald

Institut für Pharmakologie der Ernst-Moritz-Arndt-Universität
Friedrich-Loeffler-Straße 23d
D-17487 Greifswald
Phone: ++49-3834-86-5633/4
Web: http://www.medizin.uni-greifswald.de/pharmako

Halle

Institut für Pharmakologie und Toxikologie der Martin-Luther-Universität
Magdeburger Str.
D-06112 Halle
Phone: ++49-345-5571773
Fax: ++49-345-5571835
Web: http://www.uni-halle.de/MLU/medizin.html

Institut für Pharmakologie und Toxikologie Sektion Pharmazie der Martin-Luther-Universität
Weinbergweg 15
D-06120 Halle
Phone: ++49-345-5525150
Fax: ++49-345-5527025
Web: http://www.pharmazie.uni-halle.de/ph/pharmtox.html

Institut für Umwelttoxikologie der Martin-Luther-Universität

Franzosenweg 1A
D-06112 Halle
Phone: +49-345-5571630
Web: http://141.48.106.85

Hamburg

Abteilung für Allgemeine Toxikologie
Grindelallee 117
D-20146 Hamburg
Phone: ++49-40-4123-5277
Fax: ++49-40-4123-5316

Pharmakologisches Institut
Universitäts-Krankenhaus Eppendorf
Martinistr. 52
D-20251 Hamburg
Phone: ++49-40-4717-2180
Fax: ++49-40-4717-4876
Web: http://www.uke.uni-hamburg.de/FB__Facilitics.html Institutes

Hannover

Institut für Pharmakologie, Toxikologie und Pharmazie
Tierärztliche Hochschule
Bünteweg 17
D-30559 Hannover
Phone: ++49-511-8568720
Fax: ++49-511-9538581
Web: http://www.tiho-hannover.de/Forschung/Pharma/Welcome.html

Zentrum Pharmakologie und Toxikologie
Medizinische Hochschule Hannover
Carl-Neuberg-Str. 1
D-30625 Hannover
Phone: ++49-511-5322812
Fax: ++40-511-5322879
Web: http://www.mh-hannover.de/institut/toxikologie/index.html

Heidelberg

Pharmakologisches Institut der Universität
Im Neuenheimer Feld 366
D-69120 Heidelberg
Phone: ++49-6221-548246
Fax: ++49-06221-546623
Web: http://www.uni-heidelberg.de/institute/fak5/phak

Homburg

Institut für Pharmakologie und Toxikologie
Universität des Saarlandes
D-66424 Homburg/Saar
Phone: ++49-6841-166400
Web: http://www.med-rz.uni-sb.de/med__fak/pharma-toxi/index.html

Jena

Institut für Klinische Pharmakologie der Friedrich-Schiller-Universität
Bachstraße 18
D-07743 Jena
Phone: ++49-3641-633236
Fax: ++49-3641-633139

Institut für Pharmakologie und Toxikologie der Friedrich-Schiller-Universität
Löbderstraße 1
D-07740 Jena
Phone: ++49-3641-631765
Fax: ++49-3641-631761
Web: http://www.mti.uni-jena.de/~iro/pharma.html

Kaiserslautern

Institut für Lebensmittelchemie und Umwelttoxikologie der Universität Kaiserslautern
Erwin-Schrödinger-Straße
D-67663 Kaiserslautern
Phone: ++49-631-2052974
Web: http://www.uni-kl.de/FB-Chemie/

Kiel

Institut für Pharmakologie
Christian-Albrechts-Universität Kiel
Hospitalstr. 4
D-24105 Kiel
Phone: ++49-431-597-2900
Web: http://www.uni-kiel.de:8080/Pharmakologie

Institut für Toxikologie
Christian-Albrechts-Universität Kiel
Brunswikerstraße 10
D-24105 Kiel
Phone: ++49-431-597-2902

Köln

Pharmakologisches Institut der Universität
Gleueler Straße 24
D-50931 Köln
Phone: ++49-221-478-6054
Fax: ++49-221-478-5022
Web: http://www.rrz.uni-koeln.de/med-fak

Leipzig

Institut für Klinische Pharmakologie
Härtelstraße 16/18
D-04107 Leipzig
Phone: ++49-341-9724650
Web: http://www.uni-leipzig.de/stru4.html#institute

Institut für Pharmakologie Pharmazie, und Toxikologie der Veterinärmedizinischen Fakultät der Universität Leipzig

Zwickauer Str. 55
D-04103 Leipzig
Phone: ++49-341-97-38130/1
Fax: ++49-341-97-38149
Web: http://www.uni-leipzig.de/stru2.html#veter

Institut für Pharmakologie und Toxikologie der Universität
Härtelstraße 16/18
D-04107 Leipzig
Phone: ++49-341-97-24600
Fax: ++49-34197-24609
Web: http://www.uni-leipzig.de/~pharma

Lübeck

Institut für Pharmakologie
Medizinische Universität zu Lübeck
Ratzeburger Allee 160
D-23562 Lübeck
Phone: ++49-451-5002682
Web: http://www.zuv.mu-luebeck.de/selbst/instklin/instklin.htm

Institut für Toxikologie
Medizinische Universität zu Lübeck
Ratzeburger Allee 160
D-23562 Lüeck
Phone: ++49-451-5002695
Fax: ++49-451-5002703
Web: http://www.zuv.mu-luebeck.de/selbst/instklin/instklin.htm

Magdeburg

Institut für Klinische Pharmakologie
Otto-von-Guericke-Universität Magdeburg
Leipziger Straße 44
D-39120 Magdeburg
Phone: ++49-391-671-3060
Fax: ++49-391-671-3062
Web: http://www.med.uni-magdeburg.de/image/24.htm

Institut für Pharmakologie und Toxikologie
Otto-von-Guericke-Universität Magdeburg
Leipziger Straße 44
D-39120 Magdeburg
Phone: ++49-391-672875
Web: http://www.med.uni-magdeburg.de/image/23.htm

Mainz

Institut für Toxikologie der Universität
Obere Zahlbacher Straße 67
D-55131 Mainz
Phone: ++49-6131-231721
Fax: ++49-6131-230506

Pharmakologisches Institut der Universität
Obere Zahlbacher Straße 67
D-55131 Mainz
Phone: ++49-6131-17-7170
Fax: ++49-6131-17-6611
Web: http://vzdmzi.zdv.uni-mainz.de/~meincke/institut.html

Mannheim

Institut für Pharmakologie und Toxikologie der Fakultät für Klinische Medizin Mannheim der Universität Heidelberg
Maybachstraße 14-16
D-68169 Mannheim
Phone: ++49-621-331067
Fax: ++49-621-377601
Web: http://www.uni-heidelberg.de/institute/fak16/tox

Marburg

Institut für Pharmazeutische Pharmakologie und Toxikologie
Fachhereich Pharmazie und Lebensmittelchemie der Universität
Ketzerbach 63
D-35037 Marburg
Phone: ++49-6421-281310
Fax: ++49-6421-288918
Web: http://www.pharmazie.uni-marburg.de//fbpharmazie/pharmtoxic/inhalt.html

Institut für Pharmakologie und Toxikologie der Universität
Karl-von-Frisch-Strasse 1
D-35033 Marburg
Phone: ++49-6421-28-000
Fax: ++49-6421-28-5600
Web: http://www.uni-marburg.de/pharmacology

München

Institut für Pharmakologie, Toxikologie und Pharmazie der Tierärztlichen Fakultät der Universität
Königinstr. 16
D-80539 München
Phone: ++49-89-2180-2663
Web: http://www.uni-muenchen.de/lmu/fakultaeten.html

Institut für Pharmakologie und Toxikologie der Technischen Universität
Biedersteiner Straße 29
D-80802 München
Phone: ++49-89-3849-3260
Fax: ++49-89-3849-3261

Web: http://www.imse.med.tu-muenchen.de/#kliniken

Institut für Toxikologie und Umwelthygiene der Technischen Universität
Lazarettstraße 62
D-80636 München
Phone: ++49-89-1209501
Web: http://www.imse.med.tu-muenchen.de/#kliniken

Walther-Straub-Institut für Pharmakologie und Toxikologie der Ludwig-Maximilians-Universität
Nußbaumstraße 26
D-80336 München
Phone: ++49-89-514521
Fax: ++49-89-5142224
Web: http://www.med.uni-muenchen.de/vv/ss96/RTFToC33.html

Münster

Institut für Pharmakologie und Toxikologie der Universität
Domagkstraße 12
D-48149 Münster
Phone: ++49-251-835510
Web: http://medweb.uni-muenster.de/institute/campus/einrichtungen/35.html

Institut für Pharmazeutische Chemie
Abteilung Pharmakologie für Naturwissenschaltler der Universität
Hittorfstr. 58-63
D-48149 Münster
Phone: ++49-251-833339
Fax: ++49-251-833310
Web: http://www.uni-muenster.de/Chemie/PZ

Regensburg

Lehrstuhl für Pharmakologie der Universität
Universitätsstraße 31
D-93053 Regensburg
Phone: ++49-941-943-4764
Fax: ++49-941-943-4771

Rostock

Institut für Pharmakologie und Toxikologie
Schillingallee 70
D-18055 Rostock
Phone: ++49-381-396994
Fax: ++49-381-396911
Web: http://www.ipharma.med.uni-rostock.de/index.html

Stuttgart

Institut für Lebensmitteltechnologie
Fachgebiet Pharmakologie und Toxikologie der Ernährung der Universität Hohenheim
Postfach 700562
D-70593 Stuttgart
Phone: ++49-711-459-2305
Fax: ++49-711-459-3443
Web: http://www.uni-hohenheim.de/~ltserv/index.html

Tübingen

Institut für Toxikologie der Universität
Wilhelmstraße 56
D-72074 Tübingen
Phone: ++49-7071-292274
Fax: ++49-7071-292273
Web: http://www.uni-tuebingen.de/uni/tfi

Lehrstuhl Pharmakologie für Naturwissenschaftler
Pharmazeutisches Institut der Universität
Auf der Morgenstelle 8
D-72076 Tübingen
Phone: ++49-7071-294675
Fax: ++49-7071-292476
Web: http://www.uni-tuebingen.de/uni/cpi/PHARPKOL.HTML

Pharmakologisches Institut der Universität
Wilhelmstraße 56
D-72074 Tübingen
Phone: ++49-7071-292268
Fax: ++49-7071-294942
Web: http://www.uni-tuebingen.de/uni/tfi

Ulm

Abteilung Pharmakologie und Toxikologie der Universität
Albert-Einstein-Allee-11
D-89081 Ulm
Phone: ++49-731-502-3870
Fax: ++49-731-502-3872
Web: http://www.uni-ulm.de/uni/fak/medizin/pharma

Witten

Lehrstuhl für Pharmakologie und Toxikologie der Universität Witten-Herdecke
Stockumer Str. 10
D-58453 Witten
Phone: ++49-2302-669143

Würzburg

Institut für Pharmakologie und Toxikologie der Universität
Versbacher Straße 9
D-97078 Würzburg
Phone: ++49-931-201-5402
Fax: ++49-931-201-3446
Web: http://www.uni-wuerzburg.de/toxikologie

Departments of occupational medicine and departments of environmental medicine are located at most medical schools. In many of these departments scientific teams are working on toxicological topics.

INFORMATION RESOURCES

Poison Information Centers

Berlin

Landesberatungsstelle für Vergiftungserscheinungen und Embryonaltoxikologie
Pulsstr. 3-7
D-14059 Berlin
Phone: ++49-30-19240
Fax: ++49-30-32680721
Web: http://www.giftnotru/de

Virchow-Klinikum
Med. Fakultät der Humboldt-Universität zu Berlin, Abt. Innere Medizin mit Schwerpunkt Nephrologie und Intensivmedizin
Augustenburger Platz 1
D-13353 Berlin
Phone: ++49-30-450-53555, 565
Fax: ++49-30-450-53915

Bonn

Informationszentrale gegen Vergiftungen
Zentrum für Kinderheilkunde der Rheinischen Friedrich-Wilhelms-Universität Bonn
Adenauerallee 119
D-53113 Bonn
Phone: ++ 49-228-287 3211, -3333
Fax: ++49-228-2873314
Web: http://www.meb.uni-bonn.de/giftzentrale/

Erfurt

Gemeinsames Giftinformationszentrum der Länder Mecklenburg-Vorpommern, Sachsen, Sachsen-Anhalt und Thüringen
Nordhäuser Str. 74
D-99089 Erfurt
Phone: ++49-361-730730
Fax: ++49-361-7307317

Freiburg

Universitätskinderklinik Freiburg
Informationszentrale für Vergiftungen
Mathildenstr. 1
D-79106 Freiburg
Phone: ++49-761-19240 (emergency calls), -270 4300 (local operator)
Fax: ++49-761-2704457
Web: http://www.ukl.uni-freiburg.de/kinderkl./viz/homede.htm

Göttingen

Giftinformationszentrum-Nord (GIZ-Nord)
Zentrum Pharmakologie und Toxikologie der Universität Göttingen
Robert-Koch-Str. 40
D-37075 Göttingen
Phone: ++49-551-383 180, -19240
Fax: ++ 49-551-383 18 81
Web: http://www.giz-nord.de

Homburg

Universitätskliniken
Klinik für Kinder- und Jugendmedizin
Informations- und Beratungszentrum für Vergiftungsfälle
D-66421 Homburg/Saar
Phone: ++49-6841-19240, -16 8315
Fax: ++49-6841-164017
Web: http://www.med-rz.uni-sb.de/med__fak/kinderklinik/kikl6a.htm

Mainz

Beratungsstelle bei Vergiftungen
II. Medizinische Klinik und Poliklinik der Universität
Langenbeckstr. 1
D-55131 Mainz
Phone: ++ 49-6131-19 240, -232466
Fax: +49-6131-176605
Web: http://www.giftinfo.uni-mainz.de

München

Giftnotruf München
Toxikologische Abteilung der II. Medizinischen Klinik rechts der Isar
der Technischen Universität München
Ismaninger Str. 22
D-81675 München
Phone: ++49-89-19240
Fax: ++49-89-41402467

Nürnberg

II. Medizinische Klinik des Städtischen Krankenhauses Nürnberg Nord
Toxikologische Intensivstation
Flurstr. 17
D-90419 Nürnberg
Phone: ++49-911-3982451
Fax: ++49-911-3982999

Information Providers of Online Databases

DIMDI—Deutsches Institut für med. Dokumentation und Information
Weißhausstr. 27

D-50939 Köln
Phone: ++49-221-4724-1
Fax: ++49-221-411429
Web: http://www.dimdi.de

The German Institute for Medical Documentation and Information has the task to collect, evaluate, and store national and foreign literature and other information in the area of medicine and related areas and to provide access to these data to the public continuously or on demand using electronic data processing.

Fachinformationszentrum Karlsruhe (FIZ Karlsruhe)
Postfach 2465
D-76012 Karlsruhe
Phone: ++49-7247-808-555
Fax: ++49-7247-808-259
Web: http://www.fiz-karlsruhe.de/home.html

FIZ Karlsruhe is a nonprofit organization set up to provide information and information services for academic and industrial research and development, as well as for business and administration. In cooperation with its partners in the United States and Japan, FIZ Karlsruhe operates the host STN International, offering public access to databases with scientific, technical, and supplementary business information.

Internet Search Locations

German institutions involved in research or administration in the fields of toxicology and pharmacology can be accessed via subject-specific search systems.

The "Frankfurter Index"
Web: http://www.klinik.uni-frankfurt.de/findex24.htm

Mainly focused on pharmacology, whereas the searching resources at the Giftinformationszentrum Nord, http://www.giz-nord.de/giznosd/cont__links.html, are directed to institutions involved in toxicological topics.

LEGISLATION

In Germany, the manufacturer, importer, or supplier has the primary responsibility for the safety of chemical compounds. A number of laws dealing with chemical compounds provide the legal authority for control and intervention by public agencies. Although handling of chemical compounds is regulated by national legislation, national legislation must be harmonized with legislation in the European Union, and guidelines of the European Union have bindingly to be adopted by national regulation. The most important laws dealing with chemical compounds are described here.

Arzneimittelgesetz (Drug Law)
Responsibility: Bundesministerium für Gesundheit (Federal Ministry for Health)
Federal agency in charge: Bundesinstitut für Arzneimittel und Medizinprodukte (Federal Institute for Drugs and Medical Devices) in Berlin

The Drug law prescribes a procedure for the marketing authorization for drugs in which the quality, clinical efficiency, and safety of new drugs is assessed. Extensive toxicological data are required for this procedure. The Drug Law requires benefit assessment in addition to risk assessment.

Bundesimmissionsschutzgesetz (Federal Immissions Control Act)
Responsibility: Bundesministerium für Umwelt, Naturschutz und Reaktorsicherheit (Federal Ministry of the Environment, Nature Conservation and Nuclear Safety)
Federal agency in charge: Umweltbundesamt (Federal Environmental Agency)

The law is devoted to the protection of humans, animals, plants, and objects from harmful effects arising from the environment, in particular from the air. It prescribes a procedure for the approval of installations in order to minimize the emission of dangerous substances into the environment.

Chemikaliengesetz (Act on Protection against Dangerous Substances—Chemicals Act)
Responsibility: Bundesministerium für Arbeit und Sozialordnung (Federal Ministry of Labour and Social Affairs)
Federal agency in charge: Bundesanstalt für Arbeitsschutz und Arbeitsmedizin (Federal Institute for Occupational Safety and Health) in Dortmund

The law prescribes a registration procedure for all chemical compounds to be introduced into the market except those regulated by another law. The extent of toxicological data required for registration depends on the amount of the chemical to be marketed. The law regulates the classification and labeling of chemicals and the handling of chemicals in the workplace, including the establishment of threshold values.

Lebensmittel- und Bedarfsgegenständegesetz (Law on Foods and Commodities)
Responsibility: Bundesministerium für Gesundheit (Federal Ministry for Health)
Federal agency in charge: Bundesinstitut für gesundheitlichen Verbraucherschutz und Veterinärmedizin

(Federal Institute for Health Protection of Consumers and Veterinary Medicine) in Berlin

The law regulates the handling of foods, tobacco products, cosmetics, and commodities. It is devoted to the protection of the consumer by prohibiting products that may affect human health. It prescribes that only approved food additives may be used.

Pflanzenschutzgesetz (Plant Protection Law)
Responsibility: Bundesministerium für Ernährung, Landwirtschaft und Forsten (Federal Ministry for Food, Agriculture and Forestry)
Federal agency in charge: Biologische Bundesanstalt (Biological Research Center for Agriculture and Forestry)

The law prescribes a procedure for the marketing authorization for pesticides in which extensive toxicological data are required in order to ensure that the compounds do not exhibit harmful effects on humans, animals, or the environment.

These laws contain authorizations for the government to enact ordinances (Verordnungen) that regulate issues of the law in detail below the legislation level. For instance, details concerning the issues of the Chemicals Act are regulated in the Ordinance on Dangerous Substances (Gefahrstoffverordnung) published by the Federal Ministry for Labour and Social Affairs. Since Germany is a confederation, the approval of the Bundesrat (Federal Council, representing the federal states) is required for many of these ordinances. Federal agencies are responsible for the registration and marketing authorization, for the establishment of threshold values, and for the recommendation of precautions for health protection, whereas agencies of the states are responsible for supervision and prosecution.

India

SUSHMA SHARMA, S. N. AGARWAL, AND P. K. SETH

During the past two decades, the discipline of toxicology has received significant attention in India. Though currently toxicology does not exist in most universities, training and research work in the field of toxicology are being undertaken in various departments, such as botany, zoology, chemistry and biochemistry, and veterinary and medical schools. A significant amount of research work in the field of toxicology is also being conducted in laboratories of Council of Scientific and Industrial Research (CSIR), Indian Council of Agricultural Research (ICAR), and Indian Council of Medical Research (ICMR). Both academic and regulatory toxicology are being pursued and the subject has advanced from mere determination of LD_{50} in animals to understanding of the mechanism of action of the toxic chemicals at cellular and molecular levels, developing methods for monitoring exposure to chemicals, validating short-term methods for toxicity testing and risk assessment, and developing interventional strategies against adverse effects of the chemicals and drugs.

There is a significant awareness about the adverse effects of pollutants and exposure of human population through the food chain. Therefore, widespread monitoring of pesticides and metals in the major rivers, such as the Ganga, Yamuna, and Gomti, has been undertaken at the national level. Also, water quality monitoring of Indian aquatic resources at 480 stations under the Global Environmental Monitoring System and of Monitoring of Indian National Aquatic Resources is being undertaken.

For ambient air quality assessment, a National Ambient Air Quality Monitoring Programme has been initiated. Under this program monitoring stations have been established in 92 cities and towns. Likewise, all India coordinated programs involving several institutions have been undertaken on the monitoring of the heavy metals and residues of organochlorine pesticides in food materials. For safeguarding the environment, pollution control laws have been enacted and data on environmental impact, carrying capacity, and preparation of environmental management plans have been made mandatory for the new industries. Adoption of cleaner modes of production helps in resource conservation and elimination of gaseous, liquid, or solid wastes.

''Demonstration projects'' are being initiated for promotion of cleaner modes of production in selected areas. On the basis of research and development, many steps including process modification, raw material recycling, and equipment design are possible in highly polluting industries, such as fertilizer, sugar, pulp and paper, and textile.

For disposal of hazardous solid wastes, disposal sites are being identified throughout the country. A scheme of labeling of environmental-friendly products (ECOMARK) has been initiated for household and other consumer products to meet certain environment critera in addition to quality requirements of Indian standards. There has been substantial growth of the discipline of toxicology and the resources in the area.

BOOKS

Abdulla, M., Vohora, S. B., and Athar, M. (1995)
Trace and Toxic Elements in Nutrition and Health: Proceedings of the Fourth International Conference on Health and Disease: Effects of Essential and Toxic Trace Elements, New Delhi, February, 8–12, 1993
Wiley, New Delhi

This proceeding covers papers on toxicology, health and disease, oxidants, free radicals and antioxidants, environment, nutrition, therapeutics, and analyses.

Agarwal, A. (1987)
The Fight for Survival: People's Action for Environment
Centre for Science & Environment, New Delhi

Agarwal, V. P. (1990)
Recent Trends in Limnology
Society of Biosciences, Muzaffarnagar

The book has articles on marine water, lakes, rivers (especially the Ganga river), and high-altitude limnology. The book places special emphasis on the fish population and serves as a guide to deal with limnological problems.

Agarwal, V. P., and Rana, S. V. S. (1979)
Life and Toxic Environment
DAV College, Muzaffarnagar

Proceedings of the symposium on life and toxic environment held at DAV College, Muzaffarnagar, January 13–16, 1979. The book includes 10 papers related to environmental toxicology.

Agarwal, V. P., and Rana, S. V. S. (1986)
Science, Development and Environment
Society of Biosciences, Muzaffarnagar

The book contains 32 papers presented at a seminar, ''Science, Development & Environment,'' held at D.A.V. College, Muzaffarnagar, during February 1986. It gives an integrated picture of the environment in relation to the process of economic development.

Agarwal, V. P., Desai, B. N., and Abidi, S. A. H. (1989)
Management of Aquatic Ecosystems
Society of Biosciences, Muzaffarnagar

The book is the proceedings of the seminar held in December 1988 at NIO, GOA. It contains 33 papers on aquatic ecosystems and their management in the different parts of the country.

Ahmad, S., Chandra, S. V., and Ray, P. K. (1987)
ITRC Manual for Metal Analysis in Water
ITRC, Lucknow

Anand, R. P., and Bhatt, S. (1987)
Law, Science and Environment
Banayan, New Delhi

Proceedings of the conference on the environment which took place March 1–3, 1985 in New Delhi. The papers describe the role of law and science in the protection of the environment.

Athar, M., and Vohora, S. B. (1995)
Heavy Metals and Environment
New Age Internat, New Delhi

A part of *Man and Environment* series: discusses diverse issues relating to heavy metals and environmental and human health problems.

Balakrishnan, M. (1993)
Environmental Problems and Prospects in India
Oxford, New Delhi

The book has four sections: (i) Habitats, resources, and conservation; (ii) environmental problems and solutions; (iii) resource utilization; and (iv) conservation education. India's environmental problems and conservation activities with information on developments are explained.

Bandyopadhyay, J., Jayal, N. D., Schoettli, U., and Chhatrapati, S. (1985)
India's Environment: Crises and Responses
Natraj, Dehra Dun

The book is a collection of papers selected from a series of six seminars on various aspects of the environmental crises held in 1984 in various parts of India.

Beg, M. U., Saxena, R. P., Kidwai, R. M., Agarwal, S. N., Siddiqui, F., Sinha, R., Bhattacharji, B. D., and Ray, P. K. (1989)
Toxicology Map of India, Vol 1—Pesticide
ITRC, Lucknow

Bhabha Atomic Research Centre (BARC) (1970)
Proceeding of the Seminar on Pollution and Human Environment, August 26–27, 1970
BARC, Bombay

Proceedings of a seminar in which several papers on the sources of pollution and their hazards dealing with pesticides, water, air, noise, and other industrial pollutants were presented.

Bhattacharjee, J. W., Sikabit, D., Joshi, B., Pathak, S. P., Ramtake, P. W., Gaur, A., Viswanathan, P. N., and Ray, P. K. (1989)
Bacteriological Map of India in Relation to Rural Drinking Water
ITRC, Lucknow

Caius, J. F. (1986)
The Medicinal and Poisonous Plants of India
Scientific Publishers, Jodhpur

This book contains 24 papers on medicinal and poisonous plants of India, poisonous plants of important families, their identification, chemical substances, etc. Includes an index of botanical names of plants.

Chakravarty, S. (1990)
Drinking Water & Science: An Indian Experiment
Batra, New Delhi

Chakraverty, C. (1996)
Environment for Everyone
Augustan, Delhi

Chand, A. (1985)
Environmental Challenges: Global Survey
U.D.H. Pub., Delhi

Chandola, R. P., and Kandwal, R. (1995)
Environmental Factors to Biological Concept, 2 vols.
Printwell, Jaipur

The book highlights and emphasizes various factors of the environment as related to the basic factors of integral living beings. The book is divided into two

parts—the first one deals with botany and the second with zoology.

Chandra, S. V. (1982)
Toxic Metals in Environment: A Status Report of R&D Work Done in India
ITRC, Lucknow

The book describes all aspect of metals such as production, uses, environmental pollution, biological effects, interactions, therapeutic approaches, sampling and analytical procedures, and recommendations for the future.

Chaphekar, S. B., and Mhatre, G. N. (1986)
Human Impact on Ganga River Ecosystem: An Assessment
Concept Publication, New Delhi

The report is a compilation of facts about the river Ganga, from its origin in the high Himalayas to the delta region, through which it meets the Bay of Bengal. The information was collected from numerous sources, such as universities, national laboratories, and relevant departments of the central and state governments.

Chaturvedi, C. K. (1981)
Legal Control of Marine Pollution
Deep & Deep, New Delhi

The author describes the causes, sources, and effects of marine pollution and the necessity of comprehensive legal control. The appendix reproduces four Geneva conventions on laws of the sea and other conventions relevant to pollution control.

Chatwal, G., and Anand, S. (1984)
Instrumental Methods of Chemical Analysis, 2nd rev. ed.
Himalaya, Bombay

Methods of chemical analyses by spectroscopy, microwave, infrared, Raman visible spectrophotometry, and ultraviolet spectroscopy are described in detail. Chromatographic techniques are also explained.

Chauhan, P. S., and Reddy, P. P. (1988)
Nature of Genetic Variation in Man
Environmental Mutagen Society of India, Bombay

This book is a proceedings of an international symposium held during the 12th annual conference of the Environmental Mutagen Society of India, Hyderabad.

Chishti, A. (1986)
Dataline Bhopal: A Newsman's Diary of Gas Disaster
Concept Publication, New Delhi

Vital facts related to the gas leakage at Union Carbide's pesticides plant on the night of December 2 to 3, 1984, at Bhopal in India have been described.

Cier (1998)
Cier's Industrial Databook 1998
Cier, New Delhi

Desai, A. (1985)
Environmental Perception: The Human Factor in Urban Planning
Ashish, New Delhi

The book focuses on urban residents' perception of and relationship to their physical and social environment. It is an attempt to analyze residents' sensitivity awareness and adaptibility to various environmental problems in the case city of Ahemdabad.

Desh Bandhu and Ramanathan, N. L. (Eds.) (1982)
Education for Environmental Planning and Conservation: Proceedings of the International Conference on Environmental Education Organised by the Indian Environmental Society and the Department of Environment

Desh Bandhu and G. Berberet (Eds.) (1987)
Environmental Education for Conservation and Development: Proceedings of the Second International Conference on Environmental Education, New Delhi, 1985.
Indian Environmental Society, New Delhi

It includes 67 papers on environmental education.

Dikshith, T. S. S. (1996)
Safety Evaluation of Environmental Chemicals
New Age Internat, New Delhi

Dikshitht, T. S. S., Chandra, S. V., Viswanathan, P. N., and Ray, P. K. (1989)
Manual for Safety Evaluation of Chemicals
ITRC, Lucknow

Diwan, P. (1987)
Environmental Protection: Problems, Policy, Administration and Law
Deep, New Delhi

Glasson, J. (1994)
Introduction to Environmental Impact Assessment
Res Press, New Delhi

Goel, P. K., and Sharma, K. P., (1996)
Environmental Guidelines and Standards in India
Techno, Jaipur

Gupta, B. N., Agarwal, S. N., Viswanathan, P. N., Chandra, S. V., and Ray, P. K. (1984)
Environmental Hygiene: National Status Report Prepared for the Biological Coordination Council, CSIR.
ITRC, Lucknow

A national status report on biomedical aspects prepared for the Biological Coordination Council, CSIR. It includes problems, capabilities, abatment measures, and future strategy.

Gupta, P. K. (1986)
Pesticides in the Indian Environment
(Environmental Science series)
Interprint, New Delhi

The author describes the production and consumption of pesticides in India and rural prosperity as a result of the use of pesticides. Health hazards and environmental implications of pesticides are also discussed.

Gupta, P. K. (1988)
Advances in Toxicology and Environmental Health: Proceedings of the Sixth Annual Conference of the Society of Toxicology, 11–14 April, 1987 Held at Guwahati, Assam
Jagmander, New Delhi

This volume of *Advances in Toxicology and Environmental Health* includes 21 selected papers presented during the annual conference of the Society of Toxicology held in Guwahati in 1987.

Gupta, P. K. (1988)
Veterinary Toxicology (A Manual for Veterinarians)
Cosmo, New Delhi

Gupta, P. K., and Salunkhe, D. K. (1985)
Modern Toxicology, 3 vols.
Metropolitan, New Delhi

Various essays written by specialists on the currently important areas of toxicology, environmental health hazards, immunotoxicology, and clinical poisons.

Indian Chemical Manufacturers Association (1986)
Proceedings of the Lecture Series on Recent Advances in the Application of Radioisotopes and Radiation in the Chemical Industry
Indian Chemical Manufacturers Associations, Bombay

Jaffery, F. N., Chawla, G., Kakkar, P., Misra, V., Viswanathan, P. N., and Ray, P. K. (1986)
Toxicity Data Handbook, Vols. 1 and 2
ITRC, Lucknow

Jaffery, F. N., Chawla, G., Kakkar, P., Misra, V., Soni, R., Viswanathan, P. N., and Ray, P. K. (1986)
Toxicity Data Handbook, Vol. 3 (Pesticides–A) and Vol. 4 (Pesticides–B),
ITRC, Lucknow

Kelkar, S. A. (1979)
Occupational Exposure to Mercury
Popular Prakashan, Bombay

This book was published as a result of studies undertaken to determine the extent of health hazards to workers from exposure to metallic mercury in India.

Khanna, S. (1995)
Health from Waste
Tata Energy Res Institute, New Delhi

Kidwai, A. M. (1991)
Biomembranes in Health and Diseases, 2 vols.
Proceedings of an international conference organized at the Industrial Toxicology Research Centre, Lucknow, November 1–4, 1988
Today & Tomorrow, New Delhi

Krishna Murti, C. R. (1984)
Pesticide Residues in Food and Biological Tissue
INSA, New Delhi

Krishna Murti, C. R. (1991)
The Ganga: A Scientific Study
Northern Book Centre, New Delhi

Krishna Murti, C. R. (1991)
Toxic Metals in the Indian Environment
Tata McGraw, New Delhi

Kudesia, V. P. (1985/1986)
Air Pollution
Pragati Prakashan, Meerut

The book highlights the magnitude of air pollution of industries, thermal power plants, metals, methyl isocyanate, and odor and noise in India. The book deals with air pollution, instruments, sampling procedures, emission inventory, air quality management, suggestions, and air pollution laws.

Kumar, G. (1993)
Industrial Pollution, Management and Control
Concept Publication, New Delhi

Kumar, G., and Anand, P. (1993)
Expertise in Pollution Management and Control: A Directory
Institute of Social Sciences, New Delhi

The directory, divided into two parts, covers important institutions, universities, colleges, and other expertise in the country. Part A deals with expertise available in the field of industrial pollution management and control, and part B deals with forestry, ecology, and allied fields.

Kumar, R. (1987)
Environmental Pollution and Health Hazards in India
Ashish, New Delhi

This book provides general information on environmental pollution and health hazards in India.

Lobo-Mendonca, R. (1965)
Protecting the Indian Worker
SSIM, Bombay

This book is a collection of 12 papers written by Dr. R. L. Mendonca. The papers are related to prevention of toxic hazards associated with different occupations in Indian industry. Some of the papers contain original work carried out by Dr. Mendonca as a medical inspector of factories.

Malviya, R. A. (1987)
Environmental Pollution and Its Control under International Law
Chugh, Allahabad

The author offers many valuable suggestions for a better legal regime to combat the hazards caused by marine pollution.

Mathur, M. (1986)
Legal Control of Environmental Pollution
Deep, New Delhi

Mehrotra, N. K., Kumar, S., and Shukla, Y. (1990)
Carcinogenic Effects of Pesticides
ITRC, Lucknow

Mishra, S. K. (1993)
Industrial Pollution and Plants, 2 vols.
Ashish, New Delhi

Modi, N. J. (1977)
Modi's Textbook of Medical Jurisprudence and Toxicology, 12th ed.
Tirpathi, Bombay

Mukherjee, A. G. (1986)
Environmental Pollution and Health Hazards Causes and Control
Galgotia, New Delhi

This book contains 21 chapters on health hazards such as those in the metalworking trades, solvent use, lung diseases in foundry workers, cancer resulting from shipyard work, and air and noise pollution.

Nanda, J. N. (1984)
Materials and Environment
Interprint, New Delhi

The author explains corrosion protection methods which either inhibit anodic reaction by disallowing the reaction from the environment to get close to the structure or by means of organic or inorganic additives inhibiting the cathodic reactions. The electrochemical protection methods are described.

Nath, R. (1986)
Environmental Pollution of Cadmium: Biological Physiological and Health Effects (*Environmental Science* series)
Interprint, New Delhi

The book presents a critical review of selected topics on biochemical, physiological, and health effects due to cadmium exposure particularly in the area of intoxication and detoxification mechanisms.

Pandya, C. G. (1988)
Hazards in Chemical Units— A Study
Oxford, New Delhi

Parikh, C. K. (1970)
Simplified Textbook of Medical Jurisprudence and Toxicology
Medical Pub., Bombay
The book presents the subject of forensic medicine and the developments in the science. The critical evaluation of the text and its presentation enhance the status of the subject.

Patel, B. (1980)
Management of Environment
Wiley Eastern, New Delhi

This commemorative volume is dedicated to Dr. A. K. Ganguly, a distinguished fellow of both the Indian National Science Academy and the Indian Academy of Sciences and a pioneer in the field of environment and management. It contains 44 research papers explaining different environmental pollution sources and their prevention management.

Prakash, R. (1995)
Toxicity and Monitoring of Xenobiotics
Venus, New Delhi

This book includes information on the allowable limits of chemicals for health and their toxic effects on different tissues/organs of animals. The book also includes sources of high levels of xenobiotics and suggestions for remedies.

Prakash, R. (1989)
Recent Trends in Toxicology
Society of Biosciences, Muzaffarnagar

The book is the collection of 21 papers in the disciplines of biochemistry, toxicology, pharmacology, and environmental science.

Prasad, A. B. (Ed.) (1986)
Mutagenesis— Basic and Applied
Print House, Lucknow

The book is primarily based on the Proceedings of the 15th International Congress of Genetics Satellite

Symposium held at Darbhanga (India). It includes critical reviews on basic and applied aspects of mutagenesis. It contains 24 articles covering fundamental aspects of mutagenesis, improvement in cereals, pulses, and oil seeds through mutation breeding and environmental mutagenesis.

Raghavan, K. V., and Thyagarajan, G. (1988)
Hazard and Risk Analysis in Chemical Process Industries
Costed, Madras

The publication contains authoritative papers on analysis of past accidents and the principal components in design, layout, location, construction, operation, controls, and the maintenance of all systems to reduce hazards and maximize safety. The chemical plants and their products, such as fertilizers and pesticides, are discussed. The risks and means of ensuring safety in storage, transportation, and application of chemical products are also documented.

Rai, A. K. (1997)
Cynobacterial Nitrogen Metabolism and Environmental Biochemistry
Narosa, New Delhi

Raizada, R. B., and Dikshith, T. S. S. (1992)
Pesticides Development, Toxicology & Safety
ITRC, Lucknow

Rajamanickam, C. (1987)
Biomembranes: Structure Biogenesis & Transport—Proceedings of the Biomembrane Symposium
Today and Tomorrow, New Delhi

Rana, B. C. (1995)
Pollution and Biomonitoring
Tata McGraw-Hill, New Delhi

Rao, D. N., Ahmad, K. J., Yunus, M., and Singh, S. N. (1985)
Perspectives in Environmental Botany, Vol. 1
Print House, Lucknow

This book describes plants as the saviors of the environment and how they help to maintain the balance and good health of natural ecosystems. It contains 17 leading papers covering air quality, phytotoxicity, fluorides and fly ash, relative sensitivity of horticulture crops, urban industrial pollution, accumulation of ions in plant species, ecology of estuaries, and altitude variation in vegetation on the Himalyas.

Rohatgi, A. K. (1986)
Safe Handling of Hazardous Chemicals
J. K. Interprises, Bombay

Saxena, M. M. (1990)
Applied Environmental Biology—I. Resource and Management
Agro Biotech, New Delhi

Sen, A. K. (1988)
Environmental Management and Planning
Wiley, New Delhi

The proceedings of the National Symposium on Environmental Management and Planning: A Model for 2001 AD. The symposium was held on October 29–31, 1986.

Seth, P. K., and Srivastava, S. P. (1988)
A Manual for Safety Evaluation of Plastics
ITRC, Lucknow

Sharma, K. (1986)
Perspective in Nuclear Toxic and Hazardous Waste (*World Environment Science* series No. 010)
Commonwealth, New Delhi

Shastri, S. (1988)
Noise Pollution: Its Scientific & Legal Perspective
Divyajyoti, Jodhpur

Singh, K. P., Takru, R., and Ray, P. K. (1987)
Analysis of Pesticide Residues in Water
ITRC, Lucknow

Singh, Pramod (1985)
Environmental Pollution and Management
Chugh, Allahabad

The book deals with various elements of environmental pollution and suggestions have been made for environmental management.

Singh, R. B., and Misra, S. (1996)
Environmental Law in India
Concept, New Delhi

A collection of papers presented at the National Symposium on Environmental Ethics in 1992. It includes some environmental laws of India.

Singh, R. L., and Singh Rana (1982)
Environmental Appraisal and Rural Habitat Transformation (Proceedings of the IGU Symposium, Meerut, March 16–20, 1982)
National Geographical Society of India, Varanasi

These proceedings are the outcome of an international symposium on ''energy resources, environmental and habitat transformation in developing countries'' held at Meerut University. The book has four sections: Environmental appraisal; changing habitat: approach and strategy; habitat development: structure and strategy; and country level changing habitat.

Sood, P. P. (1995)
Methyl Mercury Toxication and Chelation
Venus, New Delhi

Srivastava, V. K., and Muley, E. V. (1995)
Industrial Pollution (with Specific Reference to Sugar Factories and Distilleries)

International Society for Environmental Protection, Gorakhpur

Proceedings of the workshop on industrial pollution (with special reference to sugar industries and distilleries). The book contains 26 papers on environmental pollution.

Talwar, G. P. (1983)
A Handbook of Practical Immunology
Vikas, New Delhi

Trivedi, R. K. (1998)
Advances in Wastewater Treatment Technologies
Global Science, Aligarh

Trivedi, R. N., Chari, K. S., and Pachaiyappan, V. (1979)
Pollution Control in Fertiliser Industry
The Fertiliser Association of India, New Delhi

The book describes legislation and model of disposal and tolerance limits for liquid effluents of India and foreign countries. The book also refers to ISI, central, and state board's recommendation for monitoring sampling and analysis of liquid effluents. The control technology adapted overseas is also discussed. The status of effluents discharged and preventive measures adopted/planned by the Indian Fertilizer Industry are also reviewed.

Venkotes Warloo, K. S. (1996)
Water Chemistry: Industrial and Power Station Water Treatment
New Age India, New Delhi

Viswanathan, P. N., Bhattacharjee, B. D., Kakkar, P., Raizada, R. B., Kidwai, R. M., Agarwal, S. N., Chandra, S. V., and Ray, P. K. (1990)
Toxicology Atlas of India
ITRC, Lucknow

Viswanathan, P. N., Jaffery, F. N., Misra, V., and Ray, P. K. (1986)
Disaster Preparedness in the Chemical Industry
ITRC, Lucknow

Walia, S. (1995)
Pesticides Crop Protection and Environment
Oxford, New Delhi

JOURNALS

Primary

Acta Ecologica
International Society of Environmental Science
594-A Talvandi
Kota-324 005

Advances in Biosciences
Dr. V. P. Agarwal
Society of Biosciences
25/4, Ram Bagh Road
Muzaffarnagar-251 001

Biological Memoirs
Dr. Anil Roy Chowdhury
Endocrinology Division
Central Drug Research Institute
Post Box No. 173
Lucknow-226 001

Biomedicine (Journal of the Indian Association of Biomedical Scientists)
Prof. A Namasivayam
Dept. of Physiology
Dr. ALM, Post Graduate Institute of Basic Medical Sciences, (PGIBMS)
Taramani
Chennai-600 113

Bulletin of Sciences
Wiley Eastern Ltd.
4835/24
Ansari Road
Daryaganj
New Delhi-110 002

Chemical Business
Colour Publications Pvt. Ltd.
126-A Dhuruwadi
A V Nagwekar Marg
Prabhadevi
Mumbai-400 025

Chemical Industry Digest
BLOCKDALE
15, Purshottam, 21, J P Road
Near Novrang Cinema
Andheri (W)
Mumbai-400 058

Chemical Industry News
Indian Chemical Manufacturers Association
602, Vikram Tower
Rajendra Place
New Delhi-110 008

Chemical Product Finder
Transmission House
Marol Cooperative Industrial Estate
Mathuradas Vassanji Road
Andheri (East)
Mumbai-400 059

Down to the Earth
Centre for Science and Environment

A1, Tuglakabad Institutional Area
New Delhi-110 062

Ecology
Lavanya Prints Pvt. Ltd.
1-55, Royal Industrial Estate
5 B Naigaum Cross Road
Wadala
Mumbai-400 031

Ecology Environment and Conservation Environ. Media
2nd Floor, Rohan Heights
Post Box 90
Karad-415 100

Energy Environment Monitor
ENVIS Centre of Energy
Tata Energy Research Institute
Bombay House, 24 Homimody Street
Mumbai-400 023

Environment and Ecology
Dr. S. K. Konar
Editor
Department of Zoology
Kalyani University
Kalyani 741 235

Environment India
Society of Natural Science
Department of Botany
DAV College
Gorakhpur-273 001

Environmental Bioinformation Newsletter
NEERI, Nehru Marg
Nagpur-440 020

ENVIS Newsletter
ENVIS
Environmental Pollution Control Board
5th & 6th Floor, Skylark
60, Nehru Place
New Delhi-110 019

Himalayan Journal of Environmental Science
Gurukul Kangri University
Hardwar-249 404

Indian Environment
Indian Environmental Society
8, Darya Ganj
New Delhi-110 002

Indian Journal of Agricultural Sciences
Indian Council of Agricultural Research
Krishi Anusandhau Bhawan
Pusa
New Delhi-110 012

Indian Journal of Air Pollution Control
Indian Association of Air Pollution Control
c/o Central Board for the Prevention and Control of Water Pollution
5th and 6th Floor, Skylark
60, Nehru Place
New Delhi-110 019

Indian Journal of Biochemistry and Biophysics
National Institute of Science Communication, Council of Scientific and Industrial Research
Dr. K. S. Krishnan Marg
New Delhi-110 012

***Indian Journal of Chemistry* (*Section A*)**
(Inorganic, Bio-Inorganic, Physical, Theoretical, and Analytical Chemistry)
National Institute of Science Communication, Council of Scientific and Industrial Research
Dr. K. S. Krishnan Marg
New Delhi-110 012

***Indian Journal of Chemistry* (*Section B*)**
(Organic, including Medicinal)
National Institute of Science Communication, Council of Scientific and Industrial Research
Dr. K. S. Krishnan Marg
New Delhi-110 012

Indian Journal of Chest Diseases & Allied Sciences
Vallabhbhai Patel Chest Institute
University of Delhi
Delhi-110 007

Indian Journal of Earth Sciences
Indian Society of Earth Sciences
Department of Zoology
Presidency College
Calcutta-700 073

Indian Journal of Environment and Toxicology
Jai Research Foundation
P.O. Box No. 30
Vapi-396 195

Indian Journal of Environmental Health
NEERI
Nehru Marg
Nagpur-440 020

Indian Journal of Environmental Protection
Kalpana Corporation
Post Box No. 5
D 47/47, Ramapura
Varanasi-221 010

Indian Journal of Environmental Research
International Society of Environmental Protection
Department of Chemistry
Gorakhpur University
Gorakhpur-273 009

Indian Journal of Experimental Biology
National Institute of Science Communication
Hillside Road
New Delhi-110 012

Indian Journal of Marine Sciences
National Institute of Science Communications
Hillside Road
New Delhi-110 012

Indian Journal of Medical Research
ICMR Ansari Nagar
P. B. 4508
New Delhi

Indian Journal of Medical Sciences
Back Bay View
Opp Charni Road
Mama Parmanand Road
Mumbai-400 004

Indian Journal of Occupational and Environmental Medicine
(Formerly known as *Indian Journal of Industrial Medicine*)
Indian Association of Occupational Health
Hindustan Lever House
165/166 Backbey Reclamation
Mumbai-400 020

Indian Journal of Occupational Health
c/o Dr. V. P. Parhak
103/3543 Nehru Mara
Mumbai-400 024

Indian Journal of Public Health
Indian Public Health Association
110, Chittaranjan Avenue
Calcutta-700 073

Indian Journal of Toxicology
Dr. P. K. Gupta, Editor
Division of Pharmacology & Toxicology
Indian Veterinary Research Institute
Izatnagar-243 122

Indian Journal of Veterinary Pathology
Division of Pathology
Indian Veterinary Research Institute
Izatnagar-243 122

Indian Minerals
Publication & Information Division
Geological Survey of India
29, Jawaharlal Nehru Road
Calcutta-700 016

Indian Safety Engineer
Hindustan Agencies
3rd, General Assurance Bldg
Dr. D. N. Road
Mumbai-400 001

Indian Veterinary Medical Journal
U. P. Veterinary Association
Biological Product Section
Badshahbagh
Lucknow-226 007

Industrial Engineering Journal
Institution of Industrial Engineering
NITIE Campus
Vikas Lane Road
Mumbai-400 087

Industrial Product Finder
Transmission House
Marol Cooperative Industrial Estate
Mathuradas Vassanji Road
Andheri (E)
Mumbai-400 059

Industrial Safety Chronicle
National Safety Council
Central Labour Institute Building
Sion
Mumbai-400 022

International Journal of Ecology and Environmental Science
Science and Environmental Education Society
International Scientific Publication
Jaipur

Journal of Biosciences
Indian Academy of Sciences
Post Box No. 8005
C. V. Raman Avenue
Bangalore-560 080

Journal of Ecobiology
Palani Paramount Publications
69-D Anna Nagar
Palani-624 602

Journal of Ecotoxicology and Environmental Monitoring
Palani Paramount Publications
69-D, Anna Nagar
Palani-624 602

Journal of Environmental Biology
Academy of Environmental Biology
657/5, Civil Lines (South)
Muzaffarnagar-251 001

Journal of Food Science & Technology
Association of Food Science and Technology
CFTRI
Mysore-570 013

Journal of Himalayan Geology
Wadia Institute of Himalayan Geology
33-Gen Mahadeo Singh Road
Dehradun-248 001

Journal of Human Ecology
Kamlaaj Enterprises
2273, Galiwari
Paharwali, Chawri Bazar
Delhi-110 006

Journal of the Indian Water Resources Society
Water Resources Development Training Centre
University of Roorkee
Roorkee-247 667

Journal of Industrial Pollution Control
Department of Environmental Pollution
YC College
Karad-415 110

Madhya Pradesh Paryavaran
Environmental Planning & Coordination Organization
E- 5, Area Colony
Bhopal-462 001

Mineral & Metal Reviews
Asian Industry and Information
Services Pvt. Ltd.
28/30 Anantwadi
Binani Bhavan
Bhuleshwar
Mumbai-400 002

National Academy of Science Letters
National Academy of Science
5, Lajpat Rai Road
Allahabad-211 002

Paryavaran Digest
Samanvaya Prakashan
110, Dhanmandhi
Ratlam (M P)

Pesticide Information
Pesticide Association of India
1202, New Delhi House
27, Barakhamba Road
New Delhi-110 001

Pesticide World
Concept Agrotech Consultants Pvt. Ltd.
G-30, First Floor
Lajpat Nagar-II
New Delhi-110 024

Pestology
Scientia Publication Pvt. Ltd.
8, Pushpa Bhavan
Off Tel Bhavan
Colaba
Mumbai-400 005

Pollution Research
Enviro Media
Post Box No. 90
Karad-415 110

Proceedings of the Academy of Environmental Biology
The Academy of Environmental Biology
771, Civil Lines (South)
Muzaffarnagar-251 001

Scavenger
SOCLEEN
Society for Clean Environment
Garden Resort
606 Sion-Trombay Road
Chembur
Mumbai-400 071

Vayumandal
Indian Meteorological Society
Mausam Bhavan
Lodi Road
New Delhi-110 003

WWF India
World Wide Fund for Nature—India
Pirojsha Godrej National Conservation Centre
Post Box No. 3058
172-B, Lodi Estate
New Delhi-110 003

Secondary

Abstracts of Current Literature on Toxicology
Industrial Toxicology Research Centre
M. G. Marg
Post Box No. 80
Lucknow-226 001

Current Index in Medical Sciences (CIMS)
Biogrd (P) Ltd. 640, 10-A Cross

West of Chord Road
Bangalore-560 086

Food Technology Abstracts
National Information Centre for Food
Science & Technology
Central Food Technological Research Institute
Mysore-570 013

Indian Science Abstracts
Indian National Scientific Documentation Centre
14, Satsang Vihar Marg
New Delhi-110 067

Paryavaran Abstracts
Ministry of Environment and Forest
ENVIS
Paryavaran Bhawan
C G O Complex
Lodi Road
New Delhi-110 003

NEWSLETTERS

CPCB Newsletter
Central Pollution Control Board
East Arjun Nagar
Delhi-110 032

EMSI Newsletter (Environment Mutagen Society of India)
Bio-Medial Group
Bhabha Atomic Research Centre
Mumbai-400 085

Environment Bulletin
Academy of Environmental Biology
771, Civil Lines South
Muzaffamagar-251 001

ENVIS Newsletter
Distributed Information Centre on Toxic Chemicals
Industrial Toxicology Research Centre
Post Box No. 80
M. G. Marg
Lucknow-226 001

ICMR Bulletin
Division of Publication & Information
Indian Council of Medical Research
New Delhi-110 029

Industrial Toxicology Bulletin
ITRC
Lucknow-226 001

NESA Newsletter (National Environmental Science Academy)
206, Raj Tower
Alakhnanda Community Centre
New Delhi-110 019

Ocean Drug Alert
NICDAP
CDRI
M. G. Marg
Lucknow-226 001

Safety Newsletter
National Thermal Power Corporation
NTPC Bhavan, Scope Complex
7, Institutional Area Lodi Road
New Delhi-110 003

LIBRARIES AND INFORMATION CENTERS

Administrative Staff College of India Library
Bellavista
Hyderabad-500 049
(Andhra Pradesh)

Alchemic Research Centre Pvt. Ltd. Library
CAFI Site, Post Box No. 15
Belapur Road
Thane-400 601
(Maharashtra)

All India Institute of Medical Sciences
B. B. Dikshit Library
Ansari Nagar
New Delhi-110 029

Central Arid Zone Research Institute
Jodhpur
Rajasthan

Central Drug Laboratory Library
3 Kyd Street
Calcutta-700 016
(West Bengal)

Central Food Laboratory Library
3 Kyd Street
Calcutta-700 016
(West Bengal)

Central Mining Research Institute Library
Barwa Road
Dhanbad
(Bihar)

Central Pollution Control Board
Parivesh Bhawan
CBD Cum Office Complex
East Arjun Nagar
Delhi-110032

Centre for Advanced Study in Marine Biology
Annamalai University
Parangipetti-684 052
(Tamil Nadu)

Centre for Ecological Sciences
Indian Institute of Science
Bangalore
(Karnataka)

Centre for Environmental Education
Thaltej Tekra
Ahemdabad
(Gujrat)

Centre for Environmental Studies
Anna University
Guindy
Chennai-600 025
(Tamil Nadu)

Centre for Food Technological Research Institute Information Services (FOSTIS)
Cheluvamba Mansion
Mysore-570 013

Centre for Science and Environment (CSE)
F-6, Kailash Colony
New Delhi-110 048

Environmental Planning and Coordination Organization
Paryavaran Parisar E-V Sector
Arera Colony
Bhopal
(Madhya Pardesh)

ENVIS
Botanical Survey of India
P-8 Brabourne Road
Calcutta-700 001
(West Bengal)

Govind Ballabh Pant Himalyan Paryavaran Evam Vikas Sadan
Kosi-Katarmal
Almora-263 643
(U.P.)

Indian School of Mines
Dhanbad-826 004
(Bihar)

Industrial Toxicology Research Centre, Library and Toxicology Information Centre
Mahatma Gandhi Marg
Post Box No. 80
Lucknow-226 001
(U.P.)

National Botanical Research Institute
Rana Pratap Marg
Lucknow-226 001
(U.P.)

National Environmental Engineering Research Institute
Nehru Marg
Nagpur-440 020
(Maharashtra)

National Institute of Occupational Health
Meghani Nagar
Ahmedabad-380 016
(Gujrat)

School of Planning and Architecture
Indraprastha Estate
New Delhi-110 002

Society for Development Alternatives
B-32
Institutional Area
New Mehrauli Road
Hauz Khas
New Delhi-110 016

Tata Energy Research Institute
7, Jor Bagh
New Delhi-110 003

World Health Organization
Regional Centre for South East Asia
WHO, I.P. Estate
New Delhi-110 002

World Wide Fund for Nature
172B, Lodi Estate,
New Delhi-110 003

Zoological Survey of India
M - Block, New Alipin
Calcutta-700 053
(West Bengal)

RESEARCH INSTITUTIONS ACTIVE IN THE AREA OF INDUSTRIAL AND ENVIRONMENTAL TOXICOLOGY

Council of Scientific and Industrial Research

Central Drug Research Institute
Post Box No. 173
Chattar Manzil Palace
Lucknow-226 001

Central Food Technological Research Institute
Cheluvamba Mansion
Mysore-570 013

Central Leather Research Institute
Adyar
Madras-600 020

Central Mining Research Institute
Barwa Road
Dhanbad-826 001

Central Salt & Marine Chemical Research Institute
Gijubhai Badheka Marg
Bhavnagar-364 002

Central Scientific Instruments Organisation
Sector 30
Chandigarh-160 020

Indian Institute of Chemical Biology
4, Raja SC Mullick Road
Jadavpur
Calcutta-700 032

Indian Institute of Chemical Technology
Uppal Road
Hyderabad-500 007

Industrial Toxicology Research Centre
Post Box No. 80
M. G. Marg
Lucknow-226 001

National Botanical Research Institute
Rana Pratap Marg
Post Box No. 436
Lucknow-226 001

National Chemical Laboratory
Pune-411 008

National Environmental Engineering Research Institute
Nehru Marg
Nagpur-440 020

National Institute of Oceanography
Dona Paula
Goa-403 004

Regional Research Laboratory
Bhubaneswar-751 013

Regional Research Laboratory
Canal Road
Jammu-Tawi-180 001

Regional Research Laboratory
Post Box Jorhat
Jorhat-785 006

Other Bodies

Cell for Environmental Economics
Centre for Science & Environment
4, Tighlakabad
Institutional Area
New Delhi

Central Labour Institute
Sion
N. S. Mankikar Marg
Sion
Mumbai-400 022

Centre for Earth Science Studies
Post Box 2235
Sasthamangalam
Trivandrum-695 010
Karala

Centre for Environmental Management Studies
New Delhi

Centre for the Study of Man & Environment
Calcutta

G. B. Pant Institute of Himalayan Environment
Nainital

Grehlamat Environmental Control Centre
Mathura

Indian Agricultural Research Institute
Pusa Road
New Delhi-110 012

Institute of Public Health Engineering India
Meghami Nagar
Calcutta

National Institute of Occupational Health
Meghami Nagar
Ahemedabad-380 016

National Wild Life Institute
Dehradun

Wadia Institute of Himalayan Geology
33, General Mahadev Singh Road
Vivek Vihar
Dehradun-248 001

PROFESSIONAL SOCIETIES

The Academy of Environmental Biology
Dr. R. C. Dalela
Executive Secretary
657//5, Civil Lines (South)
Muzaffarnagar-251 001

Association of Food Scientists & Technologists, India
Honorary Executive Secretary
Central Food Technological Research Institute
Mysore-570 013

Dharwad Environmental Association
Hembli Galli Shukrawar Peth
Dharwad-380 001

Environmental Mutagen Society of India
Secretary
Zoology Department
University School of Sciences
Guarat University
Ahmedbabad

Environmental Society of Tirupati
Department of Civil Engineering
SVU College of Engineering
Tirupati-517 502

Indian Academy of Neurosciences
Dr. A. K. Agarwal
Treasurer
Industrial Toxicology Research Centre
Post Box No. 80
Mahatma Gandhi Marg
Lucknow-226 001

Indian Association for Environment Management
c/o National Environmental Engineering
Research Institute
Nagpur-440 020

Indian Association of Occupational Health
Dr. B. Bhar
Dakshinayan Plot 8B
95, Southern
Calcutta-700 029

Indian Environmental Society
Daryaganj
New Delhi-110 002

Indian Institute of Pharmacological Society
Dr. J. S. Bapna
General Secretary
Department of Pharmacology
Jawaharlal Institute of Postgraduate Medical Education & Research
Pondichery-605 006

Indian Society of Environmental Scientists (ISES)
Department of Environmental Science
G. B. Pant University of Agriculture & Technology
Pantnagar-263 145

International Society of Environmental Botanists
National Botanical Research Institute
Lucknow-226 001

International Society for Environmental Protection
23, Ka Hirapuri Colony
Gorakhpur University
Gorakhpur-273 009

National Environmental Science Academy
206, Raj Tower
Alaknanda Community Centre
New Delhi-110 019

Paryavaran Parishad Kota
2 KA 2 Vigyan Nagar
Kota-324 005

SAFETY
Post Box No. 11
P. O. Sipcot Complex
Hosur-635 126

Society of Biological Chemists (India)
Dr. R. R. Dighe
Secretary
Indian Institute of Science
Bangalore-560 012

Society of Biosciences
Dr. V. P. Agarwal
Secretary General
25/4, Ram Bagh Road
Muzaffarnagar-251 001

Society for Clean Environment
606, Sion-Trombay Road
Chembur
Mumbai-400 071

Society for Environmental Communications
F-6, Kailash Colony
New Delhi-110 018

Society of Toxicology, India
Dr. V. P. Singh
President
Department of Pharmacology
Indian Veterinary Research Institute
Izatnagar
Bareilly

Other Organizations

All India Fire Equipment Manufacturer's Association
c/o Steelge Industries Limited
Opp P. O. Mazagaon
Mumbai-400 010

Bombay Chamber of Commerce and Industry
Mckinnon Mckenzie Building
Ballard Estate
Mumbai-400 038

Burns Association of India
103, Vijay Apartment
B Desai Road
Mumbai-400 036

Confederation of Indian Industry
23 and 26 Institutional Area
Lodi Road
New Delhi-110 003

Federation of Indian Chambers of Commerce and Industry
Federation House
Tansen Marg
New Delhi-110 001

Indian Chemical Manufacturer's Association Bombay
Safety Health and Environment Subcommittee
ICMA, Sir Vithaldas Chambers
16 Bombay Samachar Marg
Fort, Mumbai-400 023

Loss Prevention Association of India, Bombay
4th Floor, Warden House
Sir Pherozeshah Mehta Road
Fort, Mumbai-400 001

National Society for Air Pollution Control
c/o Navdeep Enviro & Technical Services Pvt. Ltd.
Mumbai-400 001

Pesticides Association of India
1202, New Delhi House
27, Barakhamba Road
New Delhi

Safety Appliances Manufacturers' Association
c/o Fida traders 97/99,
Dhaboo Street
Mumbai-400 001

UNIVERSITIES AND OTHER ORGANIZATIONS OFFERING TRAINING COURSES IN ENVIRONMENTAL TOXICOLOGY

Universities

Avinashilingam Institute for Home Science & Higher Education for Women
Coimbatore-641 043
Course: BSc in environmental biology

Awadesh Pratap Singh University
Rewa
Course: MSc in environmental biology

Dr. B. R. Ambedkar Open University
Road No. 46
Jubilee Hills
Hyderabad-300 033
Course: Diploma in environmental studies

Dr. Babasahab Ambedkar Marathwoda University
Aurangabad-431 003
Course: MSc in industrial microbiology

Berhampur University
Berhampur-760 007
Course: BSc in environmental science

Bharathiar University
Moruthamalai Road
Combaitore-641 046
Course: BSc in environmental science

Bharathidasan University
Palkalai Perur
Tiruchirapalli-620 024
Course: BSc in environmental zoology, MSc in environmental science

Bishop Herber College
Trichy-620 001
Course: MSc in environmental science

Centre for Environmental Management of Degraded Ecosystems and Centre for Interdisciplinary Studies of Mountain and Hill Environment
Department of Environmental Biology
Delhi University
Delhi-110 007
Course: MSc in environmental education

Centre for Environmental Science and Engineering
Indian Institute of Technology
Powai, Mumbai-400 076
Course: M Tech and PhD in environmental science and engineering

Ch. Charan Singh University
Meerut-250 005
Course: MSc in environmental science

Cochin University of Science & Technology
Cochin University P. O.
Kochi-682 022
Course: BSc in marine biology/oceanography

Garware Institute of Career Education & Development, University of Bombay
Vidyanagari
Kalena
Santacruz (East)
Mumbai-400 098
Course: Diploma in environmental pollution control technology

Govind Ballabh Pant University of Agriculture & Technology
Panthanagar-263 145
Nainital
Course: BSc in agriculture and technology

Guwahati University
Guwahati-781 014
Course: MPhil in environmental science

Himachal Pradesh University
Summer Hill
Simla-171 005
Course: Environmental biology

Jadavpur University
Calcutta-700 032
Course: MPhil and PhD in environmental science

Jamia Hamdard University
Hamdard Nagar
New Delhi-110 062
Course: MSc in environmental toxicology, botany, and biochemistry

Jawaharlal Nehru University
New Mehrauli Road
New Delhi-110 067
Course: MSc in environmental science

Kakatiya University
Department of Zoology
Warangal-506 009
Course: BSc in zoology with specialization in environmental biology, MSc in environmental biology and ecology

Karnataka University
Dharwad-580 003
Course: MSc in environmental sciences

Madurai-Kamaraj University
Palkalai Nagar
Madurai-625 021
Course: MSc in environment

Manipur University
Canchiput
Imphal-735 001
Course: BSc in environmental science

Manonmaniam Sundaranar University
University Campus
Abishekaptti
Tirunelveli-627 008
Course: BSc in environmental ecology

Marathwada University
Aurangabad-431 004
Course: BSc in environmental science, MSc in environmental science

Purvanchal University
Devkali Jasopur
Saraykhaya
Jaunpur-222 001
Course: BSc in environmental science

Dr. Ram Manohar Lohia University
Faizabad-224 001
Course: BSc in environmental science

Sambalpur University
School of Life Sciences
Jyotivihar
Burla-768 019
Course: MSc in environmental science

Shivaji University
Vidhanagar
Kolhapur-416 004
Course: MSc in environmental science

SNDT University Bombay
1, Nathibai Thackerseky Road
Mumbai-400 020
Course: BSc in environmental science/biology

Tamil Nadu Agricultural University
Coimbatore-641 003
Course: BSc in environmental science

University of Bombay
M. G. Road Fort
Mumbai-400 032
Course: BSc in environmental science

University of Calcutta
Calcutta-700 019
Course: MSc in environmental science

University of Delhi
Department of Environmental Biology
University of Delhi South Campus
Benito Juarg Road
New Delhi-110 021
Course: MSc in environmental biology

University of Kalyani
P. O. Kalyani-741 235
Nadia
Course: MSc in environmental sciences

University of Kerala
Trivandrum-695 034
Course: BSc in environmental biology and ecology

University of Madras
Centenary Building Chepauk

Triplicare
P. O. Madras-600 005
Course: MSc in environmental toxicology and environmental chemistry

University of Mysore
Post Box No. 406
Crawford
Halt Mysore-570 005
Course: BSc in environmental planning, MSc in environmental science

University of Rajasthan
Gandhi Nagar
Jaipur-302 004
Course: BSc in environmental studies

Utkal University
Vani Vihar
Bhubaenshwar-751 004
Course: BSc in environmental science

Vinoba Bhave University
Post Box No. 31
Hazaribag-825 301
Course: MSc in environmental science

Other Organizations

Asian Workers Development Institute
Sector 6
Rourkela-769 002

Central Drug Laboratory
3 Kyd Street
Calcutta-700 016

Central Labour Institute
Kasauli-173 205

Central Labour Institute
Sion
Mumbai-400 022

Gandhi Labour Institute
Ahemadabad-380 052

Gujrat Safety Council
Institute of Engineers (India) Building
Race Course Circle
Vadodora-390 007

Indian Institute of Ecology and Environment
B-2/3 janakpuri
New Delhi-110 058

Indian Institute of Social Welfare & Business Management
Calcutta-700 073

Industrial Safety and Health Association
c/o Dy Chief Inspector of Factories
694, Shankdar Bhavan
Aadarsh Nagar
Pune-411 037

Industrial Toxicology Research Centre
M. G. Marg
Post Box No. 80
Lucknow-226 001

Institute of Industrial Safety Professional of India
1/4 Bharatiya Bhavan
17th Road
Khar
Mumbai-400 052

National Civil Defence College
Nagpur

National Environmental Engineering Research Institute
Nagpur

Regional Labour Institute
Lake Town
Pattipukur
Calcutta-700 089

Regional Labour Institute
Sarvodaya Nagar
Kanpur-208 055

Regional Labour Institute
TTTI
Post Tharamani
Chennai-600 113

Thapar Institute of Engineering Technology Environmental Engineering Centre
Patiala

TESTING LABORATORIES

Accurate Analysis Pvt. Ltd.
Plot No. R-93, MIDC
Satpur
Nasik-422 007

Aditya Environmental Services
Sunder Towers
Tokarsee Road
Sewree
Mumbai-400 015

Aero Biological Centre
Turbhe

Thane-Belapur Road
Thane

Aeroclean Associates
12, Mahaveer Shopping Centre
Agra Road
Kalyan (W)-421 301

Air Pollution Monitoring Laboratory, Technology Innovation Centre, The National Rayon Corp. Ltd.
Mohane-Kalyan Dist.
Thane

Anti-Pollution Engineers
B-100, Amber, L T Road
Dahisar (W)
Mumbai-400 068

Aqua Bio-Treat
Imrat, Raikar Nagar
Dhairy Sinhagad Road
Pune-411 041

Ashwamedh Engineers & Consultants
8, Janki Nivas, M. Phule Road
Mulund (E)
Mumbai-400 081

Assam Pollution Control Board Laboratory
Rajgarh Road
Guwahati-781 007

Associated Industrial Consultants Pvt. Ltd.
Raheja Centre, 13th Floor
Nariman Point
Mumbai-400 021

Dr. Beck & Co. (India) Ltd.
147 Bombay Pune Road
Pimpri
Pune-411 018

Bhagawati Associates Pvt. Ltd.
Huroon House, 4th Floor
29, Perin
Nariman Road, Fort
Mumbai-400 001

Bharat Heavy Electricals Ltd.
Pollution Control Research Institute
BHEL, Ranipur
Hardwar-249 403

Central Drug Research Institute
Chattar Manzil Palace
Post Box No. 173
Lucknow-226 001

Central Food Technological Research Institute
Mysore-570 013

Centre for Biochemicals
V. P. Chest Institute Buildings
University Campus
Delhi-110 007

Chemistry Laboratory, Irrigation and Power Research Institute
Amritsar-143 001

Chemotech Consulants Laboratories
141, Aman Gian Industrial Estate
Pokhran Road
Thane-400 601

Cochin Refineries Pollution Control Laboratory
Cochin Refineries Ltd.
Post Bag No. 2
Ambalamugal-682 302

Dharamsi Morarji Chemical Co. Ltd.
Environmental Engineering Division
Ambarnath-421 501

ECE Labs
A-11, Dattraguru Society
Near Telecom Factory, Deonare
Mumbai-400 088

Econ Pollution Control Consultants
Lalbaugh House
Dr. Ambedkar Road
Opp. Jam Mills, Lalbaug
Mumbai-400 012

Entech Labs
Gautam Terrace
Off M. G. Road
Thane-400 602

Envirochem Analysers & Consultants
B/106, Shivashakti Complex
S V Road
Dahisar (W)
Dahisar Rly. Station
Crossing Road
Mumbai-400 068

Envirochem Laboratories Pvt. Ltd.
Cochin Devaswom Board Building
5th Floor, Round North
Trichur-680 001

Enviro Designs and Equipment
S R M Road
Near Cochin City
Traffic Police
Cochin-682 018

Enviro Labs
1/2 Gautam Terrace
Thane-400 602

Environmental Engineering Consultants
37/1, Vrindavan Society
Thane-400 601

Environmental Engineering Inc.
12, Buty Chambers, Buty Road
Sitabuildi
Nagpur-440 012

Environmental Engineering Laboratory, IIT
Kharagpur-721 302

Environmental Engineering Laboratory, MNR Engineering College
Allahabad-211 004

Environmental Engineering Laboratory, Shri Venkateswara University
College of Engineering
Tirupati-517 502

Environmental Engineering Laboratory, Walchand College of Engineering
Wishrambag
Sangli-416 415

Environmental Engineering Research Div. Lab
Maharashtra Engineering Research Institute
Dindori Road
Nasik-422 004

Environmental Enterprises
5, Arunodaya
132 Senapati Bapat marg
Opp. Matunga Road
Rly. Station, Mahim
Mumbai-400 016

Environmental Laboratory, Modern College
Sector 154
Vashi
New Mumbai-400 705

Environmental Science Laboratory, College of Basic Science & Humanities, G. B. Pant University of Agriculture and Technology
Pant Nagar-263 145
Nainital

Environtech
34, Posta Colony
Matruchaya
Chembur
Mumbai-400 071

Essen and Company Lab
No. 550, Eighth Main Road
Malleswaram West
Bangalore-560 055

Excel Industries Ltd.
Veera Desai Road, Amboli Hill
Andheri (W)
Mumbai-400 058

Fertilizers and Chemicals Travancor Ltd.
Research and Development Centre Laboratory
Udyogmandal
Via Cochin-683 501

Gadard Laboratories
Dhobi Ghat Shed, Kalawadi
G D Ambedkar Marg
Mumbai-400 033

Gandhi Laboratories
Gudhyari
Raipur-422 001

Geochem Laboratories Pvt. Ltd.
294, Shahid Bhagat Singh Road
Fort, Mumbai-400 001

Gharda Chemicals Pvt. Ltd.
MIDC Dombivli (E)
Dist. Thane-421 203

Gujrat Refinery Laboratory
Race Course Road, ERI Compound
Baroda-390 007

Haffkine Institute
Parel
Mumbai

Hema Laboratories
Bhimnagar, Tarapur Boisar Road
Boisar
Dist. Thane

Hindustan Anti-Biotics Research Centre Laboratory
Pimpri
Pune-411 018

Hindustan Ciba Geigy Ltd.
LBS Marg, Bhandup
Mumbai-400 078

Indian Aluminium Co. Ltd.
Post Box No. 5
P. O. Taloja
Dist. Raigad-410 208

Industrial Hygiene Laboratory, Inspectorate Factories and Boilers
Govt. of Goa
Altinho, Panaji

Industrial Toxicology Research Centre
M G Marg
Post Box No. 80
Lucknow-226 001

J. B. Boda Surveyors Pvt. Ltd.
Maker Bhavan-1
Sir Vithaldas Thackersey Marg
Mumbai-400 020

Klean Laboratories, Water Sewage Industrial Waste Analysis
1340 Shivaji Nagar
Pune-411 005

Laboratory of Environmental Engineering, Civil Engineering Department, University of Roorkee
Roorkee

M. P. Pradushan Niwaran Mandal
E-5 Area Colony
Bhopal

Mahabal Enviro Engineers Pvt. Ltd.
17, Chandra Vijay Society
Lokmanya Tilak Road
Mulund (E)
Mumbai-400 081

Metallurgical & Engineering Consultants Ltd.
Environmental Engineering Laboratory
Ranchi-834 002

Metel Chromatographs
Division of Universal Ferro & Allied Chemical Ltd.
S. V. Road, Manpada
Thane-400 607

Micro Environmental Consultants & Engineers
(a Division of Micro Metal India)
15, C, Kamgar Nagar
S G Barve Road
Kurla (E)
Mumbai-400 024

National Environmental Engineering Research Institute
Nehru Marg
Nagpur-440 020

National Institute of Occupational Health
P. O. Civil Hospital
Meghani Nagar
Ahemdabad-380 016

National Organic Chemicals Industries Ltd.
Thane Belapur Road
Post Box No. 73
Thane

Ordinance Factory
Dehu Road,
Pune-412 113

Paramount Pollution Control Pvt. Ltd.
Miraj Complex
Gotri Road
Race Course
Baroda-390 007

Perfect Laboratories
210, Amar Gian Services & Industry Complex
Opposite S. T. Workshop
Pokhran Road No. 1
Thane-400 601

Plant Chemical Laboratories
Trombay Generating Station
Tata Electric Company
Chembur
Mumbai-400 074

Plant Quarantine and Fumigation Station
Mumbai

Pollution Monitoring Laboratories
High Explosive Factory
Kirkee
Pune-411 003

Polytest Laboratories
12/1467, Sadashiv Peth
Pune-411 030

Project and Development India, Ltd.
Research and Development Laboratory
Sindri-828 122
Dhanbad District

Rashtriya Chemical & Fertilizers Ltd.
Central Chemical Laboratory
Chembur
Mumbai-400 074

S. G. S. India Pvt. Ltd.
Aspinwall Compound
Calvettey,
Cochin-682 001

Sandoz (India) Ltd.
P. O. Box Sandoz Baug
Kolshet Road
Thane-400 607

Sanjeevan Electronic Pvt. Ltd.
Plot No. 32
Electronnic Co-op. Estate
Pune Satara Road
Pune-411 009

Sanjeevani (TALKI) SSK Ltd.
Sahajanand Nagar
P. O. Shinganpur
Tal-Koparggaon
Ahmednagar-423 603

Sarabhai Research Centre
Baroda

School of Environment, Environmental Laboratory Chh Shahu Central Institute of Business Education & Research
University Road
Kolhapur-416 004

Shetkari Sahakari Sakhar Karkhana Ltd.
Pollution Control Laboratory
Sangli-416 416

Shreyas Laboratories
Plot No. A-28, MIDC
TTC Area
Thane

Shri Ram Institute for Industrial Research
19, University Road
Delhi-110 007

Trace Metal Environmental Laboratory
Department of Biochemistry
Post Graduate Institute of Medical Education Research
Chandigarh-160 012

U. P. State Pollution Control Board
1st Floor
Pragati Kendra
Kapurthala Complex
Aliganj
Lucknow-226 020

Ultra Check
22, Jai Commercial Complex
462 E. E. H., Opp. Cadbury Factory
Thane-400 601

Unichem Laboratory, Ltd.
Prabhat Estate Off. S. V. Road
Jogeshwari (W)
Mumbai-400 102

University Laboratory, Department of Chemistry, Ravishanker University
Raipur

Uraniam Corp. of India Ltd.
Control Research and Development Laboratory
Jaduguda Lines
Singnbhum-832 102

Vimta Labs
2-2-18/46 Durgabai Deshmukh Colony
Bagh Amberpet
Hyderabad-500 013

Water Quality Research Laboratory
Level II, Central Water Commission
Bhopal

Water and Water Research Centre
6, Vishvalaxmi Shankar Society
Opp. Kirloskar Kisan Equipments Kothrud
Pune-411 029

Waterman Laboratories
1478, Sadashiv Peth
Chintamani Apartment
Opp. Bank of Maharashtra
Tilak Road
Pune-411 030

Western Paques India Ltd.
Laboratory Division
43/81, Navsahyadri Society
Pune-411 029

ENVIRONMENTAL LAWS

The Air (Prevention and Control of Pollution) Act, 1981 (direct)
The Air (Prevention and Control of Pollution) Rules (direct)
The Atomic Energy Act, 1972 (indirect)
The Coal Mines (Conservation and Safety) Act, 1952 (direct)
The Code of Criminal Procedure, 1973 (indirect)
The Consumer Protection Acts, 1986 (indirect)
The Dangerous Drugs Acts, 1930 (direct)
The Drugs and Cosmetics Act, 1940 (direct)
The Environment (Protection) Act, 1986 together with Environmental (Protection) Rules, 1986, and Environmental Statements, Environmental Standards, Environmental Clearance and Hazardous Wastes (Management and Handlings) Rules, 1989
The Factories Act, 1948 (direct)
The Forest (Conservation) Act, 1980 (indirect)
The Indian Fisheries Act, 1897 (indirect)
The Indian Forest Act, 1927 (indirect)
The Indian Penal Code, 1860 (indirect)
The Industries (Development & Regulation) Act, 1951 (indirect)
The Insecticides Act, 1968 (indirect)
Manufacture, Storage and Import of Hazardous Chemicals Rules/Amendment Rules, 1994 (direct)

The Mines and Minerals (Regulation & Development) Act, 1957 (indirect)
The Motor Vehicles Act, 1988 (indirect)
The Narcotic Drugs & Psychotropic Substances Act, 1985 (direct)
The National Environment Tribunal Act, 1995 (direct)
The Petroleum Act, 1934 (indirect)
The Poisons Act (direct)
The Prevention of Food Adulteration Act, 1954 (direct)
The Public Liability Insurance Act, 1991 (indirect)
The Public Liability Insurance Rules (indirect)
The Water (Prevention and Control of Pollution) Act, 1974 (direct)
The Water (Prevention and Control of Pollution) Cess, Act, 1977 (direct)
The Water Prevention Control Board of Pollution Cell Rules
The Water Prevention Control Board of Pollution Rules (direct)
The Wild Life (Protection) Act, 1972 (direct)
The Workmen's Compensation Act, 1923 (indirect)

References

Association of Indian Universities (1995). *University Handbook*. Association of Indian Universities, New Delhi.

Data section (1991). *Chemical Industry Digest, Consultancy Special Issue—II,* 155–164, 176–183.

Department of Science & Technology (DST), Govt. of India (1991). *Research and development statistics,* 1990–91. DST, New Delhi.

Kumar, G., and Anand, P. (1993). *Expertise in Industrial Pollution Management and Control: A Directory*. (*Concepts International Series in Environment*–3, K. V. Paliwal, Ed.). Concept, New Delhi.

Rahul, R., and Rao, S. (1992). *The Little Green Book—A Directory of Environmental Opportunities with Special Reference to Delhi*. Kalpavriksh, New Delhi.

Seth, P. K., Agarwal, S. N., and Ray, P. K. (1988). India. In *Information Resources in Toxicology,* (P. Wexler, Ed.) 2nd ed., Elsevier, New York.

Italy

PAOLO PREZIOSI, ADRIANA DRACOS, AND IDA MARCELLO

BOOKS

Agradi, A. (1994)
Farmacologia e Tossicologia, 6th ed.
Sorbona, Milan
ISBN 88-7150-84-9

A medium-sized textbook (446 pages) of pharmacology and toxicology for pharmacy, life science, and nursing students.

Annuario Nazionale dell'Energia e dell'Ambiente (1996).
Inter-ed, Rome

This important two-volume publication (total: 1210 pages) provides a wealth of useful information on energy and the environment in Italy, including much that pertains to the field of toxicology. The volumes contain a ''Who's who?'' section with 400 biographies and accurate information on 13,000 figures, 3600 companies, 400 products and services, 200 ministerial bodies, 460 research centers, 370 associations, and 470 municipal agencies.

Annuario DEA delle Università e Istituti di Studio e di Ricerca in Italia (1997)
DEA Editrice, Rome

This publication (also issued in 1992–1995) contains updated information on Italian universities, centers for study and research, and academic and cultural institutes, with a ''Who's who?'' section at the end. Useful for consultation by toxicologists and other scientists.

Bertol, E., Lodi, F., Mari, F., and Marozzi, E. (1994)
Trattato di Tossicologia Forense
CEDAM, Padua
ISBN 88-13-18370-4

A large volume covering all the more important aspects of forensic toxicology, including historical, diagnostic, pathological, and analytical aspects of toxicology in general as well as the dynamics, pathological effects, and analysis of individual toxicants and toxicant groups. There are also chapters on environmental toxicology and doping and detailed discussions of the various forms of drug abuse. Useful for in-depth study and consultation.

Bottarelli, F. (1993)
Manuale di Tossicologia Veterinaria (R. Zilocchi, Ed.)
Tipografia Editrice Piacentina, Piacenza
ISBN 88-85381-02-2

Comprehensive coverage of general toxicology, organic and inorganic compounds, pesticides, phytotoxins, and toxic plants for students.

Bozza Marrubini, M., Ghezzi Laurenzi, R., and Uccelli, P. (1989)
Intossicazioni Acute—Meccanismi, Diagnosi e Terapia, 2nd ed.
OEMF Organizzazione editoriale Medico Farmaceutica s.p.a., Milan
ISBN 88-7076-07-9

A large volume (1135 pages) covering all aspects of poisoning, ranging from first-aid measures to accident prevention, including diagnosis, therapy, and data on toxic agents. The final part is devoted to substances of common use, pharmaceuticals, cosmetics, and household products.

Calvino, R., and Delprino, L. (1994)
Modalità per l'Analisi di Cationi ed Anioni di Interesse Farmaceutico e Tossicologico
Levrotto e Bella, Turin

A small book (84 pages) describing new methods for evaluating cations and anions of pharmaceutical and toxicological interest.

Dolara, P. (1997)
Tossicologia Generale e Ambientale
Piccin-Nuova Libraria, Padua
ISBN 88-299-1405-3

A medium-sized (308 pages) overview on general and environmental toxicology.

Ferrara Santo, D. (1989)
II Laboratorio di Farmacologia e Tossicologia Clinica
C. G. Ediz. Medico-Scientifiche Curin
ISBN 88-7110-013-1

This large volume (1022 pages) covers all the essential elements of pharmacokinetics and toxicokinetics, with particular attention to monitoring plasma levels of important drugs and toxins. In the latter category, there

is discussion of metals, metalloids, organophosphoric insecticides, analytical methods used in toxicology, volatile liquids, hemoglobin derivatives, drugs of abuse, insecticides, and herbicides. There are useful appendices at the end of the volume.

Froldi, R. (1995)
Lezioni di Tossicologia Forense
Giappichelli, Torino
ISBN 88-348-5050-5

This volume, which contains information on the most important problems of modern-day forensic toxicology, is intended for medical students, but it is also useful for students of law.

Galli Corrado, L., Marinovich, M., and Restani, P. (1991)
Tossicologia Sperimentale
OEMF spa-Organizzazione Editoriale Medico farmaceutica, Milan
ISBN 88-7076-128-2

This book was conceived primarily as a toxicology text for students enrolled in various faculties (medicine, sciences, pharmacy, agriculture, and veterinary medicine). Following discussion of the general principles of toxicodynamics and kinetics, there is in-depth coverage of specific toxic effects (such as mutagenesis, carcinogenesis, and teratogenesis) and the methods used to study them. There are also discussions of toxic effects on specific target organs, problems related to nutritional and alimentary toxicology, environmental toxicology, professional exposure to toxicants, and toxic risk assessment.

Grilli, S. (1992)
Stima del Rischio Cancerogeno. Aspetti Scientifici ed Applicativi
Cooperativa Libraria Universitaria Editrice (CLUEB), Bologna

This book presents methods and models for cancer risk assessment studies as well as interesting applicative examples for studies on IPA, PCDD, PCDF, ionizing radiation, benzene, pesticides, and organic halogenates in drinking water.

Malizia, E., Smeraglia, M., and Borgo, S. (1993)
L'estasi: Aspetti Tossicologici, Clinici, Sociali dell'ecstasy o Metilendiossimetamfetamina
CIC Edizioni Internazionali, Rome
ISBN 88-7141-103X

The authors examine the most important aspects of the drug Ecstasy, which is used in many discotheques in Italy. Technically correct information is presented in a manner that is readily accessible to nonprofessional readers.

Manara, L., and Mannaioni, P.F. (1995)
Farmacologia e Doping
Masson, Milan
ISBN 88-214-2240-2

This volume examines the principal pharmacodynamic and toxicological aspects of compounds related to the phenomenon of doping in the world of athletics. There are useful discussions of nutritional factors and those affecting muscle work, anabolic steroids, stimulants, sedatives, tranquilizers, cardiovascular drugs and diuretics, analgesics, and anti-inflammatory agents.

Pierini, G. (1995)
Appunti di Tossicologia Forense. Per il Corso di Medicina Legale
Cooperativa Libraria Universitaria, Editrice (CLUEB), Bologna
ISBN 88-8091-226-7

A synthetic handbook of forensic toxicology for medical and law students.

Silvestrini, B. (1995)
Malati di Droga. Le Sostanze d'Abuso: Danni Fisici e Psichici, Reazione Individuale, Difese
Sperling e Kupfer Editori, Milan

A nonconventional and clearly written discussion of drug abuse with a great deal of useful information, specifications, and personal evaluations.

Tox data food (prepared by Tecnoalimenti) (1991)
Dati Tossicologici di Interesse Alimentare
OEMF spa-Organizzazione editoriale Medico Farmaceutica, Milan
ISBN 88-7076-120-7

This book describes a toxicological survey in the food field conducted by a research company (Tecnoalimenti) and the Institute of Pharmacological Sciences, Faculty of Pharmacy, of the University of Milan. The text, which is intended for public-health workers and those employed in the food industry, provides information on the risk of residues and additives in foods and their toxicological implications. Its encyclopedia-like design facilitates consultation.

Vighi, M. (1989)
Ecotossicologia
Ediz. Giuridiche Scientifiche, Milan
ISBN 88-85874-01-0

A volume considering the most important aspects of environmental toxicology.

The following titles are works published in English by Italian authors.

Lotti, M., and Manno, M. (1993)
Mechanisms of Toxicity and Their Relevance in Industrial Toxicology
Serv. Grafici Editoriali, Padua
ISBN 88-86281-00-52

A precise and up-to-date examination of the mechanisms underlying the toxic effects of compounds with relevance for clinical toxicology.

Mannaioni, P.F., and Masini, E. (Eds.) (1993)
Addictive Drugs and Addictive States—The State of Art
Addiction Research Foundation of Italy, Rome

This volume represents the Proceedings of a Satellite Symposium of the VI International Congress of Toxicology held in Rome in July 1992. The 30 contributions deal with heroin addiction (policy and issues, chemotherapy, agonists and antagonists, alternative forms of treatment, and medical and psychiatric aspects), alcohol and alcoholism (biological and clinical aspects), and risks related to the abuse of cocaine, cannabis, and amphetamines. A good update on the problems of drug abuse.

Manzo, L., and Weetman, D.F. (1992)
Toxicology of Combustion Products
Fondazione Clinica del Lavoro Edizioni, Pavia
ISBN 88-7963-004-0

This volume contains presentations from a recent symposium dealing with toxicity of particles from combustion processes, inhaled automobile exhaust emissions, waste incineration, coal combustion as a source of metallic pollutants, mutagenic and carcinogenic compounds formed by the pyrolysis of protein foods, environmental tobacco smoke, pathophysiology related to marijuana smoking, metabolism of selected compounds originating from pyrolytic processes, and the clinical toxicology of cyanide and carbon monoxide released from combustion sources.

REPORTS

Chiesara, E. (Ed.) (1990, June)
Guidelines for the Evaluation of Toxic Effects of Chemicals.
Second part. Other toxic effects(in Italian)
Istituto Superiore di Sanita, serie relazioni (reports)

Guidelines established by the Italian National Toxicological Advisory Committee for the evaluation of the general toxic effects of chemicals (i.e., excluding mutagenesis, carcinogenesis, and teratogenesis).

Galli, C., Rossi, L., Vines, P., and Zapponi, G.A. (Eds.) (1991)
Risk Assessment of Chemical Carcinogens (the majority of contributions in English)
Ann. Ist. Superiore di Sanità Rome, Vol. 27, No. 4.

A monograph dedicated to the examination of the many aspects of carcinogenic risk assessment.

Marini Bettolo, G.B., Allegrini, I., Imbesi, A., Federico, R., and Manes, F. (Eds.) (1991)
Effetti degli Inquinanti Atmosferici sul Clima e la Vegetazione (*Effects of Atmospheric Pollutants on Climate and Vegetation*) (in Italian)
Gea Program, Roma

This volume contains a series of reports and resolutions on the environment presented at a meeting held in Taormina on September 26–28, 1991. Particular attention is given to the repercussions of environmental pollution on vegetation and agricultural systems.

Mucci, N., and Camoni, I. (1995)
Guidelines of the Italian CCTN for the Classification of Some Effects of Chemical Substances

Istituto Superiore di Sanità- Serie Rèlazioni (reports) 96/2 EN Definitions of the categories and the criteria for the classification of chemical substances on the basis of their potential carcinogenic, mutagenic, and toxic-reproductive effects, elaborated by the Italian National Advisory Toxicological Committee (CCTN) in 1994. All the allocations effected by the CCTN in the period 1977–1995 are reported and updated according to these criteria.

JOURNALS

Ambiente, Risorse e Salute (*Environment, Resources, Health*)
Lauri edizioni, Milan

Contains original contributions on scientific, technical, and cultural aspects of environmental questions, including those related to environmental toxicology.

Archivio di Scienze del Lavoro (*Archives of Occupational Sciences*)
Istituto di Medicina del Lavoro, Università Cattolica del S. Cuore, Rome

Original research and review articles dealing with occupational health, industrial hygiene, industrial toxicology, prevention, and safety engineering.

Currents in Toxicology and Therapy
Casa editrice Maccari, Parma

A periodical that publishes work (including monographs) dealing with toxicology and treatment.

Epidemiologia e Prevenzione (*Epidemiology and Prevention*)
Cooperativa Epidemiologica & Prevenzione a.r.1, Milan

Original contributions on occupational and nonoccupational epidemiology.

Journal of Applied Cosmetology
International Ediemme, Rome

An international journal that contains original papers, review articles, and research on the skin and cosmetics (including toxicological aspects of the latter).

Pharmacological Research Communications
Academic Press, London

A monthly peer-reviewed journal containing articles dealing with experimental or clinical pharmacology and toxicology. The journal is published by Academic Press for the Italian Society of Pharmacology.

Rivista di Tossicologia Sperimentale e Clinica (*Experimental and Clinical Toxicology Journal*)
Società editrice Universo, Rome

A quarterly journal that publishes papers dealing with experimental and clinical toxicology in Italian (and sometimes in English).

ORGANIZATIONS

Professional Societies

The *Italian Society of Toxicology*, founded in 1966, currently includes over 300 members. Fifty-five percent are pharmacologists; the rest are professionals working in the fields of anesthesiology, toxicological and pharmaceutical chemistry, and occupational medicine. The society sponsors an annual postgraduate course in toxicology and a national congress every 3 years. The Italian Society of Toxicology is a member of the Federation of the European Societies of Toxicology (FEST) and the International Union of Toxicology (IUTOX), and it contributed significantly to the VI International Congress of Toxicology held in Rome in 1992 (June 30–July 3).

CellTox (The Italian Association of in Vitro Toxicology) was founded in 1991 and currently has approximately 100 members. Its scope is to promote the use of *in vitro* systems in pharmacological and toxicological research and to develop methods and techniques for the study of toxic effects at cellular and molecular levels. Its activities include biennial congresses, continuing education courses, and scientific meetings.

The *Italian Association for the Protection of Plants* was founded to promote the dissemination of knowledge and the development of methods for protecting plants from biotic and abiotic threats ranging from environmental pollution to unsuitable agronomic techniques.

National Bodies

Consiglio Nazionale delle Ricerche (Italian National Research Council; CNR)*
P. le Aldo Moro
Roma
Phone: +39/6/49931
Fax: +39/6/4461954
e-mail: National Committee for Biology and Medicine: Com 04 @dcas.cnr.it; National Committee for Environmental and Habitat Technology: Com 13@dcas.cnr.it

The CNR does not have laboratories specifically devoted to toxicological research, although it supports many toxicologically oriented research projects and many of its laboratories are involved in basic research projects with relevance to toxicology. Each year, 14 committees composed of members of the Italian scientific community examine research proposals submitted by individual scientists or research teams and award grants for their realization. Projects related to toxicology are reviewed by committees 4 (Biology and Medicine) and 13 (for the environment). The latter committee launched (1996–1998) a program on ''environment and territory'' that involved 73 different operative units.

Consiglio Nazionale delle Ricerche (Istituto di Mutagenesi e Differenziamento del CNR)
Via Svezia 10/2a
56100 Pisa
Phone: +39/50/574161-598160
Fax: +39/50/576661

* The structure of the Consiglio Nazionale delle Ricerche (CNR) was completely revised by a law passed in 1999. There is now a President who is nominated by the Ministry for Universities and Scientific Research and Technology, an Executive Committee consisting of eight members, four of whom were nominated by the Minister and the remaining four elected by the members of 14 Scientific Committees mentioned in the text above. These latter committees have now been eliminated, and many of their functions have been taken over by a new 20-member Scientific Committee composed of elected representatives of the previous committees (10) and by an equal number of members elected from the staff of researchers at the CNR. The CNR no longer functions as the funding agency for research conducted by single individuals or groups.

This institute is involved in genotoxicity studies and the development and perfection of new techniques.

Consiglio Nazionale delle Ricerche, Istituto di Ricerca sulle Acque-Reparto Sperimentale di Idrobiologia Applicata (Italian Research Council, Institute for Research on Water, Experimental Laboratory for Hydrobiology Applied to Water Pollution)
IRSA-CNR 20047
Brugherio (MI)
Phone: +39/39/2004303
Fax: +39/39/2004692
E-mail: riggio@irsa 1.irsa.irsa.rm.cnr.it

The ecotoxicological section of this institute is in charge of monitoring and establishing quality standards for water. Studies have been conducted to determine the acute and long-term effects of industrial chemicals and environmental contaminants (detergents, heavy metals, ammonia, amines, and chlorobenzenes) on aquatic organisms (both adult and developmental stages). The accumulation of persistent organic and inorganic chemicals in fish has also been studied in the field and laboratory. Recently, studies have been undertaken to forecast distribution and fate of organic micropollutants in the environment based on their physicochemical properties. QSARs have been applied to aquatic toxicology to correlate bioaccumulation and its acute and chronic effects with simple molecular descriptors for homogenous series of organic chemicals. A toxicological approach has also been applied to field monitoring with the aim of detecting toxic organic micropollutants in surface waters.

ENEA (Ente per le Nuove Tecnologie, l'Energia e l'Ambiente)
Centro Ricerche Energia Casaccia
AMB-PRO-TOSS
Via Anguillarese, 301
00060 S. Maria di Galeria
Rome
Phone: +39/6/30484016
Fax: +39/6/30484559
E-mail: Tirindelli@Casaccia.Enea.it

The ENEA is an obligatory reference point for national policies regarding the environment, energy-saving measures, development of renewable sources of energy, and technological development. Its activities include research, development, and industrial realization of the projects it elaborates. The ENEA is headed by a president nominated by the President of the Republic and approved by the Council of Ministers. There is also a vice president elected by the nine-member Administrating Council, a Technical Commission, and a Director General. The ENEA is supervised by the Ministry of Industry and works closely with the Ministry of Universities and Scientific and Technological Research and of Environment in carrying out its programmed activities. Plans and projects are drawn up with the aid of an advisory board composed of internationally recognized experts. The structure is divided into areas, each equipped with its own laboratory. The ENEA has eight research centers located in Rome and throughout the country. In the ''Dept. of Man & Ecosystem Protection'' there is a section on toxicology involved in the following activities:

Inhalation toxicology: Evaluation of damage to the respiratory system in the urban environment due to the exposure to ozone and ultrafine particles. Studies in experimental models of the pharmacokinetics, toxicity, and mutagenicity of volatile organic compounds. Microscopic, ultrastructural, and biochemical analyses of pulmonary effects in small laboratory rodents.

Genetic toxicology: Evaluation of genotoxic effects of environmentally relevant chemicals in somatic and germ cells of experimental rodents, with particular emphasis on cytogenetic damage. Biological dosimetry of radiation-exposed human populations by multiple end points. *Reproductive toxicology:* Evaluation of damage to the reproductive integrity in experimental models and groups at risk for occupational or environmental exposure.

Environmental toxicology: Development and validation of immunosensors for pesticides and other environmental pollutants. Estimation of levels of radionuclides and heavy metals in selected population groups.

University structures and other research organizations are often involved in ENEA research activities.

World Health Organization
Regional Office for Europe
European Center for Environment and Health, Rome Division
Via Vincenzo Bona 67
00156 Rome
Phone: +39/6/487751
Fax: +39/6/4877599
E-mail: CAS@WHO.IT
Web: http://www.who.it

The Rome Division of the Environment and Health Department of the WHO Regional Office for Europe was set up in 1991. Its attentions are focused on water pollution and wastewater disposal at an international level, food safety, radiation protection, and analytical epidemiology. Its advice and assistance are available to member states of the WHO Regional Office for Europe.

Istituto Superiore di Sanità
Viale Regina Elena, 299
Rome

Phone: +39/6/49901
Fax: +39/6/4469938
Web: http://www.iss.it

The Italian National Health Institute [Istituto Superiore di Sanità (ISS)] is the main Italian institute of technical–scientific research, control, and advice in public health. Since 1978, it has served as the technical and scientific body of the Italian National Health Service. It is under the authority of the Ministry of Health. The ISS is equipped with 20 laboratories and has a permanent staff of over 1400 including more than 350 researchers and 600 fellows and trainees. The ISS promotes public health through scientific research, surveillance, and testing related to infectious and noninfectious disease, the environment, food, and drugs. The ISS Laboratories of Applied Toxicology, Comparative Toxicology and Ecotoxicology, Environmental Hygiene, Pharmaceutical Chemistry, and Pharmacology are regularly involved in research, control, and institutional activities concerning various aspects of risk and safety assessment of chemicals. Other laboratories (clinical biochemistry, epidemiology and biostatistics, food, and veterinary medicine) are also involved in these activities, and a significant role is also played by the Documentation Service. Toxicological research activities comprise more than 20 research projects in the fields of pesticides, dangerous chemicals, bioelements in the environment, mineral fibers, genotoxicity, models and methods for the assessment of toxicological and ecotoxicological risks, priority selection among chemicals, air, water, and soil quality, wastes and environmental epidemiology. Between 1991 and 1995 the ISS produced over 1000 publications on these subjects, with over half published in international journals. At the international level, the ISS participates in many scientific technical activities of the European Union regarding the classification, labeling, preparation of test guidelines and risk assessment for existing chemical substances, and activities concerning new chemical substances. The ISS is responsible for the technical aspects of national directives on pesticides, and it serves as one of the four European Community Reference Laboratories for monitoring pesticide residues in food and environmental matrices. The ISS also ensures the updating of the National Inventory of Chemical Substances, a data bank on the hazards and risks related to existing chemicals. The ISS is also involved in specific OECD activities as the national coordinator of the Toxicology Testing Guideline program. It serves as a reference point for the Complementary Information Exchange Procedure (CIEP) and the Screening Information Data Set. It is a WHO collaborating center for research and training in veterinary public health. ISS experts regularly participate, as temporary advisers, in WHO groups examining chemicals. The ISS contributes to IARC, UNEP, IPCS, and NATO-CCMS activities and programs. A National Toxicological Advisory Committee (CCTN committee) has been established within the ISS by the Ministry of Health. The committee evaluates the potential risk of carcinogenic, mutagenic, reproductive, and other toxic effects related to human exposure to chemicals and identifies specific areas for toxicological research.

TABLE 25.2 Professorships in the Area of Toxicology

Discipline	Professorship		
	Full	Associate	Total
Toxicology	5	18	23
Pharmacology[a]	156	205	361
Medicinal and toxicological chemistry analytical chemistry[a]	109	187	296
Forensic medicine[a]	50	69	119
Forensic toxicology	6	8	14

[a] Some, but not all, involved in teaching/research activities related to toxicology.

Research Institutes

In Italy there are 48 university departments of pharmacology and toxicology. Table 25.2 shows full (FP) and associate (AP) professorships in the area of toxicology. Since 1917, the Department of Pharmacology of the University of Florence has included a chair of toxicology with an associated clinical service. Toxicology services are also associated with the chairs of clinical pharmacology at the Universities of Modena (the service is mainly involved in problems of drug addiction), Padua, and Pavia (see Poison Control Centers). Finally, there are five scientific institutes for health care and therapy located in Naples, Rome, Milan, Genoa, and Pisa. These centers, which are supervised by the Ministry of Health, are involved in cancer research, including toxicological studies of carcinogenic substances and anticancer drugs.

Istituto di Ricerche Farmacologiche Mario Negri (Mario Negri Institute for Pharmacological Research)
Via Eritrea, 62
20157 Milan
Phone: +39/2/390141
Fax: +39/2/3546277 - 39001918
E-mail: mnegri@irfmn.mnegri.it
Web: http://www.irfmn.mnegri.it

The Mario Negri Institute for Pharmacological research is a scientific nonprofit foundation for biomedical research and higher education that opened in 1963. The institute is equipped with 44 research laboratories and employs more than 800 people (researchers, laboratory technicians, postgraduate trainees, supporting staff, etc.). There are also three extension laboratories located in Bergamo, Ranica (Bergamo), and S. Maria Imbaro (Chieti). The following lines of toxicological research are currently being pursued:

- Relations among toxic effects, metabolism, and disposition of xenobiotics in animals
- Influences of polychlorinated aromatic hydrocarbons on the hepatic heme pathway
- The formation and metabolism of nitrosamines under different conditions
- Development of short-term toxicity tests using isolated perfused organs and cells as models of target organ toxicity
- The effects of glutamic acid and aspartame on the central nervous system
- Mechanisms and mediators of renal injury provoked by antibiotics and anticancer agents
- Evaluation of chemical composition and toxicity of urban waste incinerator emissions
- Immunotoxicology
- Toxicokinetics

In its 35 years of activity, the institute has published approximately 5500 reports in international journals, 2200 transfer articles, and 161 books (monographs and Congress Proceedings).

Libraries

Significant collections of toxicological literature can be found in the libraries of university departments of medicinal and toxicological chemistry, forensic toxicology, occupational medicine, and pharmacotoxicology as well as in those of the universities themselves, the Istituto Superiore di Sanità and the Consiglio Nazionale delle Ricerche in Rome, the Mario Negri Institute for Pharmacological Research in Milan, and private industries.

Regional Documentation Centers

Centro di Documentazione per la Salute - CDS Regione Emilia Romagna
Via Gramsci 12,
40121 Bologna
Phone: +39/51/6079979
Fax: +39/51/251915
E-mail: cdocs@iperbole.bologna.it
Web: http://www.regione.emilia-romagna.it/cds

Comunicazione, Educazione, Documentazione, Informazione, Formazione (CEDIF)
ARPAT Agenzia Regionale Protezione Ambientale Toscana
Via Baracca 9,
50127 Firenze
Phone: +39155/3206368
Fax: +3915513206367
E-mail: ccdif@arpal.toscana.il
Web: http://www.arpat.toscana.it

POISON CONTROL CENTERS

Centro Antiveleni
Istituto di Anestesia e Rianimazione
II Cattedra di Anestesia e Rianimazione
Corso A.M. Dogliotti 14
10126 Torino
Phone: +39/11/6637637

Centro Antiveleni
Ospedale Infantile Burlo Garofalo
Via dell'Istria 65/1
Trieste
Phone: +39/40/3785373-333

Centro Antiveleni
Policlinico A. Gemelli
Largo Agostino Gemelli, 8
00168 Rome
Phone: +39/6/3054343

This center, opened in 1970, has developed a computerized system based on the utilization of three data banks: the first data bank stores all the information on toxic products (9000 documents), the second contains clinical information on all cases treated in the center (27,000 to date), and the third, interfaced with analytical laboratory instruments, allows immediate chemical–analytical identification of poisons. The service is operative 24 hours a day.

Centro di Documentazione Tossicologica
Centro Interdipartimentale sulle Intossicazione Acute
Dipartimento di Farmacologia
''E. Meneghetti''
Università degli Studi di Padova
Largo E. Meneghetti, 2
35131 Padova
Phone: +39/49/8275078

Previously known as the ''Centro di studio dei tossici—Servizio antiveleni,'' this poison control service

now operates within the Inter-Departmental Center for Research on Acute Intoxication (CIRIA), which includes the Department of Pharmacology (Chair of Toxicology, Toxicology Laboratory, and Chair of Neuropsychopharmacology) and the Institute of Anesthesiology and Resuscitation of the University of Padua. It serves the regions of northwestern Italy (Friuli-Venezia, Veneto, and Trentino Alto-Adige; total population, 7 million).

Centro Nazionale di Informazione
Tossicologica Fondazione Salvatore Maugeri
Clinica del Lavoro e della Riabilitazione I.R.C.C.S.
Via S. Boezio, 26
27100 Pavia
Phone: +39/382/24444

This center was established in 1992 at the Pavia Medical Institute as part of a convention reached between the University of Pavia and the ''Salvatore Maugeri'' Foundation, a national nonprofit organization dedicated to clinical care and research in rehabilitation and environmental medicine. It forms a part of the university's Toxicology Division. The NTCI functions as a poison control center and also carries out academic and research activities related to the management of illnesses related to chemical exposure. It serves as the coordinating center for a nationwide network of hospitals that provide training in clinical toxicology. Its staff includes physicians and research scientists working in the fields of emergency medicine, toxicology, pharmacology, and occupational and environmental health. Teaching activities are carried out within the University of Pavia postgraduate schools of medical toxicology, occupational medicine, and Anesthesiology and intensive care. The NTCI laboratory is involved in many research activities based on animal models and/or *in vitro* methods that are being conducted in conjunction with research institutes in Europe and the United States. Studies include new therapeutic methods in clinical toxicology and neurotoxicity biomarkers.

Ospedale Cardarelli
Via Cardarelli, 9
80131 Napoli
Phone: +39/81/7472870

This center serves the regions of southern Italy (Campania, Calabria, Puglia, Lucania, and Sicily—total population, approx 18 million). Chemical and toxicological studies are performed in the laboratories of the Azienda Ospedaliera ''A. Cardarelli'' and the Laboratory of the Institute of Forensic Medicine, II Faculty of Medicine, University of Naples.

Ospedale Civile
Via Montereale, 24
33170 Pordenone
Phone: +39/434/550301

Ospedale Garibaldi
Piazza Santa Maria di Gesù
95124 Catania
Phone: +39/95/7594120

Ospedale Maggiore
Largo Bartolo Nigrisoli, 2
40133 Bologna
Phone: +39/51/333333

Ospedale Maurizio Bufalini
Via Giovanni Ghirotti, 286
47023 Cesena
Phone: +39/547/352612

Ospedale Niguarda Ca' Grande
Piazza Ospedale Maggiore
20162 Milan
Phone: +39/2/66101029

This center, which works in close collaborations with the Ministry of Civil Defense, has developed a program for early warning in cases of large-scale toxic disasters. A registry is kept of the principal industrial structures in the Lombardy Region that are at risk for such disasters, with information on the substances and materials used and stored on site.

Ospedali Riuniti
Via G. Melacrino, 1
89100 Reggio Calabria
Phone: +39/965/811624

Ospedale San Martino
Viale Benedetto XV
16132 Genova
Phone: +39/10/352808

Ospedale Santissima Annunziata
Via Tiro a Segno
76100 Chieti
Phone: +39/871/345362

Ospedale Vito Fazzi
Via Rossini, 2
73100 Lecce
Phone: +39/832/665374

Policlinico Umberto I
Viale Regina Margherita, 324
00161 Roma
Phone: +39/6/490663
Fax: +39/6/4461967

Servizio Antiveleni
Servizio di Pronto Soccorso, Accettazione e Osservazione

Istituto Scientifico ''G. Gaslini''
Largo G. Gaslini, 5
16147 Genova
Phone: +39/10/56361
Fax: +39/10/3760603

Servizio Autonomo di Tossicologia
USL 10/D Università degli Studi di Firenze
Viale G. B. Morgagni, 65
50134 Firenze
Phone: +39/55/4277238

Servizio Sanitario Nazionale—Regione Liguria
Azienda USL n. 5—Spezzino
Servizio Spezia Soccorso
Centrale operativa 118
La Spezia
Phone/fax: +39/187/533296

COMPUTER FILES

The Poison Control Center of the Catholic University, School of Medicine (Largo A. Gemelli 8, 00168 Rome) has a computerized system of information on toxic products (9000 documents), clinical cases (27,000 cases), physicochemical data, and analytic procedures that operates 24 hours a day. This center is also linked with several other poison control centers in Italy.

The National Medlars Center has been established at the Istituto Superiore di Sanita' (ISS). Before 1998, Italian users who wished to make an online search on files produced or distributed by the NLM could access the ELHILL or TOXNET computers using a password assigned by the ISS. After the institution by NLM of a free web-based searching TOXNET site on the Internet (http://Toxnet.nlm.nih.gov), the tasks of the ISS are now more oriented toward disseminating knowledge of NLM files in training courses and distributing information and teaching material conceived for in-depth exploitation of toxicological resources on the Internet. Italian users are very interested in direct searching of toxicological information. An interlibrary loan documentation center has been established at the Documentation Service of the ISS for articles not available in Italy, within the activities of NLM DOCLINE (DOC on LINE) (e-mail: Dracos@iss.it).

The ISS also hosts the National Correspondent for interaction and exchange of information with the International Registry of Potentially Toxic Chemicals (IRPTC) (e-mail: caroli@iss.it.Interbusiness.IT).

In 1978, the ISS established a computerized *Inventario Nazionale delle Sostanze Chimiche* (INSC: National Inventory of Chemical Substances), a factual data bank on chemicals (in Italian) that can be consulted for routine and emergency needs. The INSC provides extensive information on chemical identification, toxicological and ecotoxicological data, occupational health and safety, environmental fate, standards, evaluation, and classification for over 2800 entries. In addition, for approximately 2000 other substances, raw data (consisting of bibliographic information and specific articles collected in the open and gray literature) are available. The INSC can be accessed via the telecomunication network by public administrators, regional agencies, and international organizations. The access to INSC is possible via INTERNET. INSC and is available to a defined list of regional contact points'.

Inventario Nazionale delle Sostanze Chimiche
(National Inventory of Chemical Substances)
Istituto Superiore di Sanità
Viale Regina Elena 299
00161 Roma
Phone: +39/6/49902372-49902023-49902593
Fax: +39/6/49387170
E-mail: inscweb@iss.it
Web: http://insc.net.iss.it

The Public Administration of the Piemonte Region in the north of Italy participates, along with other European regions, in the European Union's Regional Environmental Management Support System Based on Telematics (REMSSBOT). The project supports administrative and technical investigation of industrial plants with significant risks of accidents due to the storage and/or the processing of hazardous substances.

The REMSSBOT contact for the Piemonte Region is Paolo Gallo, C.so U. Sovietica, 216, 10134 Torino, Italy (Phone: +39/11/4618503; fax: +39/11/4618212; e-mail: gallo@csi.it).

UNIVERSITIES

This section pertains exclusively to institutions offering officially approved courses related to the disciplines of pharmacology and toxicology, those offering postgraduate specialization courses in toxicology or pharmacotoxicology, and those with PhD programs in pharmacotoxicology.

Universita' Degli Studi di Ancona (Ancona University)
60100 Ancona
Piazza Roma 23
Phone: +39/71/2202212-13-14
Fax: +39/71/2202324

Facoltà di Medicina e Chirurgia (School of Medicine)
60100 Ancona
Via Ranieri - Monte D'Ago

Phone: +39/71/2204648
Fax: +39/71/220649

Centro Universitario Interdipartimentale Interazioni Biofisiche e Biochimiche tra Molecole e Organismi (I.M.O.)—Sezione di Farmacotossicologia Umana (Interdepartmental University Center, Biophysical and Biochemical Interactions between Molecules and Organisms, Section of Human Pharmacotoxicology)
60020 Torrette di Ancona
Via Tronto, 10A
Phone: +39/71/2206036
Fax: +39/71/2206037

Universita' degli Studi di Bari (Bari University)
70121 Bari
P.zza Umberto 1
Phone: +39/80/5714271
Fax: +39/80/5714641

Facoltà di Farmacia (School of Pharmacy)
70125 Bari
Via E. Orabona 4
Phone: +39/80/5442047-2045
Fax: +39/80/5442050

Dipartimento Farmaco-Chimico (Pharmachemical Dept.)
70125 Bari
Via E. Orabona 4
Phone: +39/80/5442045
Fax: +39/80/5442724

Dipartimento Farmaco-Biologico (Pharmacobiological Dept.)
70125 Bari
Via Orabona 4
Phone: +39/80/5443374
Fax: +39/80/5442770

Facoltà di Medicina e Chirurgia (School of Medicine)
70124 Bari
Piazza G. Cesare - Policlinico
Phone: +39/80/5478660/1/2/3/4
Fax: +39/80/5478666

Dipartimento di Farmacologia e Fisiologia Umana Sez. di Farmacologia (Dept. of Pharmacology and Human Physiology, Section of Pharmacology)
70124 Bari
P.le Giulio Cesare - Policlinico
Phone: +39/80/5478448-439
Fax: +39/80/5478444

Facoltà di Medicina Veterinaria (School of Veterinary Medicine)
70126 Bari
V.le Caduti di tutte le guerre 1
Phone: +39/80/4670315
Fax: +39/80/8770315

Istituto di Farmacologia e Tossicologia Veterinaria (Dept. of Veterinary Pharmacology and Toxicology)
70126 Bari
Strada Prov. per Casamassima Km. 3 - Valenzano
Phone: +39/80/4670326
Fax: +39/80/4670607

Universita' degli Studi di Bologna (Bologna University)
40126 Bologna
Via Zamboni, 33
Phone: +39/51/259010-32
Fax: +39/51/259034

Facoltà di Farmacia (School of Pharmacy)
40126 Bologna
Viale Filopanti 7
Phone: +39/51/354380-81
Fax: +39/51/354382

Scuola di Specializzazione in Tossicologia (Postgraduate School of Toxicology)
Dipartimento di Farmacologia
40126 Bologna
Via Irnerio 48
Phone: +39/51/253548

Istituto Scienze Chimiche (Dept. of Chemical Sciences)
40126 Bologna
Via San Donato, 15
Phone: +39/51/242052
Fax: +39/51/249770

Facoltà di Medicina e Chirurgia (School of Medicine)
40127 Bologna
Via S. Vitale, 59
Phone: +39/51/232468
Fax: +39/51/233062

Dipartimento di Farmacologia (Department of Pharmacology)
40125 Bologna
Via Irnerio 48
Phone: +39/51/249561-242025
Fax: +39/51/248862

Facoltà di Medicina Veterinaria (School of Veterinary Medicine)
40064 Ozzano Emilia (BO)
Via Tolara di Sopra, 50/58
Phone: +39/51/792895-6511126
Fax: +39/51/6511157

Istituto di Farmacologia, Farmacocinetica e Tossicologia (Dept. of Pharmacology, Pharmacokinetics, and Toxicology)
40064 Ozzano Emilia (BO)
Via Tolara di Sopra, 50
Phone: +39/51/792990-792712
Fax: +39/51/799511

Universita' degli Studi di Brescia (Brescia University)
25121 Brescia
Piazza Mercato 15
Phone: +39/30/29881

Facoltà di Medicina e Chirurgia (School of Medicine)
25100 Brescia
Via Valsabbina 19
Phone: +39/30/3715201
Fax: +39/30/3700642

Dipartimento di Scienze Biomediche e Biotecnologie—Cattedra di Farmacologia (Dept. of Biomedical Sciences and Biotechnologies)
25123 Brescia
Via Valsabbina 19
Phone: +39/30/37151

Universita' degli Studi di Cagliari (Cagliari University)
09100 Cagliari
Via Università 40
Phone: +39/70/6751
Fax: +39/70/669425

Facoltà di Farmacia (School of Pharmacy)
09100 Cagliari
Via Ospedale, 72
Phone: +39/70/657749
Fax: +39/70/658521

Dipartimento Farmaco-Chimico-Tecnologico (Dept. of Medicinal and Pharmaceutical Chemistry)
09124 Cagliari
Via Ospedale, 72
Phone: +39/70/657749
Fax: +39/70/658521

Dipartimento di Tossicologia (Dept. of Toxicology)
09124 Cagliari
Via Ospedale 72
Phone: +39/70/300437
Fax: +39/70/300740

Scuola di Specializzazione in Tossicologia (Postgraduate School of Toxicology)
09124 Cagliari
Viale Diaz, 182
Phone: +39/70/300740 - 303819
Fax: +39/70/300740

Facoltà di Medicina e Chirurgia (School of Medicine)
Via S. Giorgio, 12
09124 Cagliari
Phone: +39/70/668654
Fax: +39/70/663651

Universita' degli Studi della Calabria
(Calabria University)
87030 Arcavacata di Rende (CS)
Via Pietro Bucci
Phone: +39/984/4911
Fax: +39/984/493616

Facoltà di Farmacia (School of Pharmacy)
87030 Arcavacata di Rende (CS)
Via Pietro Bucci
Phone: +39/984/493108-09
Fax: +39/984/493107

Dipartimento Farmacolobiologico (Pharmacobiological Department)
87030 Arcavacata di Rende (Cs)
Via Pietro Bucci
Phone: +39/984/493965
Fax: +39/984/493763

Dipartimento di Scienze Farmaceutiche (Department of Pharmaceutical Sciences)
87030 Arcavacata di Rende (Cs)
Via Pietro Bucci
Phone: +39/984/493965
Fax: +39/984/493032

Universita' degli Studi di Camerino (Camerino University)
Via del Bastione, 3
62032 Camerino (MC)
Phone: +39/737/4011
Fax: +39/737/40298

Facoltà di Farmacia (School of Pharmacy)
62032 Camerino (MC)
Via Sant'Agostino
Phone: +39/737/40336-630347
Fax: +39/737/637345-630347

Istituto di Farmacologia, Farmacognosia e Tecniche Farmaceutiche (Dept. of Pharmacology, Pharmacognosy and Pharmaceutical Technology)
62032 Camerino (MC)
Via M. Scalzino, 3
Phone: +39/737/40700-632538
Fax: +39/737/630618

Facoltà di Medicina Veterinaria
Via Circonvallazione, 93/95
62024 Matelica
Phone: +39/737/7891-789320
Fax: +39/737/789321

Universita' degli Studi di Catania (Catania University)
95124 Catania
Piazza Università, 2
Phone: +39/95/310355
Fax: +39/95/325194

Facoltà di Farmacia (School of Pharmacy)
Policlinico
95123 Catania, 6
Viale Andrea Doria
Phone: +39/95/580554
Fax: +39/95/338015

Dipartimento di Scienze Farmaceutiche (Dept. of Pharmaceutical Sciences)
Policlinico edificio 12
95123 Catania
Viale Andrea Doria, 6
Phone: +39/95/336441
Fax: +39/95/222239

Facoltà di Medicina e Chirurgia (School of Medicine)
Policlinico Padiglione 29
95124 Catania
Via S. Sofia
Phone: +39/95/330253
Fax: +39/95/333900

Istituto di Farmacologia (Dept. of Pharmacology)
Policinico edificio 12
95124 Catania
V.le Andrea Doria, 6
Phone: +39/95/330533, int. 261-338647
Fax: +39/95/333219

Universita' degli Studi di Catanzaro (Catanzaro University)

Facoltà di Farmacia (School of Pharmacy)
Complesso Ninì Barbieri
88021 Roccelletta di Borgia (CZ)
Cattedre di Farmacologia e Farmacognosia
I e II (I and II Chairs of Pharmacology and Pharmacognosy)
Phone: +39/961/391157
Fax: +39/961/391490

Facoltà di Medicina e Chirurgia (School of Medicine)
88100 Catanzaro
Via T. Campanella, 115
c/o Polic. Mater Domini
Phone: +39/961/712111
Fax: +39/961/775373

Universita' degli Studi di Chieti (Chieti University)
66113 Chieti
Via dei Vestini 31
Phone: +39/871/3551

Facoltà di Farmacia (School of Pharmacy)
(Institute of Drug Sciences, Dept. of Pharmacology and Pharmacognosy)
66113 Chieti
Via dei Vestini 31
Phone: +39/871/3555234-5233-5368
Fax: +39/871/3555322

Facoltà di Medicina e Chirurgia (School of Medicine)
66113 Chieti
Via dei Vestini 15
Phone: +39/871/3554113-4105-4057-561749
Fax: +39/871/3554056

Dept. of Biomedical Sciences
Section of Pharmacology and Toxicology
Palazzina B- Nuovo Polo Didattico
Phone: +39/871/3554050
Fax: +39/871/3554012

Universita' degli Studi di Ferrara (Ferrara University)
44100 Ferrara
Via Savonarola, 9
Phone: +39/532/203181
Fax: +39/532/248927

Facoltà di Farmacia (School of Pharmacy)
44100 Ferrara
Via Fossato di Mortara, 17/19
Phone: +39/532/291286
Fax: +39/532/291296

Facoltà di Medicina e Chirurgia (School of Medicine)
44100 Ferrara
Via Fossato di Mortara, 64/b
Phone: +39/532/200558
Fax: +39/532/207244

Istituto di Farmacologia (Dept. of Pharmacology)
44100 Ferrara
Via Fossato di Mortara, 17/19
Phone: +39/532/291204
Fax: +39/532/291205

Universita' degli Studi di Firenze (Florence University)
50121 Firenze
P.zza San Marco, 4
Phone: +39/55/27571
Fax: +39/55/2757430

Facoltà di Farmacia (School of Pharmacy)
50134 Firenze
Viale Morgagni, 44
Phone: +39/55/4378102
Fax: +39/55/410825

Dipartimento di Scienze Farmaceutiche (Dept. of Pharmaceutical Sciences)
50121 Firenze
Via G. Capponi, 9
Phone: +39/55/2757306
Fax: +39/55/240776

Facoltà di Medicina e Chirurgia (School of Medicine)
Azienda Ospedaliera di Careggi
Viale Morgagni 44
50134 Firenze
Phone: +39/55/417928
Fax: +39/55/4379384

Dipartimento di Farmacologia Preclinica e Clinica ''M. Aiazzi Mancini'' (Dept. of Preclinical and Clinical Pharmacology)
50134 Firenze
V.le Morgagni, 65
Phone: +39/55/4237411
Fax: +39/55/4361613

Scuola di Specializzazione in Tossicologia Medica (Postgraduate School in Medical Toxicology)
Phone: +39/55/411133
Fax: +39/55/4361613

Scuola di Specializzazione in Farmacologia (opzione Tossicologia) (Postgraduate School of Pharmacology—Option in Toxicology)
Phone: +39/55/411133
Fax: +39/55/4361613

Universita' degli Studi di Genova (Genoa University)
16126 Genova
Via Balbi, 5
Phone: +39/10/20991
Fax: +39/10/2099227

Facoltà di Farmacia (School of Pharmacy)
16147 Genova
Via Brigata Salerno (Ponte)
Phone: +39/10/3532626 (Dean)
Fax: +39/10/3532334

Istituto di Scienze Farmaceutiche (Dept. of Pharmaceutical Sciences)
16132 Genova
Viale Benedetto XV, 3
Phone: +39/10/3538357
Fax: +39/10/3538358

Dipartimento di Medicina Sperimentale Sezione di Farmacologia e Tossicologia (Dept. of Experimental Medicine, Section of Pharmacology and Toxicology)
V.le Cembrano, 4
16148 Genova
Phone: 39/10/3532650 (Deam)
Fax: +39/10/3993360

Facoltà di Medicina e Chirurgia (School of Medicine)
Via A. De Toni
16132 Genova
Phone: +39/10/3537370 (Dean)
Fax: +39/10/3537352

Istituto di Farmacologia (Dept. of Pharmacology)
16132 Genova
Viale Benedetto XV, 2
Phone: +39/10/3538805
Fax: +39/10/3538849

Istituto di Medicina del Lavoro (Dept. of Occupational Medicine)
16132 Genova
V.le Benedetto XV, 3
Phone: +39/10/3537501
Fax: +39/10/3537473

Universita' degli Studi di L'Aquila (Aquila University)
67100 L'Aquila
Piazza Vincenzo Rivera 1
Phone: +39/862/4311
Fax: +39/862/412948

Facoltà di Medicina e Chirurgia (School of Medicine)
67010 Coppito-L'Aquila
Via Vetoio - Blocco XI
Phone: +39/862/433301/314743
Fax: +39/862/433303

Scuola di Specializzazione in Farmacologia (opzione Tossicologia)
(Postgraduate School in Pharmacology, option in Toxicology)
67100 L'Aquila
Via S. Sisto (c/o Dipartimento di Medicina Interna e Sanità Pubblica)
Phone: +39/862/432879/80
Fax: +39/862/432858

Facoltà di Scienze Matematiche, Fisiche e Naturali (School of Mathematics, Physics and Natural Sciences)
67010 Coppito-L'Aquila
Phone: +39/862/433001/02 (Dean)
Fax: +39/862/433003

Dipartimento di Biologia di Base e Applicata
Cattedra di Farmacologia e Tossicologia
(Department of Basic and Applied Biology Chair of Pharmacology and Toxicology)

67010 -Coppito-L'Aquila
Via Vetoio
Phone: +39/862/433262/5
Fax: +39/862/433273-433262

Universita' degli Studi di Messina (Messina University)
98100 Messina
Via Cannizzaro
Phone: +39/90/716111

Facoltà di Farmacia (School of Pharmacy)
98100 Messina
Villaggio S. Annunziata
Phone: +39/90/358220-6766536
Fax: +39/90/355703

Dipartimento Farmacobiologico (Pharmacobiological department)
98168 Messina
Villaggio SS. Annunziata
Phone: +39/90/6766542
Fax: +39/90/355703

Dipartimento Farmaco-Chimico (Pharmacochemical Department)
98168 Messina
Villaggio SS. Annunziata
Tel. +39/90/358220-6766536
Fax: +39/90/351613

Facoltà di Medicina e Chirurgia (School of Medicine)
98100 Messina
Policlinico Univ. G. Martino
Phone: +39/90/2931621
Fax: +39/90/2931626

Scuola di Specializzazione in Tossicologia Medica (Postgraduate School in Medical Toxicology)
98100 Messina
P.zza XX Settembre
Phone: +39/90/712533
Fax: +39/90/661029

Facoltà di Medicina Veterinaria (School of Veterinary Medicine)
98100 Messina
Via S. Cecilia 30
Phone: +39/90/2336940
Fax: +39/90/692780

Dipartimento di Medicina e Farmacologia Veterinaria (Dept. of Veterinary Medicine and Pharmacology)
98100 Messina
Via S. Cecilia 30
Phone: +39/90/361656
Fax: +39/90/692780

Universita' degli Studi di Milano (Milan University)
Via Festa del Perdono, 7
20122 Milano
Phone: +39/2/58351
Fax: +39/2/58304482

Facoltà di Farmacia (School of Pharmacy)
20131 Milano
Via Balzaretti, 9
Phone: +39/2/20488324/341 (Dean)
Fax: +39/2/29404961

Istituto di Chimica Farmaceutica e Tossicologica (Dept. of Pharmaceutical and Toxicological Chemistry)
20131 Milano
V.le Abruzzi, 42
Phone: +39/2/29522041/2
Fax: +39/2/29514197

Istituto di Scienze Farmacologiche
20133 Milano
Via Balzaretti 9
Phone: +39/2/204881
Fax: +39/2/29404961

Scuola di Specializzazione in Tossicologia (Postgraduate School in Toxicology)
20133 Milano
Via Balzaretti 9
Phone: +39/2/20488320
Fax: +39/2/29404961

Facoltà di Medicine e Chirurgia (School of Medicine)
20122 Milano
Via Festa del Perdono, 7
Phone: +39/2/58352360/1/2 (Dean)
Fax: +39/2/58303774

Dipartimento di Farmacologia, Chemioterapia e Tossicologia Medica (Dept. of Pharmacology, Chemotherapy, and Medical Toxicology)
20129 Milano
Via Vanvitelli, 32
Phone: +39/2/701461
Fax: +39/2/70146371

Facoltà di Scienze Matematiche, Fisiche e Naturali (School of Mathematics, Physics, and Natural Science)
29133 Milano
Via Celoria, 16
Phone: +39/2/2664042 (Dean)
Fax: +39/2/2392213

Istituto di Farmacologia (Dept. of Pharmacology)
20129 Milano
Via Vanvitelli, 32/A

Phone: +39/2/70100131-7385568
Fax: +39/2/70002270

Facoltà di Medicina Veterinaria (School of Veterinary Medicine)
20133 Milano
Via Celoria, 10
Phone: +39/2/2360256
Fax: +39/2/2367788

Istituto di Farmacologia e Tossicologia Veterinaria (Dept. of Veterinary Pharmacology and Toxicology)
20133 Milano
Via Celoria, 10
Phone: +39/2/2663602

Universita' Degli Studi di Modena (Modena University)
41100 Modena
Via Università, 4
Phone: +39/59/329111
Fax: +39/59/218661

Facoltà di Farmacia (School of Pharmacy)
41100 Modena
Via Campi 183
Phone: +39/59/378568 (Dean), +39/59/378569 (Secretariate)
Fax: +39/59/373602 (Dean), +39/59/378560 (Secretariate)

Facoltà di Medicina e Chirurgia (School of Medicine)
41100 Modena
Via del Pozzo, 71
Phone: +39/59/373795 (Dean), +39/59/329233 (Secretariate)
Fax: +39/59/374037 (Dean), +39/59/329283 (Secretariate)

Dipartimento di Scienze Biomediche, Sezione di Farmacologia (Dept. of Biomedical Sciences, Pharmacology Section)
41100 Modena
Via Campi, 287
Phone: +39/59/428440
Fax: +39/59/428103

Scuola di Specializzazione in Tossicologia Medica (Postgraduate School in Medical Toxicology)
41100 Modena
Via del Pozzo, 71
Phone: 39/59/424064
Fax: +39/59/424069

Scuola di Specializzazione in Farmacologia (opzione in Tossicologia) (Postgraduate School in Pharmacology, option in Toxicology)
41100 Modena
Via Campi 287
Phone: +39/59/428440
Fax: +39/59/428103

Universita' degli Studi di Napoli ''Federico II'' (University of Federico II Naples)
80138 Napoli
Corso Umberto I
Phone: +39/81/54477111
Fax: +39/81/54477278

Facoltà di Farmacia (School of Pharmacy)
80131 Napoli
Via Domenico Montesano, 49
Phone: +39/81/7486122
Fax: +39/81/7486107

Dipartimento di Chimica Farmaceutica e Tossicologica (Dept. of Pharmaceutical Chemistry and Toxicology)
80138 Napoli
Via L. Rodinò
Phone: +39/81/7486403
Phone/Fax: +39/81/7486630

Dipartimento di Farmacologia Sperimentale (Dept. of Experimental Pharmacology)
80131 Napoli
Via D. Montesano 49
Phone: +39/81/7486401
Fax: +39/81/7486403

Facoltà di Medicina e Chirurgia (School of Medicine)
80134 Napoli
Via S. Pansini 5 Pad. 12
Phone: +39/81/7462006
Fax: +39/81/7463243

Dipartimento di Neuroscienze e della Comunicazione Interumana—Sezione di Farmacologia (Department of Sciences of Human Communications, Section of Pharmacology)
80131 Napoli
Via S. Pansini 5
Phone: +39/81/7463318
Fax: +39/81/7463323

Scuola di Specializzazione in Farmacologia (opzione in Tossicologia) (Postgraduate School of Pharmacology, option in Toxicology)
80131 Napoli
Via S. Pansini 5
Phone: +39/81/74633187463325
Fax: +39/81/7463323

Facoltà di Medicina Veterinaria (School of Veterinary Medicine)
80137 Napoli
Via F. Delpino 1

Phone: +39/81/441970
Fax: +39/81/444016

Dipartimento di patologia, profilassi e ispezione degli alimenti (Catterdre di Farmacologia Veterinaria e di Tossicologia Veterinaria) (Department of Pathology, Prophylasis, and Food Inspection)
Chairs of Veterinary Pharmacology and Veterinary Toxicology
Phone/Fax: +39/81/297122

Universita' degli Studi di Napoli (II Ateneo) (School of Medicine II Naples University)
80138 Napoli
Via Maria di Costantinopoli 104
Phone: +39/81/290368-296799
Fax: +39/81/298522

Facoltà di Medicina e Chirurgia (School of Medicine)
80138 Napoli
Via S. Maria di Costantinopoli 104
Phone: +39/81/5663314-5663315-299614
Fax: +39/81/298522

Istituto di Farmacologia e Tossicologia (Dept. of Pharmacology and Toxicology)
80138 Napoli
Piazzetta S. Andrea delle Dame 8
Phone: +39/81/5665887-459802-5665877
Fax: +39/81/5665878

Scuola di Specializzazione in Farmacologia (opzione Tossicologia) (Postgraduate School of Pharmacology, option in Toxicology)
80138 Napoli
P. zzetta S. Andrea delle Dame 8
Phone: +39/81/5665887
Fax: +39/81/56655878

Facoltà di Medicina Veterinaria (School of Veterinary Medicine)
Via F. Delpino, 1
80137 Napoli
Phone: +39/81/441970
Fax: +39/81/444016

Universita' degli Studi di Padova (Padua University)
35100 Padova
Via VIII Febbraio, 2
Phone: +39/49/82725111
Fax: +39/49/8273007

Facoltà di Farmacia (School of Pharmacy)
35100 Padova
Via Marzolo, 5
Phone: +39/49/8275336/5367/5328
Fax: +39/49/8275366

Dipartimento di Scienze Farmaceutiche (Dept. of Pharmaceutical Sciences)
35100 Padova
Via Marzolo, 5
Phone: +39/49/8275357
Fax: +39/49/8275366

Facoltà di Medicina e Chirurgia (School of Medicine)
35100 Padova
Via C. Battisti, 267
Phone: +39/49/8751533
Fax: +39/49/8753040

Dipartimento di Farmacologia ''E. Meneghetti'' (Dept. of Pharmacology ''E. Meneghetti'')
35100 Padova
Largo Meneghetti, 2
Phone: +39/49/8275080
Fax: +39/49/8275093

Scuola di Tossicologia Medica (School in Medical Toxicology)
35100 Padova
Largo E. Meneghetti 2
Phone: +39/49/8275080
Fax: +39/49/8273093

Facoltà di Medicina Veterinaria (School of Veterinary Medicine)
35020 Legnaro (PD) c/o Agripolis
Phone: +39/49/8272536
Fax: +39/49/8272545

Universita' degli Studi di Palermo (Palermo University)
90133 Palermo
P.zza Marina, 61
Phone: +39/91/6075111
Fax: +39/91/6110448 (6110077)

Facoltà di Farmacia (School of Pharmacy)
90134 Palermo
Via Antonino Ugo, 47/9
Phone: +39/91/6164554
Fax: +39/91/6164766

Istituto Farmaco-Chimico (Dept. of Pharmaceutical Chemistry)
90123 Palermo
Via Archirafi, 32
Phone: +39/91/6161606-6169999
Fax: +39/91/6170728

Istituto di Farmacologia e Farmacognosia (Dept. of Pharmacology and Pharmacognosy)
90134 Palermo
Via Forlanini, 1
Phone: +39/91/6512262-6512425
Phone/Fax: +39/91/6512469 - 6512262

Facoltà di Medicina e Chirurgia (School of Medicine)
90127 Palermo
Via del Vespro, 129
Phone: +39/91/6553787
Fax: +39/91/6553781

Istituto di Farmacologia (Dept. of Pharmacology)
Policlinico P. Giaccone
90127 Palermo
Phone: +39/91/6553252
Fax: +39/91/6553249

Universita' degli Studi di Parma (Parma University)
43100 Parma
Via Università, 12
Phone: +39/521/2041

Facoltà di Farmacia (School of Pharmacy)
43100 Parma
V.le delle Scienze
Phone: +39/521/905000/2
Fax: 0521/905003

Istituto di Chimica e Fisica Applicata (Dept. of Chemistry and Applied Physics)
43100 Parma
V.le delle Scienze
Phone: +39/521/905026
Fax: +39/521/905025

Istituto di Farmacologia e Farmacognosia (Dept. of Pharmacology and Pharmacology)
43100 Parma
Viale delle Scienze
Phone: +39/521/905090
Fax: +39/521/905091

Facoltà di Medicina e Chirurgia (School of Medicine)
43100 Parma
Via Gramsci, 14
Phone: +39/521/290375

Istituto di Farmacologia (Dept. of Pharmacology)
43100 Parma
Via Gramsci, 14
Phone: +39/521/290383/384
Fax: +39/521/294089

Facoltà di Medicina Veterinaria (School of Veterinary Medicine)
43100 Parma
Via del Taglio 8
Phone: +39/521/984744
Fax: +39/521/981742

Universita' degli Studi di Pavia (Pavia University)
27100 Pavia
Strada Nuova, 65
Phone: +39/382/5041
Fax: +39/382/21048

Facoltà di Farmacia (School of Pharmacy)
27100 Pavia
Via Taramelli, 12
Phone: +39/382/507370 (Dean)
Fax: +39/382/529095

Istituto di Farmacologia (Dept. of Pharmacology)
27100 Pavia
Via Taramelli, 12
Phone: +39/382/507395
Fax: +39/382/529095

Facoltà di Medicina e Chirurgia I (School of Medicine)
27100 Pavia
P. le volontari del C., 2
Phone: +39/382/520147
Fax: +39/382/526590

Sezione di Farmacologia e Tossicologia Cellulare e Molecolare (Dept. of Pharmacology)
27100 Pavia
P. zza Botta, 10
Phone: +39/382/506343

Dipartimento di Medicina Interna e terapia medica—Sezione di Farmacologia Clinica e Sperimentale (Dept. of Internal Medicine and Clinical Therapy, Section of Experimental and Clinical Pharmacology)
27100 Pavia
Piazza Botta 9/10
Phone: +39/382/506352/356/353
Fax: +39/382/22741

Scuola di specializzazione in Farmacologia (opzione in Tossicologia) (Postgraduate School of Pharmacology, option in Toxicology)
27100 Pavia
Piazza Botta 10
Phone: +39/382/506352/506353
Fax: +39/382/22741

Facoltà di Scienze Matematiche, Fisiche e Naturali (School of Mathematics, Physics, and Natural Sciences)
27100 Pavia
Piazza Botta
Phone: +39/382/506405
Fax: +39/382/506406

Istituto di Farmacologia
27100 Pavia
Piazza Botta 11
Phone: +39/382/506381-506396
Fax: +39/382/506385

II Facoltà di Medicina e Chirurgia (Varese) (II School of Medicine in Varese)

21100 Varese
Viale Borri, 57
c/o Ospedale di circolo
Phone: +39/332/278273
Fax: +39/332/265586

Scuola di Specializzazione in Farmacologia (opzione in Tossicologia) (Postgraduate School in Pharmacology, option in Toxicology)
21100 Varese
Viale Ottorino Rossi 57
c/o Ospedale di circolo
Phone/Fax: +39/332/811601

Universita' degli Studi di Perugia (Perugia University)
06100 Perugia
P.zza Universita'
Phone: +39/75/5851
Fax: +39/75/5852067

Facoltà di Farmacia (School of Pharmacy)
06100 Perugia
Via del Giochetto
Phone: +39/75/5853485
Fax: +39/75/5853416

Istituto di Chimica e Tecnologia del Farmaco (Dept. of Pharmaceutical Chemistry and Pharmaceutical Technology)
06100 Perugia
Via del Liceo
Phone: +39/75/5855122
Fax: +39/75/5847469

Facoltà di Medicina e Chirurgia (School of Medicine)
06100 Perugia
Via E. Dal Pozzo
Phone: +39/75/5853494 - 5736615 - 5731051
Fax: +39/75/5853494

Dipartimento di Medicina Clinica, Patologia e Farmacologia (Dept. of Clinical Medicine, Pathology, and Pharmacology)
06100 Perugia
Via Eugubina 42
Phone: +39/75/585841
Fax: +39/75/5855840

Sezone di Farmacologia (Pharmacology Section)
06100 Perugia
Via del Giochetto
Phone: +39/75/5853467
Fax: +39/75/5853405

Facoltà di Medicina Veterinaria
06100 Perugia
Via S. Costanzo 4
Phone: +39/75/5854407
Fax: +39/75/5854409

Universita' degli Studi di Pisa (Pisa University)
65100 Pisa
Lungarno Pacinotti, 43/44
Phone: +39/50/920111-920000
Fax: +39/50/42446

Facoltà di Farmacia (School of Pharmacy)
56100 Pisa
Via Bonanno, 6
Phone: +39/50/41581
Fax: +39/50/40517

Dipartimento di Scienze Farmaceutiche (Dept. of Pharmaceutical Sciences)
56100 Pisa
Via Bonanno, 6
Phone: +39/50/500209
Fax: +39/50/40517

Facoltà di Medicina e Chirurgia (School of Medicine)
56100 Pisa
Via Roma, 55
Phone: +39/50/560364
Fax: +39/50/554556

Istituto di Farmacologia (Dept. of Pharmacology)
56100 Pisa
Via Roma, 55
Phone: +39/50/560509
Fax: +39/50/551434

Facoltà di Medicina Veterinaria (School of Veterinary Medicine)
56100 Pisa
Via delle Piazze 2
Phone: +39/50/544028
Fax: +39/50/543549

Universita' Cattolica del ''Sacro Cuore'' (Catholic University of the Sacred Heart)

Facoltà di Medicina e Chirurgia ''Agostino Gemelli'' (School of Medicine ''Agostino Gemelli'')
00168 Roma
Largo Francesco Vito, 1
Phone: +39/6/35510264
Fax: +39/6/3051343-3058511

Istituto di Farmacologia (Dept. of Pharmacology)
00168 Roma
Largo F. Vito 1
Phone: +39/6/30154253-4367
Fax: +39/6/3050159

Universita' degli Studi di Roma ''La Sapienza'' (Rome ''La Sapienza'' University)
00185 Roma

Piazzale Aldo Moro, 5
Phone: +39/6/49913015
Fax: +39/6/49910222

Facoltà di Farmacia (School of Pharmacy)
00195 Roma
Piazzale Aldo Moro, 5
Phone: +39/6/491981
Fax: +39/6/49913888

Istituto di Farmacologia e Farmacognosia (Dept. Pharmacology and Pharmacognosy)
00185 Roma
Piazzale Aldo Moro, 5
Phone: +39/6/49912902
Fax: +39/6/49912480

Facoltà di Medicina e Chirurgia (School of Medicine)
00161 Roma
V. le Regina Elena
Phone: +39/6/4457097
Fax: +39/6/49970856

Istituto di Farmacologia Medica (Dept. of Medical Pharmacology)
00185 Roma
P. le Aldo Moro 5
Phone: +39/6/4940588

Universita' degli Studi di Roma ''Tor Vergata'' (Rome ''Tor Vergata'' University)
00173 Roma
Via Tor Vergata 135
Phone: +39/6/2020301
Fax: +39/6/2025485

Dipartimento di Neuroscienze—Sezione di Farmacologia (Dept. of Neuroscience, Section of Pharmacology)
00173 Roma
Via di Tor Vergata, 135
Phone: 39/6/72596315-6322
Fax: 39/6/72596323

Universita' degli Studi di Salerno (Salerno University)
84084 Fisciano (SA)
Via Ponte Don Melillo
Phone: +39/89/961111
Fax: +39/89/966104

Facoltà di Farmacia (School of Pharmacy)
84084 Fisciano (SA)
Via Ponte Don Melillo
Phone: +39/89/962803-05
Fax: +39/89/962804

Universita' degli Studi di Sassari (Sassari University)
07100 Sassari
Piazza Università
Phone: +39/79/228811-12
Fax: +39/79/228816

Facoltà di Farmacia (School of Pharmacy)
07100 Via Muroni 29
Phone: +39/79/228701-2
Fax: +39/79/228745

Dipartimento del Farmaco—Cattedre Farmacologia e Farmacognosia (Drug Department, Chairs of Pharmacology and Pharmacognosy)
07100 Sassari
Via Muroni 23
Phone: +39/79/228717
Fax: +39/79/228715

Istituto di Chimica Farmaceutica e Tossicologica (Dept. of Pharmaceutical and Toxicological Chemistry)
07100 Sassari
Via Muroni 23
Phone: +39/79/228719-228704

Facoltà di Medicina e Chirurgia (School of Medicine)
07100 Sassari
V.le S. Pietro, 43/B
Phone: +39/79/228200-2
Fax: +39/79/228213

Istituto di Farmacologia (Dept. of Pharmacology)
07100 Sassari
V.le S. Pietro, 43/C
Phone: +39/79/228517
Fax: +39/79/228525

Facoltà di Medicina Veterinaria (School of Veterinary Medicine)
07100 Sassari
Via Vienna 2
Phone: +39/79/229402
Fax: +39/79/229408

Dipartimento di Biologia Animale (Cattedra di Farmacologia Veterinaria) (Department of Animal Biology, Chair of Veterinary Pharmacology)
07100 Sassari
Via Vienna 2
Phone: +39/79/228510
Fax: +39/79/229432

Universita' degli Studi di Siena (Siena University)
53100 Siena
Via Banchi di Sotto, 55
Phone: +39/577/298000-42140
Fax: +39/577/298202

Facoltà di Farmacia (School of Pharmacy)
53100 Siena
Via Banchi di Sotto, 55

Phone: +39/577/298266
Fax: +39/577/270629

Dipart. Farmaco-Chimico-Tecnologico
(Dept. of Medicinal and Pharmaceutical Chemistry)
53100 Siena
Via Banchi di Sotto, 55
Phone: +39/577/298355
Fax: +39/577/270629

Istituto di Scienze Farmacologiche (Dept. of Pharmacological Sciences)
53100/Siena
Via E. S. Piccolomini, 170
Phone: +39/577/221255
Fax: +39/577/281928

Facoltà di Medicina e Chirurgia (School of Medicine)
53100 Siena
Policlinico Le Scotte
Via delle Scotte
Phone: +39/577/280020/263249
Fax: +39/577/263287

Istituto di Farmacologia
53100 Siena
Strada delle Scotte
Phone: +39/577/263280
Fax: +39/577/280896

Università Degli Studi di Teramo Facoltà di Medicina Veterinaria (School of Veterinary Medicine)
64020 Nepezzano di Teramo (TE)
Phone: +39/861/558618
Fax: +39/861/558691

Universit' degli Studi di Torino (Torino University)
10124 Torino
Via Verdi, 8
Phone: +39/11/6706111-6702200
Fax: +39/11/6702218

Facoltà di Farmacia (School of Pharmacy)
10125 Torino
Via Pietro Giuria, 9
Phone: +39/11/6707658
Phone/Fax: +39/11/6707659

Facoltà di Medicina e Chirurgia (School of Medicine)
10125 Torino
c/o Ospedale Molinette
Corso Bramante 88/90
Phone: +39/11/6335204- 6672147
Fax: +39/11/6672149

Dipartimento di Anatomia e Medicina Legale—Cattedre di Farmacologia e Farmacologia e Farmacognosia (Dept. of Anatomy, Pharmacolgy, and Forensic Medicine, Chairs of Pharmacology and Pharmacology and Pharmacognosy)
10100 Torino
Via M. D'Azeglio 52
Phone: +39/11/6707790-6707691

Facoltà di Medicina Veterinaria (School of Veterinary Medicine)
10126 Torino
Via Nizza, 52
Phone/Fax: +39/11/6687904

Universita' degli Studi di Trieste (Trieste University)
34127 Trieste
Piazzale Europa, 1
Phone: +39/40/6767111
Fax: +39/40/6763093

Facoltà di Farmacia (School of Pharmacy)
34127 Trieste
Piazzale Europa, 1
Phone: +39/40/6763527
Fax: +39/40/6753527

Facoltà di Medicina e Chirurgia (School of Medicine)
34149 Trieste
Strada di Fiume 447 - Ospedale di Cattinara
Phone: +39/40/912722
Fax: +39/40/912915

Dipartimento di Scienze Biomediche—Cattedre di Farmacologia e di Farmacologia e Farmacognosia) (Dept. of Biomedical Sciences, Chairs of Pharmacology and Pharmacology and Pharmacognosy)
34100 Trieste
Via L. Giorgieri, 7
Phone: +39/40/6763537
Fax: +39/40/55477-557435

Universita' degli Studi di Udine (Udine University)
Facoltà di Medicina e Chirurgia (School of Medicine)
33100 Udine
Piazzale s. Maria della Misericordia
Phone: +39/432/559276
Fax: +39/432/559278

Universita' degli Studi di Urbino (Urbino University)
61029 Urbino
Via A. Saffi, 2
Phone: +39/722/3051

Facoltà di Farmacia (School of Pharmacy)
61029 Urbino
Via A. Saffi, 2
Phone: +39/722/305245
Fax: +39/722/320188

Istituto di Farmacologia e Farmacognosia (Dept. of Pharmacology and Pharmacognosy)
61029 Urbino
Via S. Chiara, 27
Phone: +39/722/2671
Fax: +39/722/327670

Istituto di Scienze Tossicologiche, Igienistiche e Ambientali (Dept. of Toxicological, Health, and Environmental Sciences)
61029 Urbino
Via S. Chiara, 27
Phone: +39/722/4717

Universita' degli Studi di Verona (Verona University)
37100 Verona
Via dell'Artigliere 8
Phone: +39/45/8098211
Fax: +39/45/8098255

Facoltà di Medicina e Chirurgia (School of Medicine)
37100 Verona
Borgo Roma-Policlinico
Phone: +39/45/584172

Istituto di Farmacologia (Dept. of Pharmacology)
37100 Verona
Borgo Roma - Policlinico
Phone: +39/45/8074244
Fax: +39/45/581111

Courses Pertaining to Toxicology Held at Universities

In 1988, new norms were established for university studies that have significantly influenced the teaching of toxicology in Faculties of Medicine and Surgery, Pharmacy, Veterinary Medicine, and Biological Sciences. Courses in toxicology are generally taught by full or associate professors. However, they may also be assigned to university researchers who have obtained teaching certification (based on evaluation administered after 3 years of employment as researchers). In some cases, the courses are assigned to faculty members from other universities or nonuniversity scientists with particular experience in the given field. In the latter cases, the assignments are based on yearly contracts that can be renewed if necessary.

In the *Faculty of Medicine,* with the adoption of the so-called Table XVIII, toxicology is considered an obligatory part of the pharmacology course (which also includes basic pharmacology, pharmacology of organ systems, molecular pharmacology, neuropsycopharmacology, and chemotherapy).

Approximately 120–150 teaching hours are allotted for the pharmacology course. Most are divided between the fourth and fifth years of medical school, and 20–30 of these teaching hours are dedicated to toxicology. Written and oral examinations include questions related to this material. The program of toxicology generally covers the following material: specific receptors in toxicology; antidotes and antagonists; principles and purpose of toxicology; factors influencing drug toxicity; experimental evaluation of drug and chemical toxicity; genotoxicity, teratogens, and carcinogens; correlation between animal and human toxicity; toxic effects of drugs, heavy metals, chemicals, and environmental pollutants; adverse drug reactions; diagnosis and treatment of selected acute poisonings (psychotropic drugs, ethyl alcohol pesticides, and mushrooms); drug addiction; food toxicology; basic aspects of clinical toxicology; epidemiology of poisonings; and clinical aspects of poisoning caused by drugs, industrial chemicals, natural compounds, foods, and psychotropic agents, including drugs of abuse.

Separate courses on clinical, industrial, and forensic toxicology have been eliminated and the concepts formerly covered in these courses are included in courses on anesthesiology and intensive care, occupational medicine, and forensic medicine, respectively.

Toxicology is also taught in the *dentistry,* in which it accounts for 10–20 of the teaching hours dedicated to pharmacology. The course concentrates on area with specific relevance for dentistry, such as mercury toxicity.

In the *Faculty of Pharmacy,* the course of pharmacology is taught over a period of five semesters, one or two of which are dedicated to toxicology. The course covers the following subjects: principles and aims of toxicology; biotransformation of chemicals, mechanism of action, and toxicity testing; some topics in toxicology; toxicity of drugs of clinical interest, heavy metals, household products, and food toxicology; carcinogens, teratogens, and drugs of abuse; and topics in environmental toxicology and ecotoxicology.

In the Faculty of Pharmacy there are also other courses dealing with topics in the fields of toxicology and toxicological analysis, e.g., complementary concepts in toxicological chemistry and analysis of drugs. The programs of these course include:

Analytical toxicology: techniques and clinical and forensic applications; isolation and identification of drugs and toxic chemicals in biological materials; and toxicokinetics

Chemical toxicology: general principles; techniques in toxicological chemistry and toxicokinetics; analytical aspects; ethyl alcohol; drugs; heavy metals; organic poisons; drug of abuse, etc.

The *Faculty of Veterinary Medicine* restructured its curriculum (Table XXXIII) with the Decree of the Min-

istry of Universities and Scientific Technological Research (MURST) (*Gazzetta Ufficiale* No. 26-27, September, 1995). The course lasts 5 years. Veterinary toxicology is taught during the first 4 years within a didactic area that includes

Pharmacology, pharmacodynamics, and veterinary pharmacy
Pharmacology and veterinary toxicology
Veterinary toxicology
Veterinary chemotherapy

There are a total of 100 teaching hours/year. The objective is to give the student an understanding of the following:

Mechanisms of actions, pharmacokinetics, and metabolism of drugs used in animals (with emphasis on species differences).

Methods for administering drugs for mass therapeutics or prophylaxis

Legislation regarding drugs for veterinary use

The toxicants most frequently used in agricultural and zootechnical fields (sources, toxicodynamic properties, antidotes, and protection of human and animal health and the environment)

During the fifth year students are enrolled in one of the following profession-oriented courses: hygiene and health care of breed animals and environmental protection or technology and pathology of income-producing animals.

These courses (50 teaching hours) increase the students' understanding of previously acquired concepts of pharmaco-toxicology, particularly those regarding improper and/or illegal use of drugs or environmental contaminants in feed products.

With the adoption of the revised Table XXV, pharmacology has become an obligatory course in programs leading to a degree in *biological science* which provide for 5 years of study. The pharmacology course is generally included during the final 2 years of study (which are focused on physiopathological concepts specific to various professional fields), although at some universities it is included in the first 3 years of study which are common to all programs.

Toxicology courses are currently optional. They can be inserted into the Statutes of a Faculty of Biological Sciences, and in these cases they represent one semester of study for a total of 90 teaching hours. The following aspects are covered: general aspects of toxicology; harmful effects of chemicals on biological substrates; receptors in toxicology; antidotes and antagonists; food toxicology; and topics in environmental toxicology and ecotoxicology.

Postdoctoral Degrees in Toxicological Disciplines

Postdoctoral degree in medical toxicology
  Duration: 4 years
  Universities of Catania, Florence, Messina, Modena, and Padua
Postdoctoral degree in pharmacology (option in toxicology)
  Duration: 3 years (after 2 years of basic pharmacology)
  Universities of Cagliari, L'Aquila, Messina, Milan, Modena, Naples (Federico II), Naples (II University), Padua, Pavia (1st Medical School), Pavia (2nd Medical School—Varese), Pisa, Rome (State University ''La Sapienza'')
Postdoctoral degree in forensic toxicology
  Duration: 4 years
  Universities of Pavia and Naples
Postdoctoral degree in toxicology (school of pharmacy)
  Duration: 3 years
  Universities of Bologna, Cagliari, and Milan

Postdoctoral Degree in Medical Toxicology

Faculty or department: school of medicine
Requirement: medical doctor's degree
Number of students per year: 8 (total 32)
Maximum number of students that could be accepted: (as above)
Duration: 4 years (800 hours/year, including 400 hours of practical activities and training)
The course comprises four learning areas:
  Basis toxicology
  Pathological toxicology
  Clinical toxicology
  Diseases caused by drugs of abuse

Course	*Hours*
General toxicology	100
Experimental toxicology	200
Chemical toxicology	100
Systematic toxicology	100
Chemical carcinogenesis	100
Chemical teratogenesis	100
Ecotoxicology	100
Chemical diagnosis of diseases induced by chemical agents	100
Forensic toxicology	100
Intensive care in clinical toxicology	100
Clinical toxicology	100
Experimental toxicology of drugs of abuse	200
Clinical toxicology of drug of abuse	200

Research work
Stages
  Departments of pharmacology
  Poison control centers

Psychiatric departments
Intensive care units
Others

Outline of the topics covered in the toxicology–pharmacology courses

General toxicology
Interactions of noxious chemicals with biological systems, e.g., enzyme inactivation by xenobiotics
Specific receptors for toxic substances
Toxicokinetics
Chemical toxicology
The chemical classification of toxic compounds: inorganic poisons
Organic poisons
Drugs as potential poisons
Relevant techniques for measuring drug levels in biological fluids
Experimental toxicology
Methods for the evaluation of ID_{50}
Basic experiments in toxicology: the use of activated charcoal to protect rats against the toxic effects of strychnine and pentobarbital
Naloxone reversal of morphine-induced respiratory depression in the rabbit
Chemical carcinogenesis
Mechanisms of chemical carcinogenesis: free radicals and epoxides as ultimate carcinogens—Epigenetic carcinogenesis
Chemical teratogenesis
A survey of experimental teratology: xenobiotic compounds known to cause malformations in humans
Systematic toxicology
Systematic evaluation of the toxicity of xenobiotic compounds and of drug toxicity (toxicity of carbon monoxide; toxicity of phenobarbital)
Forensic toxicology
Law enforcement in the field of medical toxicology
Intensive care in clinical toxicology
Basic knowledge of resuscitation: cardiac massage and defibrillation
Artificial ventilation
Hemoperfusion
Clinical toxicology
Clinical evaluation of poisoning (e.g., carbon monoxide poisoning and barbiturate poisoning)
Chemical diagnosis of poisoning
Therapy of acute poisoning
Clinical aspects of drug dependence (e.g., opioid dependence and ethanol dependence)
Experimental toxicology of drugs of abuse
Pharmacodynamics and pharmacokinetics of the main drugs of abuse
Clinical toxicology of drug abuse
Patterns of abuse: clinical aspects
Antidotes and antagonists
Trends in the therapy of drug dependence

*Postdoctoral Degree in Pharmacology (Option in Toxicology)**

Faculty or department: school of medicine
Requirement: medical doctor's degree
Number of students per year: 6–20
Maximum number of students that could be accepted: 3–20
Duration: 2 years (after 2 years of basic pharmacology)
Description of the program:
Courses: lectures, 400 hours/year
Training exercises, 400 hours/year
Research work (thesis)
Visits to institutions and industrial toxicological laboratories

During the 4-year course, students spend time in the following areas: departments of internal medicine, poison control centers, laboratories of experimental pharmacology, toxicology, pathological anatomy, immunology, biochemical, and clinical chemistry analysis.

The 800 annual teaching hours include 400 hours dedicated to training exercises established by the school council to provide the student with adequate experience in professional areas.

Course	*Hours*
First year	
Basic concepts (general)	80
Medical statistics and biometry	40
Chemistry and preliminary concepts of biochemistry	40
Basic concepts in pharmacology	180
Pharmacology	60
Cellular pharmacology	20
Molecular pharmacology	20
Bioassays in pharmacology	40
Toxicology	20
Biochemistry	20
Diagnostic and clinical methodology	
Clinical pathology	40
Pharmacology	50
Special pharmacology	30
Immunopharmacology	20

(*continues*)

* The curriculum of the postdoctoral degree program in pharmacology (Option in Toxicology) is currently being revised by the MURST. The main change is expected to be a greater emphasis on practical experiences rather than theory/lectures.

Course	Hours
Toxicology	50
Teratogenesis and cancerogenesis	30
Ecotoxicology	20
Training exercises	400
Second year	
Basic concepts (general)	70
Computer techniques in medicine	30
Chemistry and preliminary biochemistry	40
Basic concepts in pharmacology	30
Bioassays in pharmacology	30
Diagnostic and clinical methodology	50
Clinical methods and allergology	20
Pharmacology	180
Special pharmacology	130
Pharmacokinetics	50
Toxicology	
Experimental toxicology	30
Chemotherapy	40
Training exercises	400
Third year	
Diagnostic and clinical methodology	100
Chemical and clinical diagnosis in toxicology	50
Anatomy and histopathology	50
Toxicology	
Toxicological chemistry	60
Experimental toxicology	80
Teratogenesis and cancerogenesis	50
Ecotoxicology	20
Chemicotoxicological analysis	40
Epidemiology	50
Training exercises	400
Fourth year	
Toxicology	
Systemic toxicology	100
Forensic toxicology and legislation in the field of toxicology	50
Clinical toxicology and therapy	70
Clinical toxicology of drug addiction	100
Pharmacotoxicological emergencies	50
Resuscitation and intensive care	50
Toxicology of the environment and food	30
Food toxicology	30
Training exercises	400

Note. Postdoctoral degrees not acknowledged by the EC.

Postdoctoral Degree in Forensic Toxicology

Responsible faculty: school of medicine
Requirement
Fourth year
- Option in medicine: university degree in medicine
- Option in chemistry: university degree in medicine, biological sciences, chemistry, pharmacy, pharmaceutical technology, or food sciences

Number of students per years: 5
Duration: 4 years

In the near future, these programs will no longer be offered.

Postdoctoral Degree in Toxicology (School of Pharmacy)

This school provides preparation in the areas of environmental and experimental toxicology with the scope of ensuring the safety of chemical and physical agents:

Faculty or department: school of pharmacy
Requirement: degree in pharmacy, chemistry and pharmaceutical technology (CTF), chemistry, biological sciences, medicine, veterinary medicine, agrarian science, or food technology
Number of students per year: 20
Duration: 3 years
Description of the program
- Courses:
  - Lectures, 90 hours/year
  - Exercises, 15 hours/year
  - Seminars, 15 hours year

Research work: thesis, at least 1 year
Visits or attachment to industrial contract and university laboratories in Italy or abroad
Outline of the topics covered in the toxicology–pharmacology courses:

First year
- Molecular biology
- Cellular biology and pharmacology
- Immunology and Immunochemistry
- Pharmaceutical chemistry and molecular toxicology 1
- Biometry and statistics
- Microbiology and hygiene
- Pharmacology and pharmacognosy 1
- Experimental toxicology 1
- Anatomy and histopathology of toxic states

During the first year, the students learn fundamental biological principles that allow them to understand mechanisms (with emphasis on cellular and molecular mechanisms) underlying toxic effects.

Second year
- Pharmaceutical chemistry and molecular toxicology 2
- Analytical, chemicophysical and chemicoclinical methods
- Experimental design
- Epidemiology
- Cancerogenesis, mutagenesis, and teratogenesis 1
- Pharmacology and pharmacognosy 2
- Kinetics and metabolism in toxicology
- Comparative pathology
- Experimental toxicology 2
- Environmental toxicology and preventive measures

During the second year, the students begin to use more sophisticated analytical methods and biological experiments for assessing the intrinsic toxicity of potential toxins.

Third year
- Experimental toxicology 3
- Nutritional toxicology
- Cancerogenesis, mutagenesis, and teratogenesis 2
- Toxicology of drug abuse
- Legislation
- Organization of toxicology laboratories and centers

During the third year, the student is provided with concrete experiences in the fields of environmental, food, and pharmaceutical toxicology to make him or her aware of the methods currently used in Italy and abroad for quantitative and qualitative analysis of toxic risks.

Research Doctorate (PhD) in Toxicology

In accordance with Law 380/80, research doctorate programs have been established in various subjects. The programs are proposed by individual professors of a given university and administered by the same university, although other universities may be involved in the student's learning experience.

Each year the Ministry of Universities and Scientific and Technological Research activates a cycle of doctorate programs and establishes the number of positions that will be offered. An entrance examination is held at the university that is administering the program. The Commission of Examiners is composed of two full professors and one associate professor; the names of the examiners are selected at random by the Ministry of Universities and Scientific and Technological Research.

The doctorate programs generally last 3 or 4 years (in some cases 5 years), during which time the student will be involved in studies and research activities approved by the program coordinator. Research activities are carried out in a university institute approved by the coordinator. At the end of the course, the student is expected to present a complete dissertation regarding his or her research to a Commission of Examiners, which is composed of two full professors and one associate professor selected at random by the Ministry of Universities and Scientific and Technological Research. The student receives a monthly salary from the state during the entire period of study. This salary is increased by 50% for study periods abroad, which can last 1 or 2 years.

The following doctorate programs are offered in the area of toxicology:

Doctorate program	*Positions/ year*	*Duration (years)*
Pharmacology and toxicology [Universities of Florence, Milan, Sassari, Padua (+Bologna, Modena, Parma, and Trieste), Turin (+Genova, Pavia, and Pisa)]	7	4
Drug addiction [University of Siena (+Cagliari and Pisa)]	2	5
Drug addiction and alcoholism [Universities of Rome ''La Sapienza'' (+Milan, Modena, and Naples (University Federico II)]	2	4
Ethanol abuse (University of Padua)	3	3
Neuropsycopharmacology and toxicology (Naples: Federico II University and II University of Naples)	1	3
Forensic toxicology [University of Verona (+Padova and Pavia)]	3	3
Occupational medicine and industrial toxicology [University of Cagliari (+Rome ''La Sapienza'' and Sassari)]	2	4
Veterinary pharmacology and toxicology [University of Naples—Federico II (+Bologna, Messina, Milan, and Turin)]	4	3

Note. Universities in parentheses are associated universities.

As a result of a recent law, research doctorate programs can now be established directly by universities.

LEGISLATION*

Italy joined the European Economic Community (EEC) in 1957 by means of the treaty of Rome and since then its legislation on control of chemical substances has essentially been in line with the EEC regulations.

Specific legislation has been developed for different categories of substances. The major categories are industrial chemicals, pesticides, food additives, feed additives, and biocides.

A key directive in toxicological field is Council Directive 67/548/EEC (O.J.L. 196, 16/8/1967) and its subsequent amendments on the approximation of the laws, regulations, and administrative provisions relating to the classification, packaging, and labeling of dangerous substances. Currently, the 7th amendment to Directive 67/548/EEC* (Dir 92/32/EEC, O.J. L.154 5/6/1992) is in force. The basic directive was implemented in Italy with Law n. 256 of 29.5.74.

Industrial Chemicals

New Substances

New substances are defined as chemicals which are placed for the first time (manufactured or imported) on the community market after September 18, 1981

* Revised by Dr. Roberto Binetti, ISS.

which therefore are not included in the European Inventory of Existing Commercial Chemical Substances. According to the sixth amendment of directive 67/548/EEC (Dir 79/831/EEC) all new substances manufactured or marketed in the EU have to be notified to the competent authority. Premarketing notification allows the identification of potential occupational/consumer risks and environmental impacts before the substance is placed on the market. A 7th amendment to directive 67/548 (Dir 92/32/EEC, O.J. L. 258, 15/10/1979) was adopted in April 1992. In Italy the 7th amendment was implemented with legislative decree No. 52 of 3.2.1997 and coordination of these notification procedures is the responsibility of the Ministry of Health. A notification unit, which is in charge of the technical and scientific aspects of the procedures, is located in the Istituto Superiore di Sanità. The 7th amendment contains many important modifications of the new substances notification scheme. Among these is a requirement that competent authorities carry out a risk assessment on the notified substances to identify possible toxicological and ecotoxicological effects and the potential for human and environmental exposure. The risk assessment required for new chemicals by Directive 92/32/EC must be carried out in accordance with the principles set out in the Commission Directive 93/67/EEC (O.J. No. L. 227 8.9.1993). Directive 93/67/EEC was incorporated in the Italian legislation by decree No. 52 of 3.2.1997. A detailed Technical Guidance Document was issued by the European Commission in support of Directive 93/67/EEC. In Italy the Ministry of Health and Istituto Superiore di Sanità are the national competent authorities for the notification procedure and risk assessment.

Existing Chemicals

Until 1993 there were no EEC requirements for the testing of existing chemicals (substances included in EINECS) marketed in the European Community before September 18, 1981 (the date specified for adoption of the EEC notification procedure described previously).

In 1993 a European Existing Substances Regulation (preferred to a directive because it is adopted immediately after the publication in the Official Journal) on the evaluation and control of the risks of existing chemicals was adopted (EEC Council Regulation No. 793/93 of March 23, 1993, O.J. L. 84, 5/4/1993). It requires industry to provide all available data on tonnage, use, physicochemical properties, toxicological and ecotoxicological effects and those on human exposure and environmental fate for all high-production volume (HPV) substances, i.e., produced in quantities of >1000 tons per annum. The member states were required to draw up lists of priority substances representing potential risks to human health and/or the environment. Three priority lists have been published as commission regulations [1179/94 (O.J. No. 131, 26.5.1994), 2268/95 (O.J. No. 231, 28.9.1995), and 143/97 (O.J. No. 25, 28.1.11997)]. All data provided by the producers and importers of these substances are stored in the International Uniform Chemical Information Database (IUCLID), and this program of activity is fully coordinated with the OECD program on existing HPV chemicals. Competent authorities in EC member states have access to all data stored in IUCLID, even data considered confidential. In Italy the IUCLID is accessible through the ISS-INSC.

A nonconfidential CD-ROM version of IUCLID was developed by the European Chemicals Bureau at the Commission's Joint Research Center at Ispra (Varese). Risk assessment required by the previously mentioned Council Regulation 793/93 shall be carried out according to the principles laid down in the Commission Regulation 1488/94 of June 28, 1994 (O.J. L. 161). In Italy a decree of November 29, 1994 appointed the Ministry of Health, with the technical cooperation of Istituto Superiore di Sanità, as the national competent authority for the application of Regulation 93/793 for existing chemicals.

European Chemical Bureau (ECB)
Joint Research Centre
Via Fermi 1
I-21020 Ispra (VA)
Italy
Phone: +39.332.78 5866
Web: http://www.ecb.ei.irc.it

Specific Chemicals

Italy follows Council Directive 76/769/EEC (O.J. L. 262, 27/9/1976) and subsequent amendment relating to restriction on the marketing and use of certain dangerous substances and preparations. Products covered by this directive include the chemicals PCB and PCT, certain lead compounds, mercury, arsenic, benzene, and other very dangerous chemicals (see Human and Environmental Monitoring).

Pesticides

Until 1991, Italy, as well as the other member states in the EU, had national regulations regarding pesticides. Pesticides must now be registered with the Department of Foodstuffs and Veterinary Medicine (agricultural pesticides) or the Department of Department of Drug Control (nonagricultural pesticides) of the Ministry of Health.

However, there are other council directives that cover other areas of pesticide use, e.g., directives fixing maximum residue levels (MRLs) for pesticide on fruit and vegetables (76/895/EEC), cereals (86/362/EEC), and foodstuffs of animal origin (76/895/EEC, 86/362/EEC, and 86/363/EEC). Directive 91/414/EEC (O.J. L. 230, 19.8.1991) concerning the introduction to the market of agricultural pesticides was implemented in Italy by Decree No. 194 of 17.3.1995. The competent authority responsible for the authorization of pesticides is the Ministry of Health. The Ministry of the Environment and Ministry of Agriculture are involved in the preliminary evaluation phase for the authorization of pesticide. Active ingredient used in agricultural pesticides certified under Directive 91/414/EEC have to be classified according to Directive 67/548/EEC regarding the classification, labeling, and packaging of dangerous substances.

Biocides

Biocide Directive 98/8/EC (O.J. No. L. 123, 24.4.1998) on the marketing of biocidal products (e.g., nonagricultural pesticides, disinfectants, and antifouling agents) is going to be adopted at the Italian level. Even biocidal active ingredients following Directive 98/8/EC are covered by Directive 92/32/EEC (concerning classification and notification procedures).

Food Additives

In Italy direct food additives are regulated by decree of the Ministry of Health No. 209 of February 27, 1996 concerning food additives permitted in the preparation and preservation of food. This decree is in accordance with EC council directives concerning food additives (94/34/EC), sweeteners (94/35/EC), coloring agents (94/36/EC), and other types of food additives (95/2/EC). The Italian decree includes a list of approved chemicals that may be used as food additives. New additives must be subjected to extensive toxicological testing in animals to demonstrate that they are safe for use in food, and their use must be shown to be absolutely necessary from a technological point of view.

Indirect food additives (chemicals used in food packaging materials) are regulated by the amended version of Council Directive 76/893/EEC. The Italian decree includes a positive list compiled by the EU of chemicals that may be used in food as indirect food additives. The safety of new additives must be demonstrated by premarketing toxicological tests conducted according to suggested guidelines. Final decisions on approval are made by the EEC Scientific Committees for Food.

Feed Additives

Feed additives are regulated by Commission Directive 95/11/EC (amending Directive 87/153/EEC).

Cosmetics

At the Italian level production and marketing of cosmetic products are regulated by the amended version of Council Directive 76/768/EEC, which provides a list of approved substances that can be used in these products.

Several amendments have been introduced; the most important is the 6th amendment (93/35/EEC). This directive on cosmetics and directive 95/17/CE were implemented in Italy by Decree No. 126 of April 24, 1997.

There are no legislative requirements concerning premarketing toxicological testing, but guidelines for testing cosmetic ingredients were provided in 1997 by the Communities Scientific Committee on Cosmetology. Final laws, rules, regulations, and all official acts concerning toxic substances are published in the *Gazzetta Ufficiale della Repubblica Italiana* (GU), issued daily. The complete text of the GU is also available via online connection, optical disk, CD-ROM, or Internet at http://www.parlamento.it.

Using the following Internet address it is possible to obtain information concerning Italian implementations of community directives: http://www.parlamento.it/Parlam/leggi/home.htm.

Human and Environmental Monitoring

In addition to the previously mentioned EEC directives on premarketing toxicological testing, several other EEC directives or decisions are included in Italian legislation.

Air quality (general environment)

Council Directive 77/312/EEC (O.J. L. 105, 28/4/1977) (concerning biological surveillance of the general population to assess the risk of lead poisoning)

Council Directive 80/779/EEC and 85/203/EEC (limits of emissions in atmosphere from steam thermoelectric plants)

Council Directive 82/501/EEC (O.J. L. 230, 5/8/1982) on the Major Accident Hazards of Certain Industrial Activities commonely named ''The Seveso Directive'' and its first amendment (Directive 87/216/EEC) were transposed into the Italian national legislation by means of Decree No. 175 of 17/5/1988. Directive 96/32/EC, better known as the ''Seveso-II'' directive (O.J. L. 10 of 14/1/1997) substitues Directive 82/501/EEC.

At the national level, Directive 96/32/EC will be adopted and will abrogate all the previous rules.

Council Directive 82/501/CEE (major chemical hazards)

Council Directive 87/217/EEC (prevention and reduction of asbestos pollution)

Council Directive 89/369/EEC (prevention of pollution caused by new municipal waste incinerators)

Council Directive 89/429/EEC (prevention of pollution caused by existing municipal waste incinerators)

Council Directive 92/55/EEC (exhaust gas emissions)

Council Directive 92/72/EEC (ozone pollution)

Council Directive 92/112/EEC (titanium dioxide wastes)

Council Directive 93/12/EEC (percentage of sulfur in certain liquid fuels)

Council Directive 93/76/EEC (restrictions on carbon dioxide emissions)

Air quality (at workplaces)

Italian law of March 5, 1963, No. 245 (prohibition of use of benzene-based solvents in some types of exposure)

Council Directive 78/610/EEC (O.J. L. 197, 22/7/1978) (protection of the health of workers exposed to vinyl chloride monomer) was implemented at national level by Decree 962 of 10/9/1982

Council Directive 82/605/EEC (O.J. L. 247, 23/8/1982) (metallic lead and its ionic compounds at work)

Council Directives 83/477/EEC (O.J. L. 263, 24/9/1983) and 91/382/EEC (O.J. L. 206, 20/7/1991) (exposure to asbestos at work)

Council Directive 86/188/EEC (O.J. L. 137, 24/5/1986) (exposure to noise at work)

Council Directive 88/642/EEC (O.J. L. 356, 24/12/1988) amending Council Directive 80/1107/EEC (O.J. L. 327, 3/12/1980) (general regulation on the protection of workers from the risks related to exposure to chemical, physical, and biological agents at work); Legislative Decree 277 of 15/8/1991 implemented Directives 80/1107/EEC, 82/605/EEC, 83/477/EEC, 86/188/EEC, and 88/642/EEC concerning the protection of workers from the risks related to the exposure to chemical, physical, and biological agents at work.

Council Directive 88/364/EEC (O.J. L. 174/44, 9/7/1988) (prohibition of manufacture and use of certain carcinogens, namely, 2-naphtylamine, 4-aminobiphenyl, 4-nitrobiphenyl, and benzidine), implemented by Decree 77 of 25/1/1992

Council Directive 89/391/EEC (O.J. L. 183, 29/6/1989) (measures to improve security and health at work)

Council Directive 90/394/EEC (O.J. L. 196, 26/7/1990) (protection from carcinogenic agents)

Decree 626 of 19/9/1994 implemented Directive 90/394/EEC together with seven other EC directives in the field of worker protection (89/391/EEC, 89/654/EEC, 89/655/EEC, 89/656/EEC, 90/269/EEC, 90/270/EEC, and 90/679/EEC)

Directive 97/42/EC (O.J. L. 179, 27/6/1997), which amends for the first time Directive 90/394/EEC on the protection of workers from the risks related to exposure to carcinogens at work, has not yet put in force in Italy.

Commission Directive 91/322/EEC (O.J. L. 177, 5/6/1991) and 96/94/EC (O.J. L. 338, 18/12/1996), which establish first and second lists of occupational exposure limits, respectively, have not yet been put into force in Italy. For other substances in Italy, the American Conference of Governmental Industrial Hygienists' (ACGGIH) Chemical Substances TLVs are generally used as reference in the industrial practice; however, these occupational exposure limits have no legal value. For carcinogenic chemicals, the goal is the reduction of the exposure to the lowest achievable levels.

Water quality

Council Directive 75/440/EEC (O.J. L. 194, 25/7/1975) (relating to the quality of surface water intended for the production of drinking water), implemented in Italy through Decree 515 of 3/7/1982.

Council Directive 76/160/EEC (regarding quality of bathing water) implemented in Italy through Decree 470 of 8/6/1982.

Council Directive 76/464/EEC (O.J. L. 128, 18/5/1976) (regarding the contamination caused by the discharge of particular dangerous substances into water bodies of the EC) (amended by Council Directives 86/280/EEC and 88/347/EEC)

Council Directive 80/68/EEC (O.J. L. 20, 26/1/1980) (regarding the protection of groundwater) against pollution caused by certain dangerous substances; implemented by Decree 132 of 27/1/1992

Council Directive 80/778/EEC (O.J. L. 229, 30/8/1980) (relating to the quality of water intended for human consumption) implemented by Decree 236 of 24/5/1988

Council Directive 82/176/EEC (regarding limit values and quality objectives for mercury discharges from chloro-alkali plants)

Council Directive 84/156/EEC (regarding limit values and quality objectives for mercury discharges from not chloro-alkali plants)

Council Directive 84/491/EEC (regarding limit values and quality objectives for cyclohexane discharges)

Council Directive 90/415/EEC (regarding industrial discharges of dangerous substances into water bodies)

Italian legislative Decree 133 of 27/1/1992 implemented Directives 76/464/EEC, 82/176/EEC, 84/156/EEC, 84/491 /EEC, and 90/415/EEC

An overall document inclusive of all the rules concerning water only by an environmental point of view is in preparation. It will not include the amendments of Directives 80/778 and 75/440 concerning health aspects.

Concerning quality of water intended for human consumption, a common position (EC) No. 13/98 was adopted by the Council of the European Communities on December 19, 1997 (O.J. C. 91 of 26/3/1998)

Limitations Concerning Specific Chemicals

Concerning the restriction on the marketing and use of certain dangerous substances and preparation, Italy follows EEC Council Directive 76/769/EEC, (O.J. L. 262, 27/9/1976). Amendments to this directive concern PCB, PCT, certain lead compounds, mercury, arsenic, and benzene. The basic Directive 76/769/EEC was put in force in Italy by the Decree of the President of the Republic No. 904 of 10/9/1982.

Wastes

Council Directives 91/156/EEC on waste (O.J. L. 78 of 18/3/1991) and 91/689/EEC on hazardous waste (O.J. L. 377 of 31/12/1991) and European Parliament and Council Directive 94/62/EC of December 20, 1994 on packaging and packaging waste (O.J. L. 365 of 31/12/1994) were transposed into the Italian national legislation by means of Decree 22 of February 5, 1997 subsequently integrated by Decree 389 of November 15, 1997.

National Health Service*

Central Structure

The Italian National Health Service was established by the National Health Service Act in 1978. The core of this system is composed of the Ministry of Health and the following technical and scientific bodies located in Rome:

Agenzia per L'Organizzazione dei Servizi Sanitari Regionali (AOSSR) (Agency for the Organization of Regional Health Services)

Commissione Unica del Farmaco (CUF) (National Drug Commission)

Istituto Superiore di Sanità (ISS) (National Institute of Health)

Istituto Superiore per la Prevenzione e la Sicurezza del Lavoro (ISPESL) (National Institute for Worker Safety and the Prevention of Work-Related Accidents)

Conferenza Permanente per i Rapporti tra lo Stato, le Regioni e le Provincie Autonome (Conferenza Stato-Regioni) (Permanent Conference for Relations between the State, Regions, and Autonomous Provinces)

Consiglio Superiore di Sanità (National Health Council)

The central structure is responsible for providing framework legislation, recommending health standards, supporting research, and establishing international relations.

Local (Regional, Provincial, and Municipal) Structures

For many years, Italy was divided into approximately 630 local health units known as Unità Sanitarie Locali. Recent legislation (1992 and 1993) drastically reduced the number of these structures and transformed them into Aziende Sanitarie Locali (ASL), with corporate management structures. There are currently 228 ASLs throughout the country. In general, each municipality has a single ASL, with the exception of some of the larger mountain communities and large municipalities.

Each ASL is responsible for public health services (in-patient and out-patient health care, diagnostic services, enforcement of sanitary norms and regulations, workplace inspection, health education programs, etc.) within its zone of jurisdiction.

The 1992 and 1993 legislation divided existing hospitals into two categories. Ninety university medical centers or large hospitals used for clinical training of medical students are considered Aziende Ospedaliere. These structures serve as health service referral centers for the nation as a whole, and most include poison control centers. The Aziende Ospedaliere have juridical personalities and total autonomy in their organization, administration, patrimony, accounting, management, and technical activities. In contrast, the Ospedali non-Aziende (1093) are considered to be branch centers of the ASL, although they have economic autonomy with budgets that are separate from those of the latter.

The provincial government is responsible for intermediate-level coordination of the services provided by the ASLs (e.g., those required by local emergency situations). Regional responsibilities include management, development, and planning of local health and environmental services.

* Revised by Dr. Romano Spiga, Department of Hygiene, Catholic University.

Until recently, no formal provision had been made for the inclusion of toxicologists among the staffs of ASLs or for the establishment of specialized toxicology services.

CONTRACT TOXICITY TESTING FACILITIES

In Italy the EU directives regarding good laboratory practice (GLP) (Council Directives 87/18/EEC, 88/320/EEC, and 90/18/EEC) were enforced by three acts: DPR 927 of November 24, 1981, the DM of June 26, 1986, and the DLvo. 120 of January 1992. Currently, 39 centers have been inspected by Italian authorities (Ministry of Health and ISS) and found to be in compliance Consequently, these laboratories will be included in the EC official list of test facilities approved to carry out GLP studies in the EU member states. Table 25.3 contains an up-to-date list of Italian test facilities with GLP compliance status.

Note added in proof. All telephone numbers in Italy were modified in 1998 (after this chapter was received for publication). To dial any number cited in this chapter from outside Italy, the caller must insert a zero (0) between the country code (39) and the code for the Italian province. For example, a number listed as +39/6/49931 is now +39/06/49931. Naturally the same correction applies to all fax numbers.

TABLE 25.3 Italian Test Facilities in Compliance with GLP Guidelines

Denomination of the test facility	Address	Field of validity	Date of the first authorization
Antoine Marxer RBM (SpA)	Via Ribes, 1 Colleretto Giocosa (TO)	Toxicological and ecotoxicological tests	January 7, 1988
Enichem Synthesis (SpA)	Via Maritano, 26 San Donato Milanese (MI)	Physical–chemical tests	July 20, 1988
G. Natta, Himont Italia	P.ie Privato, 12 ''G. Donegani'' Ferrara	Physical–chemical tests	July 20, 1988
Cyanamid Italia (SpA)	XV Strada, Zona Industriale Catania	Toxicological tests	October 7, 1988
Farmitalia Carlo Erba (now Pharmacia Upjohn)	Via Carlo Imbonati, 24 Milano	Physical–chemical and toxicological tests	March 1, 1989
Stazione Sperimental per le Industrie degli Oli e Grassi	Via Giuseppe Colombo, 79 Milano	Physical–chemical and toxicologicai tests	March 1, 1989
	Via Leonardo da Vinci, 1 Trezzano sul Naviglio (MI)	Physical–chemical, toxicological, and ecotoxicological tests	January 1, 1990
G. Donegani (SpA)	Via Fauser, 4 Novara	Physical–chemical tests	July 12, 1990
Studio Laboratorio ASA	Viale Brigate Marche, 12 F Treviso	Physical–chemical tests	May 17, 1991
Stazione Sperimentale per i Combustibili	Via Alcide De Gasperi, 3 San Donato Milanese (MI)	Physical–chemical tests	May 17, 1991
Biolab SGS	Via Buozzi, 2 Vimodrome (MI)	Physical–chemical and toxicological tests	June 4, 1991
Istituto di Ricerche e Collaudi ''M. Masini' (Srl)	Via Moscova, 1 1 Rho (MI)	Physical–chemical tests	October 20, 1991
Bioresearch	Via Europa, 35 Muggiò (MI)	Other studies	March 1, 1992
B. T. Biotecnica srl	Saronno, Varese Parma	Analytical determination of trace elements and residues, pharmaceutical	May, 1994
Boehringer–Mannheim	Viale Libertà km 0,750 Monza (MI)	Toxicological tests	May 1, 1992
Bracco	Via E. Folli, 50 Milano	Toxicological tests	November 1, 1991
Centro Ricerche Fitofarmaci ISAGRO	Via Fauser 4 Novara	Environmental fate, pharmacokinetic studies, acute toxicity studies	July 15–16, 1993
Chiesi Farmaceutici	Via Palermo, 26/A Parma	Toxicological tests	December 1, 1991

(*continues*)

TABLE 25.3 (*Continued*)

Denomination of the test facility	Address	Field of validity	Date of the first authorization
Crinos	Piazza XX Settembre, 2 Villa Guardia (CO)	Toxicological tests	July 1, 1991
Cyanamid Italia (SpA)	Zona Industriale Via F. Gorgone Catania	Toxicological tests	January 1, 1992
Farmaceutici Formenti SpA	Origgio, Varese	Preclinical biological tests, technological–pharmaceutical studies	July 6, 1994
Dompé	Via S. Martino, 12 Milano	Toxicological tests	October 1, 1991
ERSA, Ente Regionale per lo Sviluppo dell' Agricoltura	Via Sabbatini 5 Pozzuolo del Friuli (UD)	Ecotoxicological tests	May, 1995
Farmitalia Carlo Erba (now Pharmacia Upjohn)	Via Giovanni XXIII, 23 Nervìano (MI)	Toxicological tests	March 1, 1991
Glaxo	Via Fleming, 2 Verona	Toxicological tests	May 1, 1991
Istituto Gentili	Via Mazzini, 112 Pisa	Toxicological tests	December 1, 1991
IRCS	Via del Mare Pomezia (Roma)	Toxicological tests	March 1, 1992
Laboratori farmaceutici CT	Via D. Alighieri, 69-71 Sanremo (IM)	Toxicological tests	April 1, 1992
Lepetit	Via R. Lepetit Gerenzano (MI)	Analytical, chemical, and toxicological tests	April 1, 1992
Magis–Mitin	Via Cacciameli, 34 Zona Industriale Brescia	Toxicological tests	February 1, 1992
Medolanum Farmaceutici	Via S.G. Cottolengo, 15–31 Milano	Toxicological tests	October 1, 1991
Nootron Srl	Vignola Modena	Physical–chemical studies and analytical determination	March 1, 1991
Poli Industria Chimica	Via Volturno. 48 Quinto do'Stampi (MI)	Toxicological tests	January 1, 1991
Polifarma	Via Tor Sapienza, 138 Roma	Toxicological tests	May 1, 1991
Research Toxicology Center (formerly Life Science Research Rome Toxicology Center spa)	Via Tito Speri 12, Pomezia Roma	Toxicological and ecotoxicological test	October, 1995
Sigma Tau	Via Pontina, km 30 Pomezia (Roma)	Toxicological tests	May 1, 1991

Note. Source: Caroli, S. The adoption of good laboratory practice principles by Italian test facilities. *Annali Istituto Superiore di Sanita,* Vol. 30, n. 4 (1994), pp. 401–409 (updated with test facilities inspected in 1993, 1994).

Japan

TETSUO SATOH

BOOKS

Satoh, T., and Ueno, Y. (Eds.) (1995)
Essential Toxicology, 3rd ed.
ISBN 4-524-48954-1

A basic textbook in toxicology for undergraduate and graduate students. Topics such as toxicokinetics, metabolism, elimination, mutagenesis, carcinogenesis, hepatotoxicity, and the natural toxins are covered.

Satoh, T., Kariya, K., and Kitada, K. (Eds.) (1996)
Toxicology in Medicine,
ISBN 4-524-21268-x

A textbook for advanced undergraduate and graduate students to use in the classroom setting. It provides a thorough, systematic introduction to toxicology. It describes the most current knowledge on toxicology from the viewpoint of clinical pharmacy rather than fundamental pharmaceutical sciences.

JOURNALS

Biological and Pharmaceutical Bulletin (in English, monthly)
Pharmaceutical Society of Japan, Tokyo

Eisei Kagaku (in Japanese, bimonthly)
Pharmaceutical Society of Japan, Tokyo

Japanese Journal of Pharmacology (in English, monthly)
Japanese Pharmacological Society, Kyoto

Journal of Toxicological Sciences (in English, quarterly)
Japanese Society of Toxicological Sciences (formerly Toxicological Sciences), Kobe

Nihon Yakurigaku-kai Zasshi (*Folia Pharmacologica Japonica*) (in Japanese with English abstracts, monthly)
Japanese Pharmacological Society, Kyoto

Nippon Kagaku Kaishi (in Japanese with English abstracts, monthly)
Chemical Society of Japan, Tokyo

Nippon Nougeikagaku Kaishi (*Journal of the Agricultural Chemical Society of Japan*) (in Japanese with English abstracts, monthly)
Agricultural Chemical Society of Japan, Tokyo

Yakugaku Zasshi (in Japanese with English abstracts, monthly)
Pharmaceutical Society of Japan, Tokyo

ORGANIZATIONS

Governmental Institutions

Institute of Public Health
4-6-1, Shirokanedai, Minato-ku, Tokyo 108

Part of Ministry of Health and Welfare; postgraduate education and research in public health; 200 members; library of 55, 534 volumes, 725 periodicals; Publication: *Bulletin* (quarterly).

National Cancer Center
5-1-1, Tsukiji, Chuo-ku, Tokyo 104

Diagnosis, treatment, and research of cancer and allied diseases; part of Ministry of Health and Welfare; library of 43,000 volumes, 14,000 monographs, 550 periodicals; Publications: (distributed free to libraries) *Collected Papers* (in English, annually); *Annual Report* (in Japanese); *Bone Tumor Registration in Japan* (in Japanese and English, annually); *Clinical Staging of Lung Cancer, Registration and Clinical Statistics of Stomach Cancer in Japan*. *The Report of Hematologic Neoplasm's Registration in Japan* (in Japanese, annually); *Japanese Journal of Clinical Oncology* (in English, semiannually).

National Food Research Institute
Yatabe, Tsukuba, Ibaraki 305

Food processing, chemistry, technology, storage, engineering, distribution, nutrition; applied microbiology, analysis, radiation; Publication: *Report on Food, Its Science and Technology, A Series for Food Processing Technology* (annually).

National Institute of Genetics
1111, Yata, Mishima, Shizuoka 411

Part of Ministry of Education; Publication: *Annual Report*.

National Institute of Health
1-23-1, Toyama, Shinjuku-ku, Tokyo 162

Part of Ministry of Health and Welfare; Publication: *The Japanese Journal of Medical Science and Biology* (every 2 months).

National Institute of Hygienic Sciences (NIHS) (formerly Hygienic)
1-18-1, Kamiyoga, Setagaya-ku, Tokyo 158

Established in 1874 as the Tokyo Drug Control Laboratory under the Ministry of Health and Welfare. Since World War II, NIHS has greatly expanded its staff and organization (20 divisions and five experimental stations) to cope with the great concern of the public over the safety of a variety of chemicals. NIHS also contributes to the training of public health officials, inspectors, and investigators of industry. The Biological Safety Research Center (BSRC), belonging to NIHS, consists of the Divisions of Toxicology, Pharmacology, Genetics, and Mutagenesis. The Osaka branch is located in 1-1-43, Hoenzaka, Higashi-ku, Osaka 540; Publications: *Bulletin of the National Institute of Hygienic Sciences* (in Japanese with English abstracts, annually), *NIHS-Information* (*Information of Chemical Safety*).

National Institute of Industrial Health
21-1, Nagano 6-chome, Tama-ku, Kawasaki, Kanagawa 214

Part of Ministry of Labour; Publication: *Industrial Health* (quarterly).

National Institute of Mental Health
1-7-3, Konodai, Ichikawa, Chiba 272

Part of Ministry of Health and Welfare; Publications: *Journal of Mental Health* (annually), *Annual Report on Mental Health*.

National Institute of Radiological Sciences (Science and Technological Agency)
9-1, Anagawa 4 chome, Chiba, Chiba 263

Official research organization of the Science and Technological Agency, Government of Japan; Publications: *Annual Report, NIRS, Radioactivity Survey Data in Japan* (quarterly).

National Research Institute for Pollution and Resource
16-3, Onogawa, Yatabe-cho, Tsukuba, Ibaraki

Development of resources and energy, including recycling, conservation, heat utilization; industrial safety in mines; environmental pollution research. The Institute has 436 international resources.

Nongovernmental Institutions

Cancer Institute (Japanese Foundation for Cancer Research)
37-1, Kami-Ikebukuro, Toshima-ku, Tokyo 170

Departments of pathology, experimental pathology, cell biology, viral oncology, biochemistry, physics, and cancer chemotherapy. Cancer Institute Hospital and Cancer Chemotherapy Centre attached. Publication: *GANN Journal* (every 2 months).

Central Institute for Experimental Animals
1443, Nogawa, Miyamae-ku, Kawasaki, Kanagawa 213

The Preclinical Research Laboratory in this institute was founded in 1996. The major research areas are psychotoxicology using monkeys and small animals and the technical problems in drug toxicity studies. The Preclinical Research Laboratories consist of six departments (pharmacology, psychopharmacology, experimental pathology, toxicology, hematochemistry, and animal care) and 70 regular staffs. Publications; *Preclinical Research Report* (quarterly), *Annual Report* for original papers.

Hatano Research Institute
729-5, Ochiai Hatano, Kanagawa 257

Established in 1975 as the Drug and Food Safety Research Center. Research divisions consist of chemistry, pharmacology, genetics reproduction, pathology, cell biology, and food and environment. Training course in toxicology; Publication: *Annual Report*.

Institute of Environmental Toxicology
2-772, Suzuki-cho, Kodaira, Tokyo 187

Established in 1970 as a public service cooperative placed under the supervision of the Ministry of Agriculture, Forestry, and Fisheries and the Ministry of Health and Welfare. Residual analysis and toxicity testing of pesticides, basic research projects, development of new techniques for toxicological testing and training technical expert. Publication: *Collected Papers from the Institute of Environmental Toxicology* (in English and Japanese).

Mitsubishi-Kasei Institute of Life Sciences
11, Minamiooya, Machidashi, Tokyo 194

Research in human and general life sciences with 155 research staffs. Publication: *Animal Report*.

Research Institute for Natural Resources
4-400, Hyakunin-cho, Shinjuku-ku, Tokyo 169

Publications: *Miscellaneous Reports* (semiannually), *Water Pollution Research* (annually).

EDUCATION/SCHOOLS

The following are universities and colleges in Japan that have departments of toxicology and those related to toxicology.

Aichi Medical University
21, Karimata, Nagakute-cho, Aichi-gun, Aichi 480-11
Departments of Legal Medicine and Pathology

Asahikawa Medical College
Nishikagura, Asahikawa, Hokkaido 078-11
Department of Pharmacology

Azabu University
School of Veterinary Medicine
1-17-72, Fuchinobe, Sagamihara, Kanagawa 229
Departments of Veterinary Pharmacology, Food Hygiene, and Health and Environment

Chiba University
Faculty of Pharmaceutical Sciences
1-33, Yayoi-cho, Chiba, Chiba 263
Department of Biochemical Pharmacology and Toxicology

Fujita-Gakuin University
Institute for Comprehensive Medical Science
1-98, Dengakukubo, Kutsugaki-cho, Toyoake, Aichi 470-11
Department of Developmental Physiology

Fukuoka University
School of Medicine Faculty of Pharmaceutical Sciences
7-45-1, Nanakuma, Jonan-ku, Fukuoka, Fukuoka 814-01
Department of Toxicology and Hygienic Chemistry

Gifu University
School of Medicine
40, Tsukasa-cho, Gifu, Gifu 500
Departments of Public Health, Pharmacology, Biochemistry, and Pathology

Gunma University
School of Medicine
3-39-22, Showa-cho, Maebashi, Gunma 371
Institute for Behavioral Medicine

Health Sciences University of Hokkaido
Faculty of Pharmaceutical Sciences
Ishikari-Tobetsu, Hokkaido 061-02
Department of Toxicology and Hygienic Chemistry

Hiroshima University
School of Medicine
1-2-3, Kasumi, Minami-ku, Hiroshima 734
Department of Anatomy
School of Dentistry
Departments of Pharmacology and Oral Physiology

Hokkaido Institute of Pharmaceutical Science
7-1, Katsura-oka, Otaru, Hokkaido 047-02
Department of Pharmacology

Hokuriku University
Faculty of Pharmaceutical Sciences
1-10-3, Kanagawa-machi, Kanazawa, Ishikawa 920-11
Department of Toxicology and Hygienic Chemistry

Hoshi University
School of Pharmacy
2-4-41, Ebara, Shinagawa-ku, Tokyo 142
Department of Pharmacology

Iwate University
Faculty of Agriculture
3-18-8, Ueda, Morioka, Iwate 020
Department of Veterinary Phrmacology

Juntendo University
School of Medicine
1-4-45, Yushima, Bunkyo-ku, Tokyo 113
Department of Pathology

Kanazawa University
Faculty of Medicine
13-1, Takara-machi, Kanazawa, Ishikawa 920
Departments of Public Health and Legal Medicine

Keio University
School of Medicine
Shinanomachi, Shinjuku-ku, Tokyo 160
Departments of Pharmacology and Physiology

Kinki University
School of Medicine
380, Nishigama, Wakasa-cho, Minami-Kawachi-gun, Osaka 589
Departments of Anatomy, Pharmacology, and Parasitology

Kitasato University
Faculty of Pharmaceutical Sciences
1-15-1, Kitasato, Sagamihara, Kanagawa 228
Departments of Toxicology and Hygienic Chemistry

Kobe-Gakuin University
Faculty of Pharmaceutical Sciences
Yuse, Igawatani-machi, Nishi-ku, Kobe, Hyogo 673
Department of Pharmacology

Kumamoto University
School of Medicine
2-2-1, Honjo, Kumamoto, Kumamoto 860

Immunological Research Center, Departments of Pathology and Neuropsychiatry

Kyorin University
School of Medicine
6-20-2, Sinkawa, Mitaka, Tokyo 180
Department of Pharmacology and Toxicology

Kyoto University
Yoshidakonoecho, Sakyo-ku, Kyoto, Kyoto 606-01

The Kyoto University consists of nine faculties, nine graduate schools, and 26 research institutes and centers. Toxicology-related institutions are the graduate schools of medicine, pharmaceutical sciences, and agriculture, the research institute for food science, and the radiation biology center.

Kyushu University
Faculty of Pharmaceutical Sciences
1-1, Maidashi 3-chome, Higashi-ku, Fukuoka 812

The university consists of 10 faculties, 10 graduate schools, three research institutes, and nine attached institutes. The graduate schools of pharmaceutical sciences and medicine are the main centers for toxicology.

Meijo University
Faculty of Pharmaceutical Sciences
15, Yagotourayama, Tenpaku-ku, Nagoya, Aichi 468
Department of Chemical Pharmacology

Nagasaki University
Faculty of Pharmaceutical Sciences
1-14, Bunkyo-cho, Nagasaki, Nagasaki 852
Departments of Pharmacology, Hygienic Chemistry, and Physical Chemistry

Nagoya City University
School of Medicine
1, Kawasumi, Mizuho-cho, Mizuho-ku, Nagoya, Aichi 467
Department of Pathology

Nagoya University
65, Tsurumai-cho, Showa-ku, Nagoya, Aichi 466

The Nagoya University consists of eight schools, eight graduate schools, four research institutes, and six centers. The graduate schools of medicine and agriculture and the research institute of environmental medicine are the main sources of toxicological study.

Nihon University
Faculty of Pharmaceutical Sciences
7-7-1, Narashinodai, Funabashi, Chiba 274
Department of Pharmacology

Niigata College of Pharmacy
5829, Kamishinei-cho, Niigata, Niigata 950-21
Department of Toxicology

Nippon Veterinary and Zoo Technical College
1-7-1, Kyonan-cho, Musashino, Tokyo 180
Department of Veterinary Pharmacology

Osaka City University Medical School
1-5-7, Asahimachi, Abeno-ku, Osaka, Osaka 545
Departments of Hygiene, Public Health, and Pharmacology

Osaka University
2-2, Yamadaoka, Suita, Osaka 565

The Osaka University consists of 10 graduate schools, five research institutes, and six joint-use facilities. Toxicology-related papers are published from graduate schools of medicine, faculty of pharmaceutical sciences, and school of dentistry.

Shizuoka Prefectural University
Faculty of Pharmaceutical Sciences
52-1, Yata, Shizuoka, Shizuoka 422
Departments of Hygienic Chemistry and Industrial Hygiene

Showa University
School of Medicine
1-5-8, Hatanodai, Shinagawa-ku, Tokyo 142
Department of Pharmacology
Faculty of Pharmaceutical Sciences
Departments of Biochemical Toxicology and Clinical Pharmacy

Sinshu University
School of Medicine
3-1-1, Asahi, Matsumoto, Nagano 390
Department of Pharmacology

Teikyo University
School of Medicine
2-11-1, Kaga, Itabashi-ku, Tokyo 173
Departments of Public Health and Pharmacology
Faculty of Pharmaceutical Sciences
Sagamiko-cho, Tsukui-gun, Kanagawa 199-01
Department of Hygienic Chemistry

Toho University
Faculty of Pharmaceutical Sciences
2-2-1, Miyama, Funabashi, Chiba 274
Department of Biochemical Pharmacology

Tohoku College of Pharmacy
4-4-1, Komatsushima, Sendai, Miyagi 983
Cancer Research Institute

Tohoku University
Faculty of Pharmaceutical Sciences
Aoba, Aramaki, Aoba-ku, Sendai, Miyagi 980
Department of Hygienic Chemistry

The Tohoku Imperial University was founded in 1907 and was renamed Tohoku University in 1947. It includes 10 faculties, 10 graduate schools, and eight research institutes. Toxicological papers are published from the graduate schools of medicine, dentistry, agriculture, and pharmaceutical sciences. Publication: *Tohoku Journal of Experimental Medicine* (in English, bimonthly).

Tokushima University
School of Medicine
3-18-15, Kuramoto-cho, Tokushima, Tokushima 770
Departments of Legal Medicine and Pharmacology

Tokyo Medical and Dental University
School of Dentistry
1-5-45, Yushima, Bunkyo-ku, Tokyo 113
Department of Dental Technology.

Tokyo Noko University
Faculty of Agriculture
3-5-8, Saiwai-cho, Fuchu, Tokyo 183
Laboratory of Veterinary Pharmacology

Tokyo University of Pharmacy and Life Science
Faculty of Pharmacy
1432-1, Horinouchi, Hachioji, Tokyo 192-03
Departments of Hygienic Chemistry and Clinical Biochemistry

Tokyo University of Sciences
Faculty of Pharmaceutical Sciences
12, Ichigaya-Funagawara-cho, Shinjuku-ku, Tokyo 162
Department of Toxicology and Microbiological Chemistry

Toyama Medical and Pharmaceutical University
Faculty of Pharmaceutical Sciences
2630, Sugitani, Toyama, Toyama 930-01
Departments of Public Health and Clinical Analysis

University of Occupational and Environmental Health
1-1, Iseigaoka, Yahatanishi-ku, Fukuoka 807
Department of Environmental Health

University of Osaka Prefecture
Faculty of Agriculture
Mozu-Umemachi, Sakai, Osaka 591
Department of Veterinary Toxicology

University of Ryukyu
Faculty of Medicine
207, Uehara, Nishihara, Makagami-gun, Okinawa 903-01
Department of Hygiene

University of Tokyo
Hongo 7-3-1, Bunkyo-ku, Tokyo, Tokyo 113

The oldest organization for advanced learning was founded in Edo (Tokyo) in the late Tokugawa era. This was expanded to the Tokyo Teikoku Daigaku (Imperial University) and comprised three separate institutions for higher education (1789–1800). After World War II, the name was changed to the University of Tokyo, composed of 10 faculties, 13 graduate schools, and 13 research institutions. Toxicological papers are published from the graduate schools of medicine, pharmaceutical science, veterinary medicine, agriculture, and natural science.

Wakayama Medical College
9-9-Bencho, Wakayama, Wakayama 740
Departments of Pharmacology, Public Health, Hygiene, and Internal Medicine

Yokohama City University
School of Medicine
3-9, Fukuura, Kanazawa-ku, Yokohama, Kanagawa 236
Department of Pathology

The Netherlands

G. J. MULDER

BOOKS

Copius Peereboom, J.W. (Ed.) (1994)
Basisboek Milieu en Gezondheid (*Textbook on Environment and Health*)
Boom, Amsterdam
ISBN 90-53-52-048-1

Blaauboer, B.I., and Woutersen, R.A. (1988)
Toxicologie van bloed en bloedvormende organen (*Toxicology of Blood and Blood-Forming Organs*)
Pudoc, Wageningen
ISBN 90-220-0914-9

Chemiekaarten, gegevens over veilig werken met chemicaliën (*Datasystem Concerning Chemicals and Safe Working Conditions*), 11th ed. (1995)
Samson HD Tjeenk Willink, Alphen a/d Rijn
ISBN: 90-6092-804-0

Chemische feitelijkheden—actuele chemische encyclopedie—(losbladig) (*Chemical Facts—Updated Chemical Encyclopedia*) (1996)
KNCV, Den Haag

De Monchy, J.G.R., Martens, B.P.M., Phaff, R.A.S., and Nieborg-Eshuis, N.H. (1989)
Voedselallergie en -intolerantie (*Food Allergy and Intolerance*)
Bohn Stafleu & Van Loghum, Houten
ISBN 90-313-1011

Engelse, L., den, Feron, V. J., and Van der Heijden, C.A. (1984)
Chemische carcinogenese (*Chemical Carcinogenesis*)
Pudoc, Wageningen
ISBN 90-220-0828-2

Henderson, P. Th., Borm, P.J.A., and Kant, I.J. (1995)
Basisboek Arbeidstoxicologie: risico-inventarisatie en-evaluatie (*Textbook on Occupational Toxicology: Risk Assessment and Evaluation*)
Kerkebosch bv, Zeist
ISBN 90-6720-156-1

Henderson, P. Th., Van Bladeren, P.J., and Vermeulen, N.P.E. (1992)
Biotransformatie en toxicokinetiek (*Biotransformation and Toxicokinetics*)
Pudoc, Wageningen
ISBN 90-220-1036-8

Koeman, J. H. (1991)
Algemene inleiding in de toxicologie (*General Introduction to Toxicology*), 2nd ed.
Pudoc, Wageningen
ISBN 90-220-0968-8

Nationale MAC lijst (*National TLV—values*) (1999)
Ministerie Sociale Zaken en Werkgelegenheid
SDU, Den Haag
ISBN 90-12-08678-7

Nationaal Millieubeleidsplan—Kiezen of Verliezen (*National Environmental Policy—Choose or Lose*) (1990)
SDU, Den Haag
ISSN 0921-7371

Stumpel, A. R. J., and Drijver, M. (1989)
Medische Milieukunde (*Medical Environmental Sciences*)
Bohn Stafleu & Van Loghum, Houten
ISBN 90-313-1026-3

Van den Bercken, J. M. M., Van Genderen, H., and De Vlieger, M. (1986)
Neurotoxische stoffen (*Neurotoxic Compounds*)
Pudoc, Wageningen
ISBN 90-220-0829-0

Van Heyst, A. N. P. (1988)
Vergiftigingen (*Poisoning*), 4th ed.
Bohn Stafleu & Van Loghum, Houten
ISBN 90-313-0920-6

Van Loveren, H., and Vos, J. G. (1991)
Toxicologie van het immuunsysteem (*Toxicology of the Immune System*)
Pudoc, Wageningen
ISBN 90-220-1035-X

Verberk, M. M., and Zielhuis, R. L. (1990)
Voedsel in Beweging (*Food on the Move*)
Van Dokkum, W en Van der Heij, DG
ISBN 90-220-1034-1

Vermeeren, H. P. W., and Zwaard, A. W. (1986)
Risicobeheersing in het laboratorium (*Risk Control in the Laboratory*)
Van Gorcum, Assen
ISBN 90-232-2163-X

JOURNALS

Although no journals concentrate on toxicology, relevant articles may be found in the following:

Chemisch Weekblad/Chemisch Magazine
Stam Tijdschriften, Rijswijk
ISSN 0167-2746

Nederlands tijdschrift voor geneeskunde (*Netherlands Journal of Medicine*)
Bohn, Stafleu & Van Loghum, Houten
ISSN 0028-2162

Pharmaceutische weekblad
Royal Dutch Association for Advancement of Pharmacy, Den Haag
ISSN 0167-6555

Tijdschrift Kanker
Sophialaan 8, 1075 BR, Amsterdam
ISSN 0923-8018

Tijdschrift voor Bedrijfs- en verzekeringsgeneeskunde
Bohn, Stafleu & Van Loghum, Houten
ISSN 0929-600X

Tijdschrift voor diergeneeskunde (*Veterinary Journal*)
K.N.M.D., P.O. Box 14031, 3508 SB Utrecht
ISSN 0040-7453

Tijdschrift voor sociale gezondheidszorg (*Journal of Social Health Care*)
P.O. Box 9101, 6500 HB, Nijmegen
ISSN 0920-0517

ORGANIZATIONS

Private

Akzo Research bv
P.O. Box 9300
6800 SB Arnhem

BCO-Bergschot Centre for Research bv
P.O. Box 2176
4800 CD Breda

Biomedical Research—Primate Centre
P.O. Box 3306
2280 GH Rijswijk

DSM NV
P.O. Box 6500
6401 JH Heerlen

KIWA NV
P.O. Box 70
2280 AB Rijswijk

Notox
Hambakenwetering
P.O. Box 3476
5203 DL's Hertogenbosch

NV Organon
P.O. Box 20
5340 BH Oss

Solvay-Duphar by
P.O. Box 900
1380 DA Weesp

TNO—Centre for Technology and Policy Studies
P.O. Box 541
7300 AM Apeldoorn

TNO—Nutrition and Food Research
P.O. Box 360
3700 AJ Zeist

TNO—Pharma
P.O. Box 360
3700 AJ Zeist

TNO—Prins Maurits Laboratory
P.O. Box 45
2280 AA Rijswijk

Yamanouchi Europe bv
P.O. Box 108
2350 AC Leiderdorp

Governmental

Nederlands Instituut voor Onderzoek der Zee (Netherlands Institute for Marine Research)
P.O. Box 59
1790 AB Den Burg

Rijksinstituut voor de Volksgezondheid en Milieuhygiëne (RIVM) (National Institute of Public Health and Environmental Hygiene)
P.O. Box 1
3720 BA Bilthoven

Rijksinstituut voor Zuivering van Afvalwater (National Institute for Wastewater Research)
P.O. Box 17
8200 AA Lelystad

Rijks-Kwaliteitsinstituut voor Land- en Tuinbouwprodukten (RIKILT) (State Institute for Quality Control of Agricultural Products)
P.O. Box 230
7600 AE Wageningen

Certifying and Advisory Boards

Bureau Millieugevaarlijke Stoffen (Office of Dangerous Environmental Substances)
RIVM
P.O. Box 1
3720 BA Bilthoven

College ter Beoordeling van Diergeneesmiddelen (Registration Committee for Veterinary Drugs)
P.O. Box 289
6700 AG Wageningen

College ter Beoordeling van Geneesmiddelen (Registration Committee for Human Drugs)
P.O. Box 20350
2500 EJ Den Haag

College voor Toelating van bestrijdingsmiddelen (Committee for the Registration of Pesticides)
P.O. Box 217
6700 AE Wageningen

Dutch Expert Committee on Occupational Standards
P.O. Box 20350
2500 EJ Den Haag

Gezondheidsraad (Health Council)
P.O. Box 20350
2500 EJ Den Haag

Rijksbedrijfsgezondheids- en bedrijfsveiligheidsdienst (RBB) (National Service for Occupational Health and Safety)
P.O. Box 879
2700 A W Zoetermeer

Voedselallergie (Food Allergy)
P.O. Box 51
2100 AB Heemstede

Libraries

Rijksinstituut voor de Volksgezondheid en Milieuhygiëne (RIVM)
P.O. Box 1
3720 BA Bilthoven

Royal Netherlands Academy of Sciences (KNAW)
Kloveniersburgwal 29
1011 JV Amsterdam

All universities

Society

Netherlands Society of Toxicology
Secretariat: Ms. W. M. Clous
AKZO Nobel Chemicals BV
P.O. Box 247
3800 AE Amersfoort

EDUCATION/SCHOOLS

Agricultural University Wageningen
Prof. Dr. J. H. Koeman
Prof. Dr. P. J. van Bladeren
P.O. Box 9101
6700 HB Wageningen

Free University of Amsterdam
Prof. Dr. N. M. van Straalen
Prof. Dr. N. P. E. Vermeulen
P.O. Box 7161
1007 MC Amsterdam

Leiden University
Leiden/Amsterdam Center for Drug Research
Prof. Dr. G. J. Mulder
P.O. Box 9503
2300 RA Leiden

Department of Radiation Genetics and Chemical Mutagenesis
Prof. Dr. P. H. M. Lohman
Prof. Dr. Ir. A. A. van Zeeland
Prof. Dr. E. W. Vogel
P.O. Box 9503
2300 RA Leiden

Open University
Faculty of Natural Sciences
P.O. Box 2960
6401 DL Heerlen

Courses available in the area of toxicology:
General toxicology: Principles and mechanisms
General toxicology: Effects and applications
Ecotoxicology
Food, safety, and toxicity
General ecology
Soil and environment

University of Amsterdam
Prof. Dr. F. A. de Wolff
Prof. Dr. W. Admiraal
P.O. Box 19268
1000 GC Amsterdam

University of Groningen
Prof. Dr. R. A. de Zeeuw

Prof. Dr. D. A. Uges
P.O. Box 72
9700 AB Groningen

University of Maastricht
Prof. Dr. J. Kleinjans
Prof. Dr. A. Bast
P.O. Box 616
6200 MD Maastricht

University of Utrecht
Prof. Dr. W. Seinen
Prof. Dr. R. A. A. Maes
Prof. Dr. R. Kroes
Prof. Dr. V. J. Feron
Prof. Dr. C. J. van Leeuwen
Prof. Dr. P. Peters
P.O. Box 80125
3508 TC Utrecht

Prof. Dr. T. J. F. Savelkoul
University Hospital
Department of Reanimation and Clinical Toxicology
P.O. Box 16250
3500 CG Utrecht

LEGISLATION/REGULATIONS

Acts in The Netherlands Concerning Toxicology

Warenwet (Food and Commodity Act)
Vleeskeuringswet (Meat Act)
Bestrijdingsmiddelenwet (Pesticide Act)
Landbouwkwaliteitswet (Quality of Agricultural Products Act)
Diergeneesmiddelenwet (Veterinary Drugs Act)
Waterleidingwet (Drinking Water Act)
Wet Milieubeheer (Environmental Control Act)
Kernenergiewer (Atomic Energy Act)
Wet Bodembescherming (Soil Protection Act)
Wet verontreiniging oppervlakte wateren (Clean Water Act)
Wet Luchtverontreiniging (Clean Air Act)
Arbeidsomstandigheden wet (Occupational Conditions Act)

GOVERNMENT REPORTS

Reports of the Expert Committee National TLV-Board and Recent DECOS Documents

Since 1979 approximately 120 reports on a large variety of chemicals have appeared. The following are recent ones:

Butanol (1-, 2-, and *t*)	1994
Carbon disulfide	1994
Methyl methacrylate	1994
Methacrylates, ethyl mehtacrylate, *n*-butyl	1994
Methacrylate and isobutyl methacrylate Methyl-*t*-butylether	1994
Propanol (1- and 2-)	1994
Trichloropropane	1994
Acetone cyanohydrin	1995
Cadmium and inorganic cadmium compounds	1995
Calculating cancer risk	1995
Chlorine dioxide	1995
Formamide and dimethylformamide	1995
Man-made mineral fibers	1995
Methyl chloride	1995
Trichloroethane (-1, 1, 1)	1995

The following are recent reports published by the Dutch Health Council (Gezondheidsraad):

Tri- and tetrachlooretheen	1985
Acrylonitril	1985
1,2-Dichloorethaan	1986
Vinylchloride	1986
Ethyleenoxide and styreen	1986
Fijne stof	1986
Fenol	1987
Chloroform and tetrachloormethaan	1987
Benzeen	1987
Dichloormethaan	1987
Propyleenoxyde	1987
Cadmium	1988
Hechachloorcyclohexanen	1988
Ozon	1988
Tolueen	1988
Asbest	1988
Koper	1989
Nitraat	1990
Fluoriden	1990
PAK	1990
Chroom	1991
Chloorfenolen	1992
Arseen	1993
Radon	1993
Chloorbenzenen	1993
Carcinogens	1994
Deeltjesvormige luchtverontreiniging	1995
Betekenis van mutageniteitstests (mutagenicity testing)	1995
Dioxins; Polychlorinated dibenzo-*p*-dioxins, dibenzofurans, and dioxin-like polychlorinated biphenyls	1996

Risk is more than just a number	1996
Risks of pesticides to groundwater ecosystems	1996
Toxicology-based recommended exposure limits	1996
Marihuana as medicine	1996
Beoordeling carcinogeniteit van stoffen	1996
Lead in drinking water	1997
Hormone disruptors in humans	1997
The food web approach in ecitoxicological risk assessment	1997
Benzene	1997
Carcinogenen en anti-carcinogenen in de voeding	1997
Zinc	1997
1,2-Dichloropropane: Evaluation of the effects on reproduction	1999
Health effects of low level exposures	1999

Norway

RICHARD WIGER AND ERIK DYBING

BOOKS

During the past 15 years there have been no books concerned primarily with toxicology published in Norway.

JOURNALS

In Norway there are no special journals in the field of toxicology. One of the reasons for not having journals strictly in Norwegian is the fact that the Nordic (Scandinavian) countries cooperate in publishing journals together. For example, The Nordic Pharmacological Society, of which the Norwegian Society of Pharmacology and Toxicology is a member, publishes *Pharmacology and Toxicology*.

The journal that publishes most of the toxicological articles written in Norwegian is the *Tidsskrift for Den norske lægeforening (The Journal of the Norwegian Medical Association)* (P.O. Box 1152, Sentrum, 0107 Oslo, Norway; ISSN 0029-2001). The journal includes sections concerning medical science and research, epidemiology, health political issues, review articles, letters to the editor, book reviews, and news for society members.

There are several special reports concerning different aspects of toxicology such as criteria documents regarding individual chemicals, classification, and labeling of chemical substances for toxic effects, peroxisome proliferators, biomarkers, etc.

MAJOR ORGANIZATIONS

The Norwegian Society of Pharmacology and Toxicology, Section of Toxicology
c/o Department of Environmental Medicine
National Institute of Public Health
P.O. Box 4404 Torshov
N-403 Oslo

The Norwegian Society of Pharmacology and Toxicology is the main organization for toxicology in Norway. It includes three speciality sections: one for toxicology, one for pharmacology, and another for clinical pharmacology and clinical toxicology.

The Norwegian Biochemical Society
c/o Dr. Knut Jan Andersen
P.O. Box 7 Haukelandsykehus
N-5022 Bergen

Within this society there are several special interest groups such as that for biochemical toxicology, including neurotoxicology, genetic toxicology, and the toxicology of solvents.

The National Poison Information Center
P.O. Box 8189 Dep
N-0034 Oslo

This center provides emergency information in connection with accidental poisonings. The center maintains a registry of the composition of products and evaluates the toxicity of chemical substances, products, pharmaceuticals, and plants. It provides antidote lists and information to hospitals and physicians, and publishes pamphlets for the public.

OTHER ORGANIZATIONS

Directorate of Public Roads
Grensevn. 92
N-0663 Oslo
Phone: +47 20073500
Fax: +47 20073768

Directorate for Wildlife and Freshwater Fish
Tungasletta 2
N-7005 Trondheim
Phone: +47 73580500
Fax: +47 73915433

Ministry of Agriculture
P.O. Box 8007 Dep.
N-0030 Oslo
Phone: +47 22249090
Fax: +47 22245607

Ministry of Energy and Industry
P.O. Box 8014 Dep.
N-0030 Oslo

Phone: +47 22249090
Fax: +47 22249525

Ministry of the Environment
P.O. Box 8013 Dep.
N-0030 Oslo
Phone: +47 22249090
Fax: +47 22249560

Ministry of Health and Social Affairs
P.O. Box 8011 Dep.
N-0030 Oslo
Phone: +47 22249090
Fax: +47 22249577

Ministry of Transport and Communication
P.O. Box 8010 Dep.
N-0030 Oslo
Phone: +47 22249090

National Council on Smoking and Health
Møllergt. 24
N-0179 Oslo
Phone: +47 22348990
Fax: +47 22423440

Norwegian Board of Health
P.O. Box 8128 Dep.
N-0032 Oslo
Phone: +47 22249090
Fax: +47 22349590

Norwegian Polar Research Institute
P.O. Box 5072 Majorstua
N-0301 Oslo
Phone: +47 22959500
Fax: +47 22959501

Norwegian Radiation Protection Authority
P.O. Box 55
N-1345 Østerås
Phone: +47 67162500
Fax: +47 67146407

State Pollution Control Authority
P.O. Box 8100 Dep.
N-0032 Oslo
Phone: +47 22573400
Fax: +47 22676706

RESEARCH INSTITUTES

The following provides a summary of institutes in Norway that conduct research in toxicology, together with addresses, contact persons, and key words for research areas.

National Universities and Colleges

The College of Veterinary Medicine
Post Office Box 8146 DEP.
N-0033 Oslo
Department of Pharmacology, Microbiology, and Food Hygiene
Prof. Inger Nafstad
Toxicokinetics, teratology, and human monitoring of chlorinated hydrocarbons

Section of Food Hygiene
Prof. Tore Aune
Food toxicology and algal toxins

The Norwegian University of Science and Technology
7000 Trondheim

Department of Pharmacology and Toxicology
Faculty of Medicine
Prof. Odd G. Nilsen
Inhalation toxicology, toxicokinetics, metal toxicology, and toxicology of solvents

Department of Zoology
Faculty of Chemistry and Biology
Dr. Bjørn Munro Jenssen
Ecotoxicology and effects of organic environmental contaminants on birds and mammals

University of Bergen

Department of Pharmacology
Faculty of Medicine
5000 Bergen
Prof. Ole Jacob Broch
Neuropharmacology

Department of Anatomy and Cell Biology
Faculty of Medicine
5000 Bergen
Prof. Stein Ove Døskeland
Algal toxins and cell death/apoptosis

University of Oslo

The University of Oslo includes several institutes that conduct some research within the area of toxicology:

Department of Pharmacology
Faculty of Medicine
P.O. Box 1057 Blindern
N-0316 Oslo
Prof. Thoralf Christoffersen
Carcinogenesis

Department of Anatomy
Faculty of Medicine
P.O. Box 1110 Blindern

N-0317 Oslo
Prof. Jon Storm Mathiesen
Neurotoxicology

Department of Physiology and Biochemistry
Faculty of Medicine
P.O. Box 1052 Blindern
N-0316 Oslo
Dr. Pål Brodin
Neurotoxicology

Institute of Biology
Faculty of Mathematics and Science
P.O. Box 1066 Blindern
N-0316 Oslo
Prof. Frode Fonnum
Neurotoxicology, detoxication enzymes, and aquatic, terrestrial, and plant toxicology

University of Tromsø
9000 Tromsø
Institute of Medical Biology
Dr. Wim Vader
Ecotoxicology

Other Governmental Institutions

Central Veterinary Laboratory
Department of Toxicology
Ullevålsvn. 68
N-0454 Oslo
Dr. Jannecke Utne Skåre

Monitoring of environmental contaminants in animals, toxicology of domestic animals, and horse racing forensic medicine

Defense Department Research Institute
Department of Toxicology
N-2007 Kjeller
Prof. Frode Fonnum
Neurotoxicology and genetic toxicology

Institute of Occupational Health
P.O. Box 8149 Dep.
N-0033 Oslo
Prof. Tor Norseth

Toxicology of metals, solvents, mineral fibers and polyaromatic hydrocarbons, and biological monitoring of carcinogens

National Institute of Forensic Toxicology
P.O. Box 9334 Ila
N-0132 Oslo
Prof. Jørg Mørland

Ethanol toxicology, behavioral toxicology, and identification of ethanol and narcotic substances in man

National Institute of Public Health
Department of Environmental Medicine
P.O. Box 4404 Torshov
N-0403 Oslo
Prof. Erik Dybing

Toxicology of food additives and contaminants, analysis of chloroorganic compounds in food and drinking water, genetic toxicology, biochemical toxicology, metabolism, mechanisms of cytotoxicity, reproductive toxicology, air pollution toxicology, immunotoxicology, and metal toxicology.

The Norwegian Radium Hospital
Laboratory for Occupational and Environmental Cancer
Montebello
N-0310 Oslo
Prof. Tore Sanner
Carcinogenesis

EDUCATION/SCHOOLS

Graduate work in Norway is conducted within a slightly different system than that in the United States. The completion of the first university degree after approximately 4 years leads to a cand. mag., which is equivalent to an American bachelor's degree. Thereafter, a 2-year program leads to a cand. scient., which is similar to a master of science degree. At this point, there are two alternatives for obtaining a doctorate. The dr. scient. and dr. ing., which are similar to an American PhD, involve completing a program that includes course work and original research under an adviser. The other alternative is an advanced research degree which usually takes approximately 4 years beyond the master's level and consists of research only and culminates in the public defense of a thesis that normally consists of from 5 to 10 original articles in scientific journals. This degree is called dr. philos. at the faculty of mathematics and science, dr. med. at the faculty of medicine, dr. med. vet. at the faculty of veterinary medicine, and dr. odont. at the faculty of dentistry. Dr. philos. and dr. med. degrees can be earned from all universities, but a major distinction between this and other degrees is that the candidate does not have to conduct his or her research at or be affiliated with a university institute. Thus, for example, a person working at the Department of Environmental Medicine at the National Institute of Public Health can submit his or her thesis to the appropriate faculty at the University of Oslo, which in turn has to deem it worthy to be defended publicly. The university ap-

points a committee of experts who serve as opponents in the public defense.

Because of these differences in the educational system in Norway compared to other countries, it is not unusual to earn a dr. philos. degree on a research project in toxicology without being a student at a department within the university system. The following gives an overview of the different institutions of higher learning and which of the faculties offer formalized courses in toxicology or toxicology and pharmacology.

Courses in Toxicology or Pharmacology and Toxicology

The College of Veterinary College Medicine
Department of Pharmacology, Microbiology and Food Hygiene
Prof. Inger Nafstad
Section of Food Hygiene
Prof. Tore Aune

Graduate studies in toxicology may lead to the following degrees: dr. scient. and dr. med. vet.

University of Bergen
Faculty of Medicine
Department of Pharmacology
Dr. Ole Jacob Broch

Graduate studies in toxicology may lead to the following degrees: Cand. scient., dr. scient., dr. philos. and dr. med.

University of Oslo
Faculty of Medicine
Department of Pharmacology
Prof. Thoralf Christoffersen

Faculty of Mathematics and Science
Institute of Biology
Prof. Frode Fonnum

Graduate studies in toxicology may lead to the following degrees: Cand. scient., dr. scient., dr. philos., dr. med., and dr. odont.

University of Tromsø
Faculty of Medicine
Institue of Medical Biology
Section of Pharmacology
Prof. Jarle Aarbakke

Graduate studies in toxicology may lead to the following degrees: Cand. scient., dr. philos., and dr. med.

University of Trondheim
Faculty of Medicine
Department of Pharmacology and Toxicology
Prof. Odd. G Nilsen

Graduate studies in toxicology may lead to the following degrees: Cand. scient., dr. scient., dr. ing., dr. scient., and dr. med.

RESEARCH AND TESTING LABORATORIES

Institutions Involved in Toxicological Testing or Analysis

The Nordic Institute for Testing of Dental Materials
Kirkeveien 71
N-1344 Bærum
Dr. Jon E. Dahl

Dental material toxicology

The Norwegian Institute for Air Research
P.O. Box 130
N-2001 Lillestrøm
Dr. Bjarne Siverstsen

Environmental monitoring of air pollution and exposure analysis

The Norwegian Institute for Water Research
P.O. Box 173 Kjelsås
N-0411 Oslo
Dr. Torsten Källkvist

Aquatic and ecotoxicology testing, environmental monitoring of aquatic pollution, and analysis of exposure

NORWEGIAN TOPOGRAPHY, GOVERNMENT, AND LEGISLATION

The following presents a summary of legislation concerning pollution, hazardous toxic waste, and product control in Norway. At the end of this chapter are listed the various authorities with addresses. Food and drinking water additives and contaminants are regulated by the Norwegian Food Control Authority, whereas pesticides are regulated by the Department of Agriculture. Detailed compilations of these latter areas are unfortunately not available.

The Kingdom of Norway is in the western part of Scandinavia with Sweden to the east; inside the Arctic Circle, it borders on Finland and Russia. It includes the archipelago of Svalbard, halfway between the North Cape and the North Pole, which consists of Spitzbergen, a dozen other islands, and numerous small islands.

The climate of Norway is tempered by the Gulf Stream, whose influence extends to Svalbard. The At-

lantic and the North Sea coastal areas have mild winters and cold wet summers. Inland, the climate is drier and with colder winters. The coast includes many deep fjords with shallow sills across their entrances, which make them natural traps for pollutants. Norway has several oil and gas wells on its continental shelf area in the North Sea.

Government and Administration

Norway is a constitutional and hereditary monarchy, with legislative power being held by parliament (Storting). Executive power is nominally held by the king but is exercised by the cabinet (Council of State) led by the prime minister. The cabinet is appointed by the king in accordance with the will of the Storting.

The country is divided into 19 counties (fylker), including the city councils of Oslo and Bergen. The country is divided into 435 urban and rural municipalities (kommuner). These municipalities are administered by locally elected councils through an executive committee (formannskap) and have considerable autonomy in environmental matters. Smaller municipalities cooperate on a district basis, establishing common laboratory services and appointing inspectors.

By the treaty of Svalbard, February 9, 1920, Norway was granted sovereignity over Svalbard and the territorial waters of the archipelago. Nearly half of Svalbard is designated as parks and nature reserves. There is a Russian coal mining community in the archipelago which is largely independent of the Norwegian government.

The Ministry of the Environment was established by Royal Decree of May 5, 1972 (IDHL, 26:256). It has broad responsibility for most aspects of environmental protection covering water, air, noise, and waste, as well as nature reserves. It is responsible for the coordingation of local planning under the Building and Planning Act of 1965. Planning is regarded as a local responsibility under this act, with guidance from the Ministry of the Environment.

The National Council for Nature Conservation was established by Nature Protection Law No. 63 of June 19, 1970 (IDHL, 23:306) and plays a significant part in overall planning policy under the Ministry of the Environment, especially for thinly populated areas.

A Royal Decree of May 24, 1974 (IDHL, 26:580) established the State Pollution Control Authority (SPCA) under the Ministry of the Environment. It functions as a secretariat for the Pollution Control Council, the Aircraft Noise Abatement Commission, and the Governmental Control Group.

Norway is signatory to the Nordic Convention on the Protection of the Environment (February 19, 1974). The convention rules that the environmental interest of neighboring countries (Denmark, Finland, and Sweden) must be equated with the corresponding interest in Norway.

Basic Legislation

The purpose of the comprehensive Pollution Control Act of March 13, 1981 is to protect the environment from pollution and to reduce existing pollution as well as to promote the improved treatment of waste. The Pollution Control Council, the SPCA, and the Ministry of the Environment are responsible for the administration of this act and for regulations according to the act.

The purpose of the Product Control Act of June 11, 1976 is to prevent products from causing damage to health or disturbance of the environment in the form of pollution, waste, or noise or similar effects. The administration of the act and of the regulations according to the act is divided among the Product Control Council, the SPCA, and the Minsistry of the Environment.

Both the Pollution Control Council and the Product Control Council include representatives from a number of authorities and organizations with an interest in these matters. The tasks of these councils include working out guidelines and making decisions on matters of importance on fundamental principles.

The SPCA, which has the main administrative responsibility of implementing both of these acts, may make decisions on individual matters, give licenses to polluting activities, and has the responsibility for controlling these licenses. These tasks may be granted to other central and local authorities. The SPCA may also impose provisional prohibitions of a product. The Ministry of the Environment has the ultimate responsibility for the implementation of both these acts and issues regulations under them.

Water

Legislation for the control of water pollution was consolidated in Law No. 75 of June 26, 1970 on the prevention of water pollution (IDHL, 23:307). This act has been replaced by the Pollution Control Act. The basic principle of both these acts is that all activities that may pollute the waters of the kingdom must be licensed by the SPCA or by local authorities in the counties.

According to these two acts there have been worked out regulations on discharge of wastewater containing oil (from gasoline stations, etc.), of sewage from small settlements, and of wastewater from smaller industries. These regulations also apply to certain agricultural activities.

The quality of drinking water is the responsibility of the health and food authorities according to the Royal Decree of September 28, 1951 (IDHL, 4:103). New regulations from January 1, 1995 apply to drinking water supply systems whereby they must deliver water of satisfactory quality for drinking water, water used for food preparation, and water used for hygienic purposes.

The Regulations of January 21, 1972 (IDHL, 26:568) apply to control of trade in drinking water. Monitoring at every stage of the operation must be carried out in accordance with the guidance given by the National Food Control Authority.

Air

The Pollution Control Act also applies to emissions of gas or smoke, noise, etc. and remains the basic law controlling air pollution from industry. Licenses are required for nearly all industrial undertakings as well as for gas-, coal-, or oil-fired boilers and power plants. The Regulation of March 11, 1985 regulates the sulfur content of fuel oil.

Acidification of lakes caused by sulfur and nitrogen oxides in the air is generally considered to be a major pollution problem in Norway. In the late 1970s lakes in an area more than 13,000 km^2 in southern Norway were practically devoid of fish; however, this situation has improved. In addition, the fish stocks were depleted in an area of 20,000 km^2. The affected areas are still increasing. Damaging effects on human health, a reduction in the yield of forests and crops, and corrosion of material, including historical monuments, are among the other effects of acid precipitation.

This acidifacation is a consequence of emissions of sufur dioxide and other pollutants in the atmosphere. Many studies confirm that these pollutants travel hundreds of kilometers in the atmoshpere. It is estimated that about 90% of the sulfate depositions in Norway are caused by emissions in other countries.

The regulation of December 13, 1985, persuant to the Product Control Act, regulates the content of lead and benzene in gasoline. The Norwegian Board of Health was responsible for establishing guidelines and standards for indoor air quality in 1990 (IK-2322) and methods for analyzing indoor air quality in 1994 (IK-2462). The State Pollution Control Board has also established norms for many factors related to outdoor air quality.

Noise

The Pollution Control Act of March 13, 1981 is used to control noise from industrial operations. The Road Traffic Act of 1965 covers the control of motor vehicles with regard to noise and the use of speed limits and town planning as a means of reducing the impact of noise from traffic. The Product Control Act is another important instrument for the reduction of noise emitted by different products. Regulations have been promulgated for transportable compressors, power lawnmowers, bulldozers, excavators, and loaders. The Ministry of Communications has the administrative authority over both motor vehicles and aircraft.

Solid and Hazardous Waste

The basic principle concerning waste in the Pollution Control Act is that no one may empty, leave behind, store, or transport waste in such a way that leads to damage to health or the environment.

The municipalities are responsible for the collection and treatment of municipal waste. The industry itself is responsibile for an adequate treatment of waste from the production. Treament of the waste must be licensed by the SPCA (incinerators for municipal waste and treatment of industrial waste) or by local authorities in the counties (landfills for municipal waste). The authorities may also issue requirements to recycle certain waste. Special regulations have been created for the delivery, collection, reception and disposal of certain categories of hazardous waste.

Product Control

The Product Control Act became operative on September 1, 1977. Product control, which is directed at production, imports, sales, use, and other treatments, may as a general rule apply to each and every product, including raw materials, auxilliary materials, semimaufactured goods, and finished goods.

All persons who are involved with products that can cause damage to health or the environment are required to show prudence and take reasonable measures to prevent and limit harmful effects. Thus, special responsibility is imposed on persons producing or importing products.

Regulations persuant to the Act of Product Control:

Regulations of June 1, 1990 concerning labeling, sale, etc. of chemical substances and products that may involve hazard to health

Regulations of July 3, 1990 concerning list of substances, risk phrases, safety phrases, etc.

Guidlines to the previously mentioned regulations:

Regulations of June 1, 1979 concerning prohibition against the manufacture and import of aerosol cans or the like where chlorofluorocarbons (CFCs) are employed as propellant

Regulations concerning polychlorinated biphenyls (PCBs), dated November 16, 1979

Regulations concerning the compositition and use of dispersants to combat oil spills, dated February 2, 1980

Regulations concerning labeling and use of detergents and degreasing agents, dated October 1, 1983

Regulations concerning phosphates in detergents and the labeling of detergent packaging, dated April 18, 1985

Regulations concerning contents of lead compounds and benzene in petrol, dated December 13, 1985

Regulations of April 9, 1986 imposing temporary prohibition on the production, import, and sales of oil lamps with loose wick holders, colored lamp oil, and color concentrate intended to be added to lamp oil

Regulations concerning a prohibition on highly flammable textiles, dated February 13, 1984

Radiation

The Nuclear Energy Safety Authority is part of the Ministry of Oil and Energy. Regulations of January 23, 1983 (IDHL, 28:1031) on ionizing and other radiation implying health hazards have been made by Crown Resolution. On behalf of the Ministry of Health and Social Affairs, the National Institute of Radiation Hygiene administers these regulations, which date back to law No. 1 of June 18, 1983 on the use of X-rays and radium. The Minister of Defense may exempt certain installations and materials from the provisions of the regulations.

Russia

B. A. KURLYANDSKI AND K. K. SIDOROV

BOOKS

This section covers publications issued since 1980. All publications are available only in Russian except those after which (Eng) is indicated.

Abilev, S. K., and Poroshenko, G. G. (1986).
Accelerated methods for forecasting mutagenic and blastomogenic properties of chemicals. **In** ***Seriya: Toxicologiya*** (G. A. Stepansky and L. M.Fonstein.-M., Eds.), VINITI Vol. 14, 152–171

Anisova, S. N., Sokolova, S. A., *et al.* (Compilers) (1995)
List of Maximum Allowable Concentrations and Tentative Safe Levels of Harmful Substances in Water of Fisheries Water Reservoirs
Medinor, Moscow

Artamonova, V. G. (1981)
First Medical Aid at Occupational Intoxications
Meditsina, Leningrad

Asfandiyarov, R. I., *et al.* (1995)
Acute Poisonings by Sulfur-Containing Gases
Izdat-poligraf. Komplex ''Volga,'' Astrakhan

Berdinskikh, N. K., and Zalyotok, S. P. (1987)
Polyamines and Tumor Growth
N. Ya.Dzyubko, Ed.-in-Chief
USSR Institute for Problems of Oncology
Naukova Dumka, Kiev

Bespamyatnov, G. P., and Krotov, Yu. A. (1985)
Maximum Allowable Concentrations of Chemicals in the Environment
Khimiya, Leningrad

Boltovsky, I. S. (1989)
Narcomania, Toxicomania
Izdat-voKazanskogo Universiteta, Kazan
ISBN 5-7464-0095-5

Bruevitch, T. S. (1980)
Blastmogenicity of Oil Refining Products
Meditsina, Moscow

Bruevitch, T. S. (1982)
Occupational Allergic Dermatosis (etiology and pathogenesis)
Meditsina, Moscow

Bukovsky, M. I., Sidorov, K. K., Zholdakova, Z. I., *et al.* (1990)
Safe Levels of Harmful Substances in the Environment
Severodonetsk

Danilov, V. B. (1985)
Hygiene and Toxicology of Furan Polymers
FAN, Tashkent
(AN UzUSSR, Academic Council on Issue of Biosphere)

Dinerman, A. A. (1980)
The Role of Environmental Pollutants in Disturbances of Embryologic Development
Moscow

Dueva, L. A., Kogan, V. Yu., Suvorov, S. V., and Sterengarts, R. Ya. (1989)
Occupational Allergens
UNEP, IRPTC, USSR State Committee for Protection of Nature, USSR Commission for UNEP
Center of International Projects, Goskomprirody SSSR, Moscow

Dunayevsky, V. V., and Styazhkin, V. D. (1990)
Narkomania and Toxicomania
Meditsina, Leningrad
ISBN 5-225-01334-1

Dzyubko, N. Ya. (Ed.); Berdinskikh, N. K., and Zalyotok, S. P. (1987)
Polyamines and Tumor Growth
USSR AcSc, Institute for Problems of Oncology
Naukova Dumka, Kiev

Eitingon, A. I., Poddubnaya, L. T., Ulanova, I. P., *et al.* (1985)
Toxicological, Sanitary and Chemical Characteristics of Polymeric Materials at Burning: Reference and Methodological Manual
VIAM, Moscow

Filov, V. A. (Ed.); Bandman, A. L., Gudzovsky, G. A., Dubeikovskaya, L. S., *et al.* (1988)
Harmful Chemical Substances. Inorganic Compounds of I–IV Groups
Khimiya, Leningrad
ISBN 5-7245-0035-3

Filov, V. A., (Ed.); Bandman, A. I., Volkova, N. V., Grekhova, T. D., *et al.* (1989)
Harmful Chemical Substances. Inorganic Substances of V–VIII Groups
Khimiya, Leningrad
ISBN 5-7245-0264-X

Filov, V. A., (Ed.); Bandman, A. L., Voitenko, G. A., Volkova, N. V., *et al.* (1990)
Harmful Chemical Substances. Hydrocarbons. Halogen-Derivative Hydrocarbons
Khimiya, Leningrad
ISBN 5-7245-0265-8

Filov, V. A., *et al.* (Eds.); Bandman, A. L., Voitenko, G. A., Volkova, N. V., *et al.* (1994)
Harmful Chemical Substances. Halogen- and Oxygen-Containing Organic Compounds
Khimiya, St. Petersburg
ISBN 5-7245-0396-4

Gabovich, R. D., and Priputina, L. S. (1987)
Hygienic Basis for Protection of Food from Harmful Chemical Compounds
Zdorovya, Kiev

Gadaskina, I. D., and Tolokontsev, N. A. (1988)
Poisons Yesterday and Nowadays: Essays about the History of Poisons
(From the molecule to the organism)
USSR AcSc
Nauka, Leningrad
ISBN 5-02-025638-2

Golikov, S. N., Sanotski, I., and Tiunov, L. A. (1986)
General Mechanisms of Toxicity
Meditsina, Leningrad

Grushko, Ya. M. (1979)
Harmful Inorganic Compounds in Industrial Sewage Water
Khimiya, Leningrad

Grushko, Ya. M. (1982)
Harmful Organic Compounds in Industrial Sewage Waters, 2nd ed.
Khimiya, Leningrad

Grushko, Ya. M. (1986)
Harmful Organic Compounds in Industrial Releases into the Atmosphere
Khimiya, Leningrad

Grushko, Ya. M. (1987)
Harmful Inorganic Compounds in Industrial Releases into the Atmosphere
Khimiya, Leningrad

IARC (Karamysheva, A. F., Trans.) (1987)
Carcinogenic Substances
Meditsina, Moscow

Ilnitski, A. P., Korolyov, A. A., and Khudoley, V. V. (1993)
Carcinogenic Substances in Aquatic Medium
Nauka, Moscow

Izmerov, N. F., (Ed.) (1984)
Preventive Toxicology: Collection of Training and Methodical Materials, 2 Vols.
UNEP, IRPTC, GKNT, USSR Commission for UNEP
Centre of International Projects, GKNT, Moscow (Eng)

Izmerov, N. F., Sanotski, I. V., and Sidorov, K. K. (1982)
Toxicometric Parameters of Industrial Toxic Chemicals under Single Exposure
Center of International Projects, GKNT, Moscow (Eng)

Izmerov, N. F., Sidorov, K. K., Korbakova, A. I. *et al.* (1991)
Maximum Allowable Concentrations of Harmful Substances in the Occupational Air, 2 vols.
Promedek, Moscow

Kagan, Yu. S. (1981)
General Toxicology of Pesticides
Zdorov'ya, Kiev

Kagan, Yu. S. (Ed.); Kopanev, V. A., Ginzburg, E.Kh., and Semyonova, V. N. (1988)
Method for Probabilistic Assessment of Toxic Effect
AN SSSR Siberian Branch, Institute for Cytology and Genetics, MZ RSFSR, Novosibirsk, Research Institute for Hygiene
Nauka, Novosibirsk
ISBN 5-02-02668-0

Kakhn, Kh. A., and Talvoya, Kh. G (Compilers) (1983)
Medical Toxicology (Information and bibliographical reference book)
Valgus, Tallin

Katsnelson, B. A., Alekseyeva, O. T., Privalova, L. I., and Polzik, Ye. V.
Pneumoconiosises: Pathogenesis and Biological Prophylaxis
Izd-stvo UrO RAN, Yekaterinburg

Kasparov, A. A., and Sanotski, I. V. (Eds.) (1986)
Toxicometry of Environmental Chemical Pollutants
UNEP, IRPTC, USSR Commission for UNEP
Center of International Projects, GKNT, Moscow (Eng)

Koloyanova-Simeonova, F., and Sanotski, I. V. (Eds.) (1982)
Issues of Occupational Toxicology
SEV, Postoyannaya komissiya po sotrudnichestvu v oblasti zdravookhraneniya.-Vypusk 2
Moscow

Kopanev, V. A., Ginzburg, E. Kh., and Semyonova, V. N. (1988)
Method for Probabilistic Assessment of Toxic Effect
AN SSSR Siberian Branch Institute for Cytology and Genetics
MZ RSFSR, Novosibirsk
Research Institute for Hygiene
Nauka, Novosibirsk
ISBN 5-02-02668-0

Korolenko, P. P., and Bochkaryova, N. L. (1982)
Specificities of Some Exogenic Intoxications under Conditions of the North
Nauka, Novosibirsk

Kovshilo, V. Ye. (Ed.); Stankevich, V. V., Genel, S. V., Gnoyeva, V. L., *et al.* (1980)
Toxicology and Hygiene in the Use of Polymeric Materials in the Food Industry
Meditsina, Moscow

Kundiev, Yu. I., Trakhtenberg, I. M., *et al.* (1982)
Hygiene and Toxicology of Lubricant and Cooling Liquids
Zdorovya, Kiev

Kurlyandski, B. A., and Filov, V. A. (Eds.); Arbuzova, T. P., Bazarova, L. A., Balabanova, E. A., *et al.* (1992)
Harmful Chemical Substances. Nitrogen-Containing Organic Compounds
Khimiya, St. Petersburg
ISBN 5-7245-0410-3

Kutyrin, I. M. (1980)
Protection of the Air and Surface Waters against Pollutions
USSR AcSc
Nauka, Moscow

Levina, E. N., and Gadaskina, I. D. (Eds.) (1985)
Harmful Substances in Industry: Organic Substances
Khimiya, Leningrad

Luzhnikov, Ye. A. (1982)
Clinical Toxicology: Textbook
Meditsina, Moscow

Luzhnikov, Ye. A., and Kostomarova, L. G. (1989)
Acute Poisonings: Guidelines for Physicians
Meditsina, Moscow
ISBN 5-225-01553-0

Melnikov, N. N., Novozhilov, K. V., and Belan, S. R. (1995)
Pesticides and Regulators of Plant Growth
Khimiya, Moscow
ISBN 5-7245-0960-1

Mikhailov, S. S., and Shcherbak, I. G. (1983)
Metabolism of Phosphororganic Poisons
Meditsina, Moscow

Okunev, V. N., Smolyar, V. I., and Lavrushenko, L. F. (1987)
Pathogenesis, Prevention and Treatment of Fluor Intoxication
Zdorov'ya, Kiev

Orlov, B. N., and Gelashvili, D. B. (1985)
Zootoxicology: Venomous Animals and Their Poisons
Vysshaya Shkola, Moscow

Orlov, B. N., Gelashvili, D. B., and Ibragimov, A. K. (1990)
Venomous Animals and Plants in the USSR
Vysshaya Shkola, Moscow

Oxeguendler, G. I. (1991)
Poisons and the Body: Issues of Chemical Hazard
Nauka, St. Petersburg
ISBN 5-02-025827-X

Panasyuk, Ye. N., Datsenko, I. I., Shtabsky, B. M., *et al.* (1985)
Chemical Pollutants of the Atmosphere and Human Work Efficiency
Zdorov'ya, Kiev

Pavlov, A. V. (Ed.); Sedokur, L. K. (Compiler) (1986)
Pesticides Reference Book: Hygiene of Use and Toxicology, 3rd ed.
Urozhay, Kiev

Rapoport, Zh. Zh., Roshchin, A., Veselov, V., and Rubanovich, V. M. (1987)
Metal Allergosises
Izdat-Krasnoyarskogo Universiteta

Rotenburg, Yu. S. (Ed.); Tutelyan, V. A., Bondarev, G. I., and Martinchik, L. (1987)
Nutrition and Processes of Biotransformation of Alien Substances
Itogi nauki i tekhniki Seriya: Toxicologia, VINITI, Vol. 15, Moscow

Sanotsky, I. V. (Ed.) (1987)
Methodical Recommendations for Toxicometry
CMEA, UNEP, IRPTC
SEV, Moscow

Sanotsky, I. V., and Fomenko, V. N. (1986)
Long-Term Effects of Chemicals on the Organism
Center of International Projects, GKNT, Moscow (Eng)

Sanotsky, I. V, and Ulanova, I. P. (1983)
Hygienic and Toxicological Criteria of Harmfulness in Evaluating Hazards of Chemical Compounds
Center of International Projects, GKNT, Moscow (Eng)

Sheftel, V. O. (1981)
Hygiene and Toxicology of Plastics Used in Water Supply Systems
Zdorov'ya, Kiev

Sheftel, V. O. (1982)
Polymeric Materials (Toxic Properties) (Ref. ed.)
Khimiya, Leningrad

Sheftel, V. O. (1991)
Harmful Substances in Plastics (Ref. ed.)
Khimiya, Moscow

Sheftel, V. O., Dyshinevich, N., and Sova, P. Y. (1988)
Toxicology of Polymeric Materials
Zdorov'ya, Kiev
ISBN 5-3111-00002-3

Shevchenko, A. M., and Yavorovsky, A. P. (1985)
Prevention of Occupational Intoxications in Production and Use of Epoxide Resins
Zdorov'ya, Kiev

Sidorenko, G. I., and Itskova, A. I. (1980)
Nickel: Hygienic Aspects of Protection of the Environment
AMN SSSR
Meditsina, Moscow

Stepansky, G. A., Fonstein, L. M. (Eds.); Abilev, S. K., and Poroshenko, G. G. (1986)
Accelerated Methods for Forecasting Mutagenic and Blastomogenic Properties of Chemicals
Itogi nauk I tekhniki Seriya: Toxicologiya Vol. 14, VINITI, Moscow

Suvorov, S. V., and Shterengarts, R. Y. (1986)
Harmful Substances on the Railway Transport
Transport, Moscow

Tashmukhamedov, B. A., and Usmanov, P. B. (1991)
Neurotoxins in Studies of Biological Membranes
Vysshaya shkola, Moscow

Tiunov, L. A., and Kustov, V. V. (1980)
Toxicology of Carbon Oxide, 2nd ed.
Meditsina, Moscow

Trakhtenberg, I. M., Timofiyevskaya, L. A., and Kvyatkovskaya, I. Ya. (1987)
Investigation Methods for Chronic Effects of Chemical and Biological Pollutants
Zinatne, Riga

Trakhtenberg, I. M. (Ed.); Trakhtenberg, I. M., Sova, P. Ye., Sheftel, V. O., and Onikiyenko, F. A. (1991)
Issues of Toxicological Norm Setting (modern perception and methodological approaches and basic parameters and constants)
Meditsina, Moscow
ISBN 5-225-00375-3

Trakhtenberg, I. M., Kolesnikov, V. S., and Lukovenko, V. P. (1994)
Heavy Metals in the Environment: Modern Hygienic and Toxicological Aspects
Navuka i tekhnika, Minsk
ISBN 5-343-01103-9

Turusov, V. S., and Parfyonov, Yu. D. (1986)
Methods for Identification and Regulation of Chemical Carcinogens
Meditsina, Moscow

Uzhdavini, E. R. (1986)
Toxicology of Organic Sulfure Compounds
Institute for Organic Synthesis
Zinatne, Riga

Valdman, A. V., Babayan, E. A., and Zvartau, E. E. (1988)
Psychopharmacological and Medico-Legal Aspects of Toxicomania
Meditsina, Moscow
ISBN 5-225-00103-3

Vaskovskaya, L. F. (1985)
Circulation and Transformation of Chloro-, Fluoro-, Mercury Derivative Preparations in the System Environment-Biological Target
Kiev

Yershov, Yu. A., and Pletnyova, T. V. (1989)
Mechanisms of Toxic Action of Inorganic Compounds
Meditsina, Moscow
ISBN 5-225-01484-4

Zhamgotsev, G. G., and Predtechenski, M. B. (1993)
Medical Aid to Patients Affected by Highly Active Poisonous Substances
Meditsina, Moscow
ISBN 5-225-02632-X

Series

Reviews of Scientific Literature in Russia on Selected Hazardous Chemicals
IRPTC (UNEP Chemicals) for the period 1982–1998; numbers of issues are given in brackets. Most issues of the series are published in English

Acenaphthylene (16), acetaldehyde (111), acetone (97), acrylamide (104), acrolein (50), aflatoxins (101), aldicarb (114), aldrin and dieldrin (129), alkylbenzene sulfonates (116), allyl alcohol (73), aniline (53), aniline, bromo-, chloro-, nitro- (60), antimony (71), arsenic (20), asbestos (2), atrazine (IB)

Basudin (63), benomyl (112), benzo(*a*)pyrene (43), benzene (90), benzidine (123), beryllium (63), boron and its inorganic compounds (116), bromophos (96), 1,3-butadiene (131), butiphos (113)

Cadmium (69), calcium + inorganic compounds (98), captan (6), carbaryl (71), carbathione (19), carbofuran (103), carbon disulfide (41), carbon tetrachloride (27), caprolactam (35), chlordane (132), chlorobenzenes (108), chloroprene (14), chromium (68), cobalt (100), coumaphos (Co-ral) (88), cresols (92)

2,4-D (70), dalapon (95), DDT (39), DDVP (79), decamethrin (102), demetonmethyl (4), dianisidine (125), dibrom (66), dichlorobenzidine (130) dichloroethane (25), dicofol (Kelthan) (45), dimethylamine (64), dimethyl phthalate (24), dimethyl sulfate (91), dimethoate (5), dinocap (Karathane) (87), dinoseb (106)

Epichlorohydrin (86), esters of O-phthalic acid (23), ethylbenzene (57) fenitrothion (26), fenthion(99), formaldehyde (13), formamide (56)

Heptachlor (3), hexachlorobenzene (134)

Lindane (40), lead (42), leptophos (124)

Malathion (8), maneb (48), mercury (ll), methachlor (Lasso) (84), methanes, halogenated (59), methanol (34), methylbromide (126), methylparathion (9), mineral oils (1), molybdenum (105), monuron (77), morpholine (55)

2-Naphthylamine (122), nickel + compounds (58), nitrates (21), nitrites (22), nïtrobenzene (51), nitrogen oxides (115), nitrosamines (47), noruron (Herban) (81)

Organomercury compounds (117), oxamyl (93)

Paraquat (136), parathion (10), pentechloronitrobenzene (110), pentachlorophenol (75), phenol (61), phenol, nitro- (74), phosmet (46), polychlorinated biphenyls (107), prometryne (29), propanide (76), propachlor (Ramrod) (83), pyrethroids (119), pyridine (54)

Selenium (98), simazine (28), schradan (octamethyl) (82), sodium fluoride (38), streptomycin (36), strobane (45), styrene (49)

Tetraethyl lead (121), thallium (17), tillam (72), tetradifon (Tedion) (89) thiram (12), toluenes, halogenated (62), toluylene diisocyanate (30), toxaphene (32), trichlorofon (33), trifluralin (80)

Urea herbicides (109)

Vamidothion (44), vanadium (67), vinyl chloride (37)

Warfarin (zoocoumarin) (85)

Xylenes (52)

Zinc + compounds (94), zineb (31), ziram (15)

JOURNALS

Academy of Sciences News
Series: Biology

Advances in Current Biology
Russian Academy of Sciences
ISSN 0042-1342

Archive of Pathology (1935–)
6 times per year
ISSN 0004-1955

Biophysics (1956–)
6 times per year
ISSN 0006-3029

Bulletin of Experimental Biology and Medicine (1936–)
Monthly
ISSN 0365-9615

Chemo-Pharmaceutical Journal (1967–)
Monthly
ISSN 0023-1134

Experimental and Clinical Pharmacology (1938–)
6 times per year
ISSN 0869-2092

Hygiene and Sanitary (1992–)
6 times per year
ISSN 0016-9900

I. P. Pavlov Journal of Higher Nervous Activity (1951–)
6 times per year
ISSN 0044-4677

Military Medical Journal (1823–)
Monthly
ISSN 0026-9050

Morphology. Archive of Anatomy, Histology, Embryology (1916–)
6 times per year
ISSN 0004-1947

Occupational Medicine and Industrial Ecology (1957–)
Until 1993 was titled *Occupational Hygiene and Diseases*
Monthly
ISSN 0016-9919

Pathological Physiology and Experimental Therapy (1957–)
4 times per year
ISSN 0031-2991

Problems of Medical Chemistry (1995–)
6 times per year
ISSN 0042-8809

Toxicological Review, (1993–)
6 times per year
ISSN 0869-7922

ORGANIZATIONS

Commission on Carcinogenic Factors
Chairman: Deputy Chief of the Department Gossanepidnadzor

L. P. Gulchenko
101479 Moscow, Vadkovsky per. 18-20
Phone: (095)973 16 47
Fax: (095) 973 15 49

Commission on State Sanitary and Epidemiological Norm Setting
Chairman: First Deputy Minister of Health G. G. Onishchenko
101479 Moscow, Vadkovsky per. 18–20
Phone: (095)973 27 44
Fax: (095) 973 18 02

Department for Protection and Reproduction of Fish Resources and Regulation of Fisheries (Glavrybvod)
Chief: V. M. Brokhis
107 140 Moscow, Verkhnaya Krasnoselskaya 17a/1
Phone: (095)264 92 43
Fax: (095)264 93 21

Department of Sanitary and Epidemiological Surveillance (Gossanepidnadzor)
Chief: A. A. Monisov
101479 Moscow, Vadkovsky per. 18–20
Phone: (095)973 26 66
Fax: (095) 973 15 49

Ministry of Agriculture and Food of the Russian Federation (Minselkhozprod)
Minister: A. A. Semyonov
107139 Moscow, Orlikov per. 1/11
Phone: (095)207 42 43/208 17 60
Fax: (095)207 83 62

Ministry of Economy
Directorate of Economy, Chemical, Microbiological, and Medical Industry
Department of Chemical Industry
Chief: C. N. Safonov
Miuskaya pl. 3, Moscow
Phone/Fax: (095)251 31 49

Ministry of Health of the Russian Federation
Minister: V. I. Starodubov
101431 Moscow, Rakhmanovsky 3
First Deputy Minister: G. G. Onishchenko
101479 Moscow, Vadkovsky per. 18–20
Phone: (095)973 27 44
Fax: (095) 973 18 02

Ministry of the Russian Federation of Civil Defense, Emergencies and Elimination of Consequences of Natural Disasters
Minister: S. K. Shoygu
103012 Moscow, Teatralny pr. 3
Phone: (095) 926 39 01
Fax: (095) 924 19 46

Russian Federal Service for Hydrometeorology and Environmental Monitoring (Roshydromet)
Chief: A. I. Bedritsky
123242 Moscow, Novovagankovsky per. 12
Phone: (095) 252 14 86
Fax: 255 22 16

Russian Register of Potentially Hazardous Chemical and Biological Substances
Director: B. A. Kurlyandski
101479 Moscow, Vadkovsky per. 18–20
Phone/Fax: (095)973 26 57
E-mail: kurlyandski@regdang.msk.ru

Standing Committee for the Control of Narcotics
Chairman: E. A. Babayan
121 Moscow, Gagarinsky per. 20
Phone: (095) 241 37 01
Fax: (095) 241 33 00

State Commission for Chemical Protection of Plants and Biologically Active Substances (Goskhimkomissiya)
Chairman: D. A. Orekhov
107139 Moscow, Orlikov per. 1/11
Phone: (095) 207 63 90
Fax: (095) 208 62 84

State Committee of the Russian Federation for Fishery
101031 Moscow, Rozhdestvensky Blvd 12
Phone: (095) 924 11 39
Fax: 928 83 49

State Committee of the Russian Federation on Environmental Protection
Chairman: V.I. Danilov-Danilyan
123832 Moscow, Bolshaya Gruzinskaya 4/6
Phone: (095) 254 27 66
Fax: (095) 254 82 83

MAIN POISONING TREATMENT CENTERS

Center for Extracorporeal Detoxication Methods
Ekatelrinburg Region, Nizhny Tagil

Central Municipal Clinical Hospital
650053 Kemerovo, ul.Ostrovskogo 22

Central Municipal Hospital
693000 Yuzhno-Sakhalinsk, ul.Tikhookeanskaya 1

Central Municipal Hospital No. 6
440060, Penza, ul.Stasova 7

Chair for Anesthesiology and Resuscitation, Voronezh Medical Institute
394000 Voronezh, Moskovsky pr. 151

Children's Regional Hospital
305035 Kursk, ul.Koltsova 13

Clinical Hospital No. 10
672064 Chita, ul.Lenina 8

First Medical Aid Hospital
660100 Krasnoyarsk, ul.Kurgashova 17

First Medical Aid Hospital
432700 Ulyanovsk, ul.Ryleyeva 30a

First Medical Aid Hospital No. 2
344000 Rostov-on-Don, ul.Yevdokimova 2

First Medical Aid Hospital (Toxicological Department)
644112 Omsk, ul.Perelyota 9

First Medical Aid Hospital, Toxicological Center
Chuvash Republic, 428017 Cheboksary, Moskovsky pr. 47

1st Municipal Clinical
First Medical Aid Hospital, Toxicological Center
414045 Astrakhan, Kubanskaya ul. 1

1st Municipal Hospital
586002 Orenburg, pr.Gagarina

Health Department of the Region
160000 Vologda, ul.Gertsena 2

Hospital No. 9 in the Kuybyshevskiy district
6640001 Irkutsk, ul.Radischcheva 5

Hospital No. 33
603076 Nizhniy Novgorod, pr.Lenina 54

Institute of Toxicology
193019 Saint Petersburg, ul.Bekhtereva 1

M. A. Tverye Medical Station No. 9
614022 Perm, ul.B.Ignatovykh 2

Medical Station, Barnaul Production Association
''Khimvolokno''
656000 Barnaul, ul.Titova 29

Municipal Children's Clinical Hospital No. 1 (Poisonings Treatment Department)
664001 Irkutsk, Deputatskaya 22

Municipal Clinical First Aid Hospital, Municipal Poisonings Treatment Center
620000 Ekaterinburg, ul.8 Marta 78

Municipal Clinical Hospital (Hemodialysis Division)
214001 Smolensk, ul.Frunze 40/1

Municipal Clinical Hospital No. 1
640001 Kurgan, ul.Kirova 63

Municipal Clinical Hospital No. 2, Poisonings Treatment Unit
690000 Vladivostok, ul.Russkaya 57

Municipal Clinical Hospital No. 21
450071 Ufa, ul.Lesnoy Prospect 3

Municipal Clinical Hospital No. 34
663054 Novosibirsk, ul.Titova

Municipal First Medical Aid Hospital
454000 Chelyabinsk, ul.Pobedy 287

Municipal First Medical Aid Hospital
305035 Kursk, ul.Pirogova 14

Municipal First Aid Hospital No. 10
680000 Khabarovsk, Ulchsky per. 1

Municipal Hospital
Komi Republic, 167610 Syktyvkar, ul.Puchkina 114

Poisonings Treatment Center at Moscow N.V. Sklifosovsky Research Institute for First Medical Aid
129010 Moscow, B. Sukharevskaya pl.3

Regional Clinical Hospital
Toxico-Nephrological Center of the Tyumen Region Committee for Public Health
625000 Tyumen, ul.Kotovskogo 25

Regional Hospital No. 1
398055 Lipetsk, ul.Moskovsakaya

Regional M.I. Kalinin Clinical Hospital
443002 Samara, ul.Tashkentskaya 159

Regional Poisonings Treatment Center
Information Toxicological Center
620001 Ekaterinburg
Sibirsky tract
8-oykm
Association ''Psychiatry''

Semashko First Medical Aid Hospital
300008 Tula, ul.Pervomayskaya 13

Zemlyachka First Medical Aid Hospital No. 54
400000 Volgograd, ul.Angarskaya 13

LIBRARIES

Far East State Scientific Library
680620 Khabarovsk, ul.Muraviyova Amurskogo 1/72
Phone: (412) 33 12 20
Fax: (412) 33 31 55

Fundamental Library of the Komi Scientific Center
Ural Branch of the Russian Academy of Medical Sciences
167630 Syktyvkar Komi, Kommunisticheskaya ul.24

Fundamental Library of the Russian Academy of Medical Sciences
125874 Moscow, Baltiyskaya ul.8
Phone: (095) 151 19 71

Library for Foreign Literature
(founder M. Rudomino)
109189 Moscow, Nikoloyamskaya 6
Phone: (095) 915 36 21
Fax: (095) 915 36 37

Library for Natural Sciences
Russian Academy of Medical Sciences
119890 Moscow, Znamenka 11
Phone: (095) 291 22 89
Fax: (095) 291 24 03/291 18 43

Library of the Research Center for Socio-Occupational Problems in Labour Protection
Moscow 119021, Obolensky per. 10
Phone: (095) 246 48 85

Medical Library
656031 Altai Territory, Barnaul, ul.Papanintsev 144

Regional Medical Library
640000 Kurgan, ul.Tomina 61

Regional Medical Library
460000 Orenburg,ul.Kobozeva 20

Regional Medical Library
614600 Perm, ul.Pushkina 83

Regional Medical Library
432063 Ulyanovsk ul. 3- Internatsionalnaya 1ya

Regional Scientific Medical Library
650063 Kemerovo, pr. Oktyabrsky 22

Regional Scientific Medical Library
156601 Kostroma, ul.Ostrovskogo 31

Regional Scientific Medical Library
630087 Novosibirsk, ul.N.-Danchenko 130

Regional Scientific Medical Library
302027 Orel, Priborostroitelnaya ul.42

Regional Scientific Medical Library
440026 Penza
ul.Lermontova 28

Regional Scientific Medical Library
443095 Samara
Tashkentskaya ul.59

Regional Scientific Medical Library
170000, Tver, Subscribers' Box 252

Regional Scientific Medical Library
400005 Volgograd, ul.7-aya Gvardeyskaya 33

Republican Scientific Medical Library
450057 Bashkorstan, Ufa, ul.Frunze 48

Republican Scientific Medical Library
670000 Buryat, Ulan-Ude, Sovetskaya ul.32

Republican Scientific Medical Library
428038 Chuvashia Cheboksary, Moskovsky pr.9

Russian Academy of Sciences Library
119890 St. Petersburg, Birzhevaya, liniya 1
Phone: (812) 218 35 92
Fax: (812) 218 74 36
E-mail: ban spb@glus.aps.org

Russian National Library
191069, St. Petersburg, Sadovaya 18
Phone: (812) 310 71 37
Fax: (812) 310 61 48
E-mail: rub@glus.apc.org

Russian National Public Library for Science and Technology
103031 Moscow, Kuznetsky Most 12
Phone: (095) 925 95 89

Russian State Library
101000 Moscow, Vozdvizhenskaya 3, Russia
Phone: (095) 202 57 90
Fax: (095) 200 22 55
E-mail: irgb@glus apc.org

Russian State Patent and Technical Library
121857 Moscow, Berezhkovskaya, nab. 24
Phone: (095) 240 41 97
Fax: (095) 240 44 37

Scientific Library by M. Gorky of the St. Petersburg State University
199034 St. Petersburg, Universitetskaya nab. 7/9
Phone: (812) 218 95 46/218 95 54
Fax: (812) 218 13 46

Scientific Library of the Moscow Lomonosov State University
103009 Moscow, Mokhovaya ul.9
Phone: (095) 202 86 45
Fax: (095) 202 94 04

Scientific Medical Library
394000 Voronezh, Studencheskaya ul.107

State Central Medical Library
117418 Moscow, Nakhimovsky pr.
Phone: (095) 120 24 85
Fax: (095)128 87 39

State Regional Scientific Library
644099 Omsk, ul.Krasny put 11

Territorial Scientific Library
660049 Krasnoyarsk, ul.K.Marx 334

CONTRACT LABORATORIES

A. A. Sysin Research Institute for Human Ecology and Environmental Health, Russian Academy of Medical Sciences
119121 Moscow, Pogodinskaya ul.10

Angarsk Branch of the Research Institute of Biophysics
665830 Angarsk-30, Irkutsk Region

Angarsk Research Institute for Occupational Health and Professional Diseases
665827, Angarsk

Ekaterinburg Medical Scientific Center for Health Prophylaxis and Protection of Industrial Workers
620014 Ekaterinburg, ul.Popova 30

Institute of Biophysics
123182 Moscow, Zhivopisnaya ul.46

Institute of Occupational Health
105275 Moscow, Budennogo prospekt 31

Ivanovo AS Bubnov State Medical Institute
153623 Ivanovo, pr.F.Engels 8

Moscow FF Erisman Research Institute of Hygiene
141000 Mytishchi, ul.Semashko 2, Moscow Region

Moscow IM Sechenov Medical Academy
119881 Moscow, B.Pirogovskaya 2/6

National Research Center for Biologically Active Compounds
142450 Kupavna Railway Station, Moscow region, ul.Kirova 23

Nizhni Novgorod Research Institute for Hygiene and Occupational Pathology
603600 Nizhni Novgorod, ul.Semashko 20

Novosibirsk Branch of the Scientific and Production Association ''Hygiene and Occupational Pathology''
630108 Novosibirsk, ul.Parkhomenko 7

Perm Polytechnical Institute
614600 Perm, Komsomolsky pr. 29a

Perm Scientific and Production Center for Ecological Safety of Population
614000 Perm, ul.Kuiybysheva 50

Perm State Medical Institute
614000 Perm, ul.Kuiybysheva 39

Research Institute for Preventive Toxicology and Disinfection
117246 Moscow, Nauchny pr.18

Research Institute of Nutrition, Russian Academy of Medical Sciences
109240 Moscow, Ustyinski pr.2/14

Russian Academy of Advanced Medical Studies
123836 Moscow, ul.Barricadnaya 2

Samara Branch of ''Hygiene and Occupational Pathology''
Scientific and Production Association
443099 Samara, Chapayevskaya ul.87

Saratov Research Institute for Rural Hygiene
410760 Saratov, ul.Chernyshevskogo 135

State Research Institute for Organic Chemistry and Technology
111024 Moscow, Shosse Entuziastov 38

State Scientific Center for Antibiotics
111023 Moscow, Nagatinskaya ul.3a

Stavropol State Medical Institute
335014 Stavropol,ul.Mira 310

St. Petersburg Medical Academy of Advanced Studies
193015, St. Petersburg, ul.Saltykova-Shchedrina 41

St. Petersburg Academician IP Pavlov Medical Institute
197089 St. Petersburg, ul.Lva Tolstogo 6/8

St. Petersburg Research Institute for Hygiene and Occupational Pathology
188633 Leningrad Region, Post Office Kuzmolovsky

St. Petersburg Research Institute for Occupational Hygiene and Professional Diseases
193036 St. Petersburg, ul.2-aya Sovetskaya 4

St. Petersburg Research Institute of Toxicology
193019 St. Petersburg, ul.Bekhtereva 1

St. Petersburg State Medical Academy
195067 St. Petersburg, Piskarevsky pr. 47

Ufa Research Institute of Occupational Health and Human Ecology
450092 Ufa, ul.Stepana Kuvykina 94

Ural State Medical Institute
620000 Ekaterinburg, pl.Kommunarov

DATABASES

Abbreviations

DBMS; database management system
DF; delivery of fragments
RD; replication of a database

RS; retrospective search on one-time request
SCSTI; state classifier of scientific and technical information
SPI; selective provision of information on continuous request

Toxicology

Type of DB: Bibliographic database with abstracts
SCSTI: 34,47
Toxicology
Retrospective search: 1981
Memory size: 107.82 MB
Computer: Sequent
DBMS: Oracle
Network: RELCOM
Owner: VINITI, Moscow [Phone: (095)155-46-07/155-45-02]

Narcotical Toxicology

Type of DB: Bibliographic database with abstracts
SCSTI: 34,47,67
Narcotical toxicology
Retrospective search: 1981
Memory size: 69.79 MB
Computer: Sequent
DBMS: Oracle
Network: RELCOM
Services: SPI, RS, RD, DF
Owner: VINITI, Moscow [Phone: (095) 155-46-07, 155-45-02]

Information Search System for Forecasting Toxicity Indicators; Database for Toxic Properties (LD_{50}, MAC) (ISS CHANGE-TOX)

Type of DB: documentary and factual
SCSTI: 31, 34, 35, 34, 47
Chemical information, chemistry, toxicology, ecology, prediction of properties of chemicals, molecular modeling
Memory size: 0.4 MB
Computer: IBM PC
DBMS: CP
Services: DF
Owner: Scientific Research Centre: ''C'', Moscow
[Phone: (095) 271 82 57]

Information Search System for Forecasting a Broad Range of Toxicity Indicators of Chemical Compounds; Includes Chemicals Database

Type of DB: documentary and factual
SCSTI: 31
Chemical information, chemistry, toxicity indicators of chemicals, prediction of properties of chemicals, molecular modeling
Memory size: 25 MB
Computer: IBM PC
Services: DF
Owner: Scientific Research Centre, Moscow
[Phone: (095) 271-82-57]

Full-Text Database for Chemicals Posing Risk to Humans (Information Search System ''CHANGE-COMPASS-CARC'')

Type of DB: full-text
SCSTI: 31
Chemical information, chemistry, carcinogenicity of chemical substances
Memory size: 36 MB
Computer: IBM PC
DBMS: Compass
Services: DF, RD, RS
Owner: Research Centre ''E'', Moscow
[Phone: (095) 271-82-57]

Inventory and Codes of Chemicals Polluting the Atmospheric Air

Type of DB: Factual
SCSTI: 87
Protection of the environment: codes, MACs, amounts of payments for release of more than 1500 substances into the atmosphere, TSEL
Retrospective search: 1992
Computer: IBM PC
Services: RD
Owner: World Centre of Radiation Data, Saint-Petersburg
[Phone: (812) 225 43 84]

Comprehensive List of MACs and TSELs of Pollutants in the Occupational Air

Type of DB: factual
SCSTI: 87
Data on pollutants in the occupational air: main names, synonyms, trade names, MACs, TSELs, hazard classes, prevalent physical state, effects on the organism, data on harmful products of macrobiological synthesis and strains (products generated by microorganisms)
Retrospective search: 1990
Computer: IBM PC
OS: MS DOS
DBMS: ZBASE, Clipper
Services: DF, RS, DF
Owner: Scientifico-Production Enterprise, ''Logus,'' Moscow Region, Krasnogorsk
[Phone: (095) 562 69 90]

Comprehensive List of MACs and TSELs of Pollutants in the Air of Populated Areas

Type of DB: factual
SCSTI: 87
Data on pollutants in the air of populated areas: main names, synonyms, trade names (harmful substances producing summation effect are also included)
Retrospective search: 1990
Computer: IBM PC
OS: MS DOS
DBMS: ZBASE, Clipper
Service: RD, RS, DF
Owner: Scientifico-Production Enterprise ''Logus,'' Moscow Region, Krasnogorsk
[Phone: (095) 562 69 90]

Consolidated List of MACs of Harmful Substances in Water

Type of DB: Factual
SCSTI: 87
List of MACs of substances in water: names, synonyms, molecular formula, sanitary norms for fisheries and water management (information is grouped according to the classes of chemicals; pesticides, synthetic surface-active substances, and dyes are allotted to a special group)
Retrospective search: 1990
Memory size: 1.39 MB
Computer: IBM PC
OS: MS DOS
DBMS: ZBASE, Clipper
Services: RD, RS, DF
Owner: Scientifico-Production Enterprise ''Logus,'' Moscow Region, Krasnogorsk [Phone: (095) 562 69 90]

Regulated Characteristics and Control Method for Harmful Substances in Soil

Type of DB: factual
SCSTI: 87
Data on harmful substances in soil; substances are referred to compounds classes and types; every substance is given MAC, critical indicator of harm, indicator of persistence toxicity, hazard class, and analytical method; for metals a background content and MAC basing on several characteristics are reported; every substance is presented by the main name and trade name
Memory size: 0.209 MB
Computer: IBM PC
OS: MS DOS
DBMS: ZBASE, Clipper
Services: RD, RS, DF
Owner: Scientifico-Production Enterprise ''Logus,'' Moscow Region, Krasnogorsk
[Phone: (095) 562 69 90]

REGULATORY DOCUMENTS

Occupational Health

Maximum allowable concentrations (MACs) of harmful substances in occupational air. RF Ministry of Health. Hygienic norms: ГН 2.2.5.686-98

Tentative safe exposure levels (TSELs) of harmful substances in occupational air RF Ministry of Health. Hygienic norms: ГН 2.2.5.687-98

Atmospheric Air

MACs of pollutants in the ambient air of residential areas. RF Ministry of Health. Hygienic norms: ГН 2.1.6.695-98

TSELs of pollutants in the ambient air of residential areas. RF Ministry of Health. Hygienic norms: ГН 2.1.6.696-98

Water

MACs of chemicals in the water of water objects used for drinking and domestic–recreation purposes. RF Ministry of Health. Hygienic norms: ГН 2.1.5.689-98

TSELs of chemicals in the water of water objects used for drinking and domestic–recreation purposes. RF Ministry of Health. Hygienic norms: ГН 2.1.5.690-98.

Soil

MACs and tentative allowable concentrations (TACs) of chemicals in soils with different physical and chemical properties (gross contents, mg/kg). Goscomsanepidnadzor Rossii. appr. 1991.11.19. Hygienic norms: No. 6229-91, M., 1991

TACs of heavy metals and arsenic in soils with different physicochemical properties (gross contents, mg/kg). Gossanepidnadzor. appr. 1994 12.27. Hygienic norms: ГН 2.1.7.020-94. Addendum No. 1 to the List of MACs and TACs No. 6229-91, M., 1994

Spain

M. REPETTO

BOOKS

Historical

Ximenez de Lorite (1790)
De los daños que puede causar a la salud pública la tolerancia de algunas manufacturas dentro de los pueblos (*Of the Damage to Public Health which Can Be Caused by the Tolerance of Some Factories within Towns*)
Sevilla

The first work published in Spanish that refers to health problems caused by air pollution.

Orfila, M. (1847)
Tratado de Medicina Legal (*Treatise on Forensic Medicine*)
J. M. Alonso, Madrid

A historical work in four volumes, of which the third and fourth are dedicated to toxicology, with numerous practical examples of poisoning, fraudulence with foodstuffs, etc.

Mata, P. (1875)
Compendio de toxicología general y particular (*Compendium of General and Special Toxicology*)
Madrid: Bailly-Bailliere.

A book on Orfila; it criticizes his work while at the same time it praises Anglada's (Anglada, J., *Traite de Toxicologie Generale,* Bailliere, Paris, 1835).

Perez-Argiles, V. (1943)
Toxicología General (*General Toxicology*)
Morata, Madrid

Textbook specially oriented toward forensic toxicology.

Recent

Aguar, O. (1982)
Drogas y fármacos de abuso (*Medicines and Drugs of Abuse*)
C.G.C.O. de Farmaceuticos, Madrid

Presents terminological matters, signs and symptoms in consumers, first aid to the poisoned, health legislation on these substances, and some simple methods of analysis.

Blas, L. (1955)
Química Toxicológica Moderna (*Modern Toxicological Chemistry*)
Aguilar, Madrid

This book is very systematic; although elementary, it is very instructive.

Cabrera, R., Mencias, E., and Cabrera, J. (1993)
Toxicología de los Psicofármacos (*Psychotropic Toxicology*)
L. Beecham, Madrid

An epidemiological study of poisoning by psychotropics, considering pharmacokinetics and pharmacodynamics in general, and that pertains to the different groups of this type of medicines.

Camí, J. (1995)
Farmacología y toxicidad de la MDMA (*Pharmacology and Toxicity of MDMA*)
Neurociencias, Barcelona

Review of the pharmacology, effects, and clinical characteristics of ''ecstasis.''

Casas, M., Gutiérrez, M., and San, L. (1993)
Adicción a psicofármacos (*Addiction to Psychotropics*)
Neurociencias, Barcelona

An update on patterns of consumption, abuse, and dependence on anxiolytics (benzodiazepines), antidepressives, amphetamines, and natural and synthetic opiates.

Casas, M., Gutiérrez, M., and San, L. (1995)
Avances en Drogodependencias (*Advances in Drug Addiction*)
Neurociencias, Barcelona

The current situation of the criteria regarding therapeutic methods based on the substitution of opiates by methadone, buprenorphine, etc. and the use of antagonists.

Coordinadora de ONGs (1995)
Directorio. Organizaciones no-gubernamentales que intervienen en drogodependencias (*Directory. Non-Governmental Organizations Intervening in Drug Addictions*)
OMGs, Madrid

File on human resources and associations of all types with activities in the fight against drug addiction.

Delgado, A. (1979)
Patología prenatal por medicamentos, tóxicos, agentes físicos y metabólicos (*Prenatal Pathology Due to Medicines, Poisons, and Physical and Metabolic Agents*)
Ministerio Sanidad, Madrid

Fundamentally directed at pediatricians, this work offers toxicokinetic and physiopathological information, fundamental in the teratological aspect of toxic agents.

Felices, F., Nogué, S., and Civeira, E. (1993)
Medicina Intensiva Práctica. Intoxicaciones Agudas (*Practical Intensive Medicine. Acute Poisoning*)
IDEPSA, Madrid

Describes the general basis for the treatment of acute poisoning, with chapters covering medicines, drugs of abuse, alcohol, and other frequent agents of poisoning.

Freixa, F., and Soler, P. A. (Eds.) (1981)
Toxicomanías (*Drug Addiction*)
Fontanella, Barcellona

Collective and multidisciplinary study of drug addiction.

Fundación MAPFRE (1978)
2d Simposio de Higiene Industrial (*2nd Symposium on Industrial Hygiene*)
MAPFRE, Madrid

Revision of the strategy of the taking of samples, and toxicology of metals and solvents.

Fundación Valenciana de Estudios Avanzados (1983)
Saturnismo profesional; estado actual (*Professional Saturnism; the Present State*)
Facta, Valencia

Lectures from a symposium on lead poisoning.

del Giorgio, J. A. (1977)
Contaminación Atmosférica (*Air Pollution*)
Alhambra, Madrid

After general consideration on the sources of pollution and contaminating products, and the meteorological implications, the book expounds the characteristics of the surveillance network and control of air pollution.

Gisbert-Calabuig, J. A. (1985)
Medicina Legal y Toxicología (*Forensic Medicine and Toxicology*)
Fundación García Muñoz, Valencia

An extensive text and reference book for forensic science students. Fundamentally directed toward forensic toxicology, with a few clinical indications.

Kozma, C., and Aranjo, A. (1980)
Medicamentos y embarazo (*Medicines and Pregnancy*)
Cirde, Madrid

Clinical, toxicological, and pharmacokinetic aspects of the use of medicines during pregnancy and the monitoring thereof.

Ladrón de Guevara, J., and Moya, V. (1995)
Toxicología Médica (*Medical Toxicology*)
McGraw-Hill, Madrid

Contains a general section, several chapters on basic, clinical, and workplace toxicology, followed by a descriptive dictionary of poisonous compounds.

López-Gomez, L., and Gisbert-Calabuig, J. A. (1962)
Toxicología Forense, 3d Vol. del Tratado de Medicina Legal (*Forensic Toxicology*)
Saber, Valencia

This is an independent volume of an ample general work on forensic medicine.

Manzanera, R., Torralba, I., and Solanes, P. (1995)
Plan municipal de acción sobre drogodependencias (*Municipal Plan of Action on Drug Addiction*)
Corporation, Barcelona

Municipal plans for the prevention, treatment, and reinsertion of drug addicts.

Marruecos, L., Nogué, S., and Nolla, J. (1993)
Toxicología Clínica (*Clinical Toxicology*)
Springer Verlag Ibérica, Barcelona

A study of epidemiology, physiopathology, laboratory and clinical diagnosis; also addressing the therapeutics of the principal types of acute poisoning, with special discussion of the most frequent groups of poisons.

Marti, A. (1983)
Guia para el analisis de metales en el aire (*Guide for the Analysis of Metals in the Air*)
Instituto Nacional de Seguridad e Higiene en el Trabajo, Madrid

Mateu, J. (1994)
Toxicología Médica (*Medical Toxicology*)
Doyma, Barcelona

Compilation of the symptoms and therapeutics of poisoning by domestic products, cosmetics, and products for personal hygiene, detergents and soaps, disinfectants, pesticides, fuels, etc. and by poisonous animals.

Mateu, J. (1995)
El niño intoxicado (*The Poisoned Child*)
McEdiciones, Barcelona

A very attractively presented book; addressed to the public rather than to health professionals, with the intention of preventing poisonings and to give first aid to the poisoned.

Menéndez, M. (1975)
Manual técnico de Higiene Industrial. Toxicología (*Technical Manual of Industrial Hygiene. Toxicology*)
Servicio Social de Higiene y Seguridad del Trabajo, Madrid

Presents diverse classifications of pollutants peculiar to occupational environments, according to their physical and chemical characteristics and physiopathological effects.

Piqueras, J. (1996)
Intoxicaciones por plantas y hongos (*Poisonings by Plants and Toadstools*)
Masson, Barcelona

Summarizes the author's experience in the treatment of patients poisoned by plants and especially by toadstools, with a detailed classification and description of the botanical and toxicological aspects.

Repetto, M. (1978)
Toxicología de los Aerosoles (*Toxicology of Aerosols*)
Universidad, Sevilla

This book studies the physiochemical properties of colloidal dispersions and the uses and applications of aerosols, as much to military, agricultural, or medical ends as to meteorological. It revises knowledge of absorption by inhalation, of lung clearance, and of local or systemic pathologies that aerosols can cause. This book also presents the appropriate methodology for toxicity testing.

Repetto, M. (1997)
Toxicología Fundamental, 3rd ed. (*Fundamental Toxicology*)
Díaz de Santos, Madrid

This is a multidisciplinary text in which, from biological, chemical, anatomical, and physiological knowledge, physiopathological processes of toxic origin are explained. Also, some chapters are dedicated to the basis of toxicological analysis and the treatment of the poisoned.

Repetto, M., *et al.* (1985)
Toxicología de la Drogadicción (*Toxicology of Drug Addiction*)
Díaz de Santos, Madrid

This is a collective book, whose authors—physicians, chemists, biologists, pharmacists, a judge, and a psychologist—approach the different aspects of the problem of drug addiction from their personal points of view.

Repetto, M., *et al.* (1995)
Toxicología Avanzada (*Advanced Toxicology*)
Díaz de Santos, Madrid

This collective work is a profound examination of several toxicological subjects, which covers from the most ancient to the most recent knowledge, based on extensive research of the literature.

Repetto, M., and Sanz, P. (1995)
Glosarios de términos usados en toxicología (*Glossary of Terms Used in Toxicology*)
Doble Cero, Sevilla

This is the Spanish version of the IUPAC glossary (Duffus *et al.*, 1993), including over 1000 terms.

Rodríguez, C. (1992)
Dopage (*Doping*)
Interamericana, McGraw-Hill, Madrid

Describes the history of doping, substances and methods used, and provides lists of forbidden substances—their chemistry, pharmacology, and analysis. Control and preventive action are discussed.

Tena, G., and Piga, A. (1971)
Compendio de Toxicología Práctica (*A Compendium of Toxicological Practice*)
Antibióticos, León

A small volume with eminently practical information and advice for the treatment of acute poisoning.

Valledor, A. (1994)
Envenenamiento por animales (*Poisoning Due to Animals*)
Díaz de Santos, Madrid

A review of the habits and characteristics of animals (vertebrates and invertebrates) of all the world, whose behavior produces poisoning or urticaria, and also of the preventive and therapeutic actions applicable in each case.

Vega, A. (1993)
La acción social ante las drogas (*Social Action with Regard to Drugs*)
Narcea, Madrid

Social aspects of education and the prevention of drug consumption are discussed.

Villalon, A., and Monclus, A. (1974)
Contaminación ambiental (*Air Pollution*)
Jims, Barcelona

Considers the principal polluting agents, their physicochemical and toxicological properties, physiopathological risks, preventive and emergency measures, and analytical methods.

Villanúa, L. (1977)
Toxicología (*Toxicology*)
Universidad de Madrid, Madrid

The first part is dedicated to general toxicology and the second and more extensive section to analytical procedures.

Computer Programs

Argemi, J., and Mateu, J. (1993)
Base de datos toxicológica. Informtoxic (*Toxicology database. Informtoxic*)
Infofarma España S. L., Barcelona

A collection of discs for use with a PC. They contain detailed information on clinical and toxicological aspects regarding domestic products, and bites and stings of poisonous animals, together with the general treatment of poisonings.

Related Areas

Illera, M. (1994)
Diccionario de acrónimos para las Ciencias de la Salud (*Dictionary of Acronyms for Health Sciences*)
Fundación Wellcome, Madrid

JOURNALS

Speciality Journals—Toxicology

Adicciones (*Addictions*)

Edited by the ''Socidrogaalcohol'' Society. Presents papers on aspects of research, symptoms, or epidemiology regarding abuse of drugs or alcohol.

Bulletin of the Instituto Nacional de Toxicologia (1967–)
Sevilla, Madrid

Drogalcohol (*Drug Alcohol*) (1975–)
Servicio de Alcoholismo y Toxicomanías, Valencia

Review specializing in clinical problems of drug addiction.

Proceedings of the Association Española de Toxicologia

Meeting 1, Barcelona, 1971; Meeting 2, Sevilla, 1974; Meeting 3, Sevilla, 1979.

Proceedings of the Bicongress of Toxicology

First Iberoamerican Congress and TIAFT meeting, Sevilla, 1982.

Speciality Journals—Related Areas

Alimentaria (*Foodstuffs*) (1963–)
Servicio de Informática y Documentación Alimenticia, Madrid

Mapfre Seguridad (*MAPFRE Security*) (1980–)
Fundación MAPFRE, Madrid

Revista de Agroquimica y Tecnologia de Alimentos (*Review of Agrochemistry and Technology of Foodstuffs*) (1960–1994)
Instituto de Agroquímica, Valencia
New title since 1994: ***Revista española de Ciencia y Tecnologia de Alimentos*** (*Spanish Journal of Food Science and Technology*).

Revista de Sanidad e Higiene Publica (*Review of Health and Public Hygiene*) (1926–)
Dirección General de Salud Pública, Madrid

Salud y Trabajo (*Health and Work*) (1977–)
Instituto Nacional de Higiene y Seguridad del Trabajo, Madrid

General Scientific Journals

Farmaceutico (*Pharmacy*) (1966–)
C. Farmaceutico, Madrid

Investigacion y Ciencia (*Investigation and Science*) (1975–)
Prensa Científica, Barcelona

Mundo Cientifico (*Scientific World*) (1981–)
Fontalba, Barcelona

Panorama del Medicamento (*Panorama of Medicines*) (1976–)
C. O. Farmaceútico, Madrid

Quimica e Industria (*Chemistry and Industry*) (1954–)
Asociación Nacional Químicos, Madrid

ORGANIZATIONS

Governmental Organizations

Agencia del Medicamento (Drugs Agency)
Majadahonda, Madrid

This is the means of control of food and drugs of the Ministry of Health.

Instituto Nacional de Higiene y Seguridad en el Trabajo (National Institute of Hygiene and Safety at Work)
Torrelaguna, 73, 28027 Madrid

Composed of four territorial departments and 40 provincial offices; its concern is to watch over the health of the workers and control occupational contamination.

Instituto Nacional de Toxicologia (National Institute of Toxicology) with three territorial departments
Mercés, 08002 Barcelona (e-mail: dire@bar.inaltox.es)
Luis Cabrera 9, 28002 Madrid (e-mail: dire@mad.inaltox.es)
C. S. Jerónimo s/n°, P.O. Box 863 41080 Sevilla (e-mail: dire@sev.inaltox.es)

Its basic function is forensic toxicology, but it also collaborates in clinical toxicology and carries out toxicity studies on new substances, necessary by law. It has a telephone toxicological information service.

Nongovernmental Organizations

Asociacion Española de Toxicologia (Spanish Toxicological Association)
V. Carrera, Secretary
P.O. Box 374
03080 Alicante
Web: http://tox.umh.es/aet

Made up of professionals of any qualification who work in some field of toxicology. A national meeting is held every 2 years and a quarterly journal is edited.

Grupo Español en Métodos Alternativos (Spanish Group on Alternative Methods)
P.O. Box 863
41080 Sevilla
Web: http://tox.umh.es/aet/gtema/

Grupo Inter-UCI de Toxicologia Aguda (GITAB) (Inter-Intensive Care Units for Acute Toxicology Group)
Barcelona

Formed by the doctors who work in the different hospitals in northeastern Spain that have intensive care units for poisoned patients.

Sociedad Española de Medicina Legal y Social (Spanish Society of Forensic and Social Medicine)
Goya, 99, 28009 Madrid

Groups together all Spanish forensic doctors and other professionals from related sciences.

POISON CONTROL CENTERS

Banco de Datos de Plaguicidas (Data Bank on Pesticides)
Zurbano, 34
21004 Madrid
Phone: 91-410-0238

Centro de Datos de Plaguicidas (Data Bank on Pesticides)
Zurbano, 34
21004 Madrid
Phone: 91-410-0238

Centro de Informacion de Medicamentos (Center of Information on Medicines)
Valenzuela, 5
21014 Madrid
Phone: 912-32-4300

Plan Nacional sobre Drogas(National Plan on Drug Abuse)
P. Prado 18
28014 Madrid
Phone: 91-596-1643

Servicio de Informacion Toxicologia (Toxicological Information Service)
Madrid phone: 91-562-0420
Sevilla phone: 954-37-1233
Barcelona phone: 93-317-4400

LEGISLATION AND REGULATIONS

Governmental Resolution of 16.1.1996 (List of substances, pharmacological groups, and methods of doping forbidden in sport)

Law 3/1996 (Control of trade in substances which could be used in the preparation of drugs of abuse. Regulation 865/1998)

Ley de Aguas (Water law) (2-8-1985); Regulations 849/1986 and 927/1988

Ley Basica de Residuos Toxicos y Peligrosos (Basic Law of Toxic and Dangerous Substances) (20/1986); Regulation 833/1988; OM 14-3-1998

Ley del Medicamento (Medicine Law) 25/1990

Ley de Proteccion del Medio Ambiente (Law of Environmental Protection) (3/8/1972)

Normas de Seguridad de los Juguetes Infantiles y Articulos de Broma (Rules for the Safety of Toys for Infants and Articles for Games) (6-11-1985)

Real Decreto sobre Productos Fitosanitarios (Regulation on Fitosanitary Products) 2163/1994

Reglamentacion Tecnico-Sanitaria para la Fabricacion, Comercializacion y Utilizacion de Plaguidicidas (Technic-Sanitary Regulations for the Manufacture, Commercialization, and Use of Pesticides) (30-11-1983). OM. 29/11/1995, 11-12-1995.

Reglamento sobre Preparados Peligrosos (Regulation on Dangerous Preparations) 1078/1993; OM 20-02-1995

Reglamento Sobre Sustancias Toxicas y Peligrosas (Regulations on Toxic and Dangerous Substances) (28-10-85) R.O. 363/1995

EDUCATION/SCHOOLS

In various Spanish university faculties, such as pharmacy, medicine, and veterinary colleges, and some chemistry and biology, the discipline of toxicology is studied within the normal curriculum and also as monographic courses.

Food toxicology is currently taught at several university departments within the new Food Science and Technology degree programs. Different university faculties and professional societies provide monographic courses and specialization programs for postgraduates.

Sweden

ELISABETH MALMBERG AND GUNILLA HEURGREN

BOOK

Lönngren, R. (1992)
International Approaches to Chemicals Control; A Historical Overview
National Chemicals Inspectorate, Stockholm

JOURNALS

Arbete och Hälsa
National Institute for Working Life
(ISSN 0346-7821)

Part of this scientific series contains the criteria documents of the Nordic Expert Group and the Criteria Group of the Swedish National Institute for Working Life.

In Sweden there are no other special journals in the field of toxicology. One of the reasons for not having journals strictly in Swedish is the fact that the Nordic (Scandinavian) countries cooperate in publishing journals, for example, *Pharmacology and Toxicology* (ISSN: 0901-9928) and *Scandinavian Journal of Work, Environment & Health* (ISSN: 0355-3140).

DATABASES

ARBLINE
National Institute of Working Life
S-171 84 Solna
Web: http://www.niwl.se

A bibliographic database in the field of occupational environment and the time coverage is from 1980 on. ARBLINE is available online at KIBIC, Karolinska Institute, Solna, and at http://www.niwl.se/bibl/arbline.

ELIN (Environment Online)
Swedish Environmental Protection Agency
S-106 48 Stockholm
Web: http://www.environ.se

A bibliographic database referring to literature and projects in the area of environmental protection, nature conservation, wildlife preservation, and pollution control. Subject coverage: Air, water, and soil pollution, toxic waste, natural resources, wildlife, flora, environmental monitoring, environmental engineering, environmental hygiene, landscape, toxicology, and environmental impact. The time coverage is from 1970 on.

Baltic (http://www.otatrip.hut.fi/vtt/baltic/intro.html) is a bibliographic database covering the Baltic area, i.e., all marine areas from the Gulf of Finland and Bothnia in the east and north to the Belt Sea and the Kattegatt in the west. Baltic contains references to reports (including ''gray literature''), journal articles, books, conference proceedings, dissertations, etc. Subject coverage: All aspects of the marine environment of the Baltic Sea area, for example, ecology, fauna, and flora, fisheries, hydrography, pollution, environmental impact, and research, planning, and administrative measures. The time coverage is from 1970 on.

RISKLINE
National Chemicals Inspectorate
P.O. Box 1384
S-171 27 Solna
Web: http://www.kemi.se

It is the only existing bibliographic database containing solely peer-reviewed international information in complete series. Each reference in RISKLINE is furnished with a critical evaluation which represents the unanimous opinion of a group of toxicological experts on the value of the research presented in the document. By evaluated material is meant reports that have been screened and admitted by concensus of a group of researchers and specialists. RISKLINE is updated quarterly with 100–150 references. The time coverage is from 1972 on. It is available online at http://www.kemi.se and as a subfile of TOXLINE at the National Library of Medicine (NLM), Washington, DC (http://www.igm.nlm.nih.gov) and at other database vendors, i.e., Dialog and DataStar. It is also available on CD-ROM as a subfile of TOXLINE and TOXLINE Plus, Silver Platter.

SWEMED
KIBIC, Karolinska Institute
Library and Information Center

P.O. Box 200
S-171 77 Stockholm
Web: http://www.kib.ki.se

It is a bibliographic database containing references to medical journal articles and reports published in Sweden and Norway, and also to medical dissertations from Swedish and Norwegian universities. The time coverage is from 1982 on.

TOXICOLOGY RESEARCH AND EDUCATION

Toxicology research and education focusing on human toxicology and ecotoxicology is carried out in Sweden at universities and colleges (e.g., institutes of toxicology, pharmacology, genetics, and hygiene) as well as at research institutions connected to central authorities such as the National Institute for Working Life, the National Board of Occupational Safety and Health, and the Swedish Environmental Protection Agency. Research is also done at special research and investigation institutions, such as the National Defense Research Instiute and the Institute of Environmental Medicine at Karolinska Institute, and in health care at clinics for occupational medicine. The center for education and training in toxicology is the Karolinska Institute and for ecotoxicology Uppsala University.

MINISTRIES

Ministry of Agriculture
S-103 33 Stockholm
Phone: 46(8)405 10 00
Fax: 46(8)20 64 96
Swedish National Food Administration

Ministry of Defense
S-103 33 Stockholm
Phone: 46(8)45 10 00
Fax: 46(8)723 11 89
National Defense Research Institute

Ministry of the Environment
S-103 33 Stockholm
Phone: 46(8)405 10 00
Fax: 46(8)24 16 29
National Chemicals Inspectorate
Swedish Environmental Protection Agency
Swedish Radiation Protection Institute

Ministry of Health and Social Affairs
S-103 33 Stockholm
Phone: 46(8)405 10 00
Fax: 46(8)723 11 91
Swedish National Institute of Public Health

Ministry of Industry and Trade
S-103 33 Stockholm
Phone:46(8)405 10 00
Fax: 46(8)411 36 16
National Inspectorate of Explosives and Flammables
Swedish Board for Technical Accreditation (SWEDAC)

Ministry of Labour
Division for Working Condition
S-103 33 Stockholm
Phone: 46(8)405 10 00
Fax: 46(8)20 73 69
National Board of Occupational Safety and Health
National Institute for Working Life
Swedish Council for Work Life Research

GOVERNMENTAL AGENCIES

National Board of Occupational Safety and Health
S-171 84 Solna
Phone: 46(8)730 90 00
Fax: 46(8)730 19 67
Web: http://www.arbsky.se
Occupational Hygiene Department
Contact: Anne-Christine Svärd, 46(8) 730 94 32

The board is the central authority in Sweden for matters concerning occupational safety and health. The board's duties include

- Supervision, coordination, and development of activities in the occupational safety and health sector
- Responsibility at national level for the enforcement of the Work Environment Act of 1977 and the Working Hours Act of 1982. These acts apply to all areas of working life—equally to private and public activities. The board issues regulations and recommendations on the application of this legislation. In the context of occupationl safety and health the board is also responsible for the central enforcement of the Chemical Products Act of 1985.
- Preparation and dissemination of information in the occupational safety and health sector.
- Responsibility for the Occupational Injury Information System (ISA).

Labour Inspectorate
Under the direction and supervision of the board the Labour Inspectorate is responsible at the regional level for the enforcement of legislation concerning

the working environment and working hours and (within its range of jurisdiction) the legislation concerning chemical products.

National Chemicals Inspectorate
P.O. Box 1384
S-171 27 Solna
Phone: 46(8)730 57 00
Fax: 46(8)735 76 98
Web: http://www.kemi.se
Contact: Lars Freij, 46(8)730 68 21

Supervising agency

The National Chemicals Inspectorate (KemI) is the supervising agency responsible for enforcing the Chemical Products Act in Sweden. KemI coordinates national activities and promotes international work with chemicals control. The overriding goal, of KemI is to reduce the risks to health and the environment caused by chemical substances and products. KemI's main branches of activity are the limitation of risks with regard to general chemicals and pesticides, supervision focusing on manufacturers and importers of chemicals, guidance addressed to local and regional environmental authorities, and the improvement of knowledge concerning properties, hazards, and occurrence of chemicals. KemI produces the database RISKLINE. Sweden has three overarching objectives for chemicals control:

1. Chemical substances and preparations must be sufficiently investigated as regards their effects on health and the environment and their occurrence and flow structure in society. Information about the risks must be possessed by everyone who handles the chemical substances and preparations.
2. Harmful substances shall as far as possible be replaced with less harmful ones.
3. Hazards to health and the environment are to be eliminated through the safe handling of chemical substances and preparations.

Manufacturers and importers of chemical products have the main responsibility for chemicals control, whereas the National Chemical Inspectorate (KemI) supervises the handling, importation, and exportation of chemical substances and preparations. KemI has the particular task to assess both health and environmental aspects connected with the use of chemicals. Other authorities are involved in chemicals control with KemI as the central supervisory authority.

Products register

All manufacturers and importers have to report their production and import of chemicals to the Products Register at KemI. The reports must contain information on hazards to human health and the environment of the substances. This makes the register an important tool for a well-functioning chemicals control for authorities, companies, and the public at large.

National Defense Research Institute
FOA NBC
Cementvägen 20
S-901 82 Umeå
Toxicological investigations
Contact: Rune Berglind, 46(90)10 67 35; fax: 46(90)10 68 00; Web: http://www.foa.se

Research at FOA NBC Defence is not exclusively conducted for the Swedish Total Defence system. FOA NBC has, for example, been successful in acquiring clients in the field of environmental protection.

Risk evaluation of chemical accidents

One research area focuses on chemical accidents. The methodologies involved include calculations of dispersion, field exercises, and studies of risks involving toxic, explosive, or inflammable chemicals. Typical situations under investigation include the release of large amounts of chemicals during short time periods.

Analysis of hazardous agents

The analytical chemistry group tests and analyses hazardous agents indoors and outdoors. They also detect trace amounts of hazards such as PCB and dioxins. Volatile organic compounds in the atmosphere are analyzed in order to map air pollution and identify potential sources.

Testing potentially hazardous agents

The classification of chemical products is another area of research maintained at FOA. This work includes obtaining basic information to be included in chemical safety data sheets. When data are not available on a specific substance, FOA conducts *in vivo* and *in vitro* testing. Examples of applied studies in which FOA has been involved include the investigation of occupational chemical hazards and the evaluation of hazardous substances in the environment.

National Institute for Working Life
S-171 84 Solna
Phone: 46(8)730 91 00, information: 46(8) 730 94 00
Fax: 46(8)730 19 67
Web: http://www.niwl.se

The institute is Sweden's R&D center for occupational health and safety, working life, and the labor market. Other important tasks are the dissemination and appli-

cation of knowledge through education and training, publications, and international collaboration. The institute carries out research and development within labor legislation and the labor market; work organization and production technology; psychosocial working conditions; occupational medicine, allergy, and effects on the nervous system; ergonomics; work environment technology and musculoskeletal disorders; and chemical hazards and toxicology. The institute's role as a national center for issues on working life includes the responsibility for desseminating information to decision makers, the parties in the labor market and others in working life, and to other scientists. Information on the institute's operations is spread via conferences, theme days, trade fairs and exhibits, and scientific periodicals, reports, and popular-science books, magazines, and newsletters. The library at the institute has national responsibility for maintaining an up-to-date collection of the most important literature on working life and has about 59,000 titles. The library also has advanced IT and ADP services.

The National Swedish Inspectorate of Explosives and Flammables
P.O. Box 1413
S-171 27 Solna
Phone: 46(8)799 83 30
Fax: 46(8)29 52 25
Web: http://www.sprangamnes.se
Contact: G-A Björkman, 46(8)764 96 63

The National Swedish Inspectorate of Explosives and Flammables is the central administrative authority for questions dealing with explosives and flammables. The inspectorate is divided into divisions: the Division for Flammable Liquids, the Division for Explosives and Flammable Gases, and the Defence Division. The inspectorate supervises and inspects, authorizes explosives and issues licenses to manufacture these, assists in instructing, assists in investigations of accidents, follows up developments, examines safety technical license matters, gives advice and directions in specific cases, and issues regulations and recommendations.

Swedish Board for Accreditation and Conformity Assessment (SWEDAC)
P.O. Box 878
S-501 15 Borås
Phone: 46(33)17 77 00
Fax: 46(33)10 13 92
Web: http://www.swedac.se

One of SWEDAC's duties is to assess the competence of certification bodies within well-defined areas and in accordance with given specifications (standards or equivalent). This assessment is based partly on an assessment of the documentation that describes the quality system and activities of the certification body and partly on the results of one or more visits to the certification body in order to assess how its activities are performed in practice. Part of the assessment includes participation of SWEDAC as an observer of at least two certifications carried out by the applicant. Assessment is conducted in accordance with SWEDAC's General Regulations for Accredited Certification Bodies. The regulations are based on the international standards EN 45 011, EN 45 012, and EN 45 013. If assessment indicated that the certification body meets the specified requirements, SWEDAC will grant accreditation.

Swedish Council for Work Life Research
P.O. Box 1122
S-111 81 Stockholm
Phone: 46(8)791 03 00
Fax: 46(8)791 85 90
Web: http://www.ralf.se
Contact: Birgit Kalfopoulu Augustsson, 46(8)791 03 69

The main tasks of the Swedish Council for Working Life Research are to prepare comprehensive programs for R&D as a basis for supporting R&D activities; monitor, follow-up, and evaluate the activities that it finances; support the development of multidisciplinary knowledge with a long-term perspective; encourage further research into the conditions of women in working life; provide information on its activities and on the results of the R&D activities that it supports; and promote international collaboration and the exchange of experience.

Occupational medicine/chemical hazards
Toxicology
Physical health risks
Safety and risk assessment

Swedish Environmental Protection Agency
S-106 48 Stockholm
Phone: 46(8)698 10 00
Fax: 46(8)20 29 25
Web: http://www.environ.se
Contact: Håkan Björndal, 46(8)698 11 77

The Swedish Environmental Protection Agency is the national authority with central supervisory and regulatory powers and a role as investigator in the environmental field. The agency is the central authority on issues regarding the environment. Priority is given to the following three areas in the efforts to deal with environmental problems: transport, agriculture and forestry in terms of biodiversity, and industry and trade (production, products, and waste). The approach

used involves varying combinations of the following activities:

Environmental research
: The aim is to survey and analyze threats faced and the need for action, i.e., to produce the scientific data necessary for the implementation of environmental protection measures. The Swedish EPA Research Council and Waste Research Council are responsible for allocating funds for such research.

Environmental monitoring and surveys
: This includes continuous monitoring of the state of the environment and recording long-term changes in that state as well as surveying the occurrence and distribution of various types of ecosystems. Data from these activities are needed both for environmental research and for the implementation of environmental protection measures.

Action programs and studies.
: These include carrying out studies and other projects of a general policy or strategic nature, often as requested by the government.

International work
: As the central environmental agency, it is the task of the Swedish EPA to produce the data underlying the standpoints adopted by Sweden in international environmental work and contribute with expertise.

Environmental legislation and its implementation

Grants and compensation

Acquisition of land and management of protected areas

Information, education, and training

Swedish National Food Administration
P.O. Box 622
S-751 26 Uppsala
Phone: 46(18)17 55 00
Fax: 46(18)10 58 48
Web: http://www.slv.se
Contact: Jerker Sörenson, 46(8)17 55 07

The Food Administration's responsibilities are to look after the interests of the consumer in the food area, lead and coordinate food control, examine the composition and nutritional value of foods, give advice and instructions on food questions, guide the consumer toward better food habits, which is carried out in three main ways: (i) by issuing food standards, (ii) through food control, and (iii) by providing information and training.

Food Standards
: The Food Administration leads and coordinates public food control. The daily supervision and control throughout the country is carried out mainly by the municipal Environmental and Health Protection Committees. The public health inspectors take samples at food industries, catering establishments, restaurants, food shops, and waterworks. Research divisions are the nutrition division, toxicology division, and three chemistry divisions.

Swedish National Institute of Public Health
Department Health and Environment
S-103 52 Stockholm
Phone: 46(8)566 135 00
Fax: 46(8)566 135 05
Web: http://www.fhinst.se
Contact: Inga Sävenstrand-Rådö, 46(8)783 35 34

The Swedish National Institute of Public Health, established in 1992, is a government body created to establish a public health platform, increase resources by collaboration between sectors, and emphasize action for decreased differences in health-related issues due to social conditions, gender, and location. The Swedish National Institute of Public Health's main tasks are to prevent disease and other forms of ill health and promote good health for everyone in Sweden. Special attention is given to gain health in groups exposed to the greatest health risks. The institute is organized in eight programs: alcohol and drugs; allergies; sex and human relations, preventions of abortion and STD; diet and exercise; injuries; tobacco; child and youth health; and women's health. Each program initiates activities which support local and regional public health work in municipalities, county councils, businesses, organizations, and in education and also promote collaboration between different authorities at the national level.

Swedish Radiation Protection Institute
S-171 16 Stockholm
Phone: 46(8)729 71 00
Fax: 46(8)729 71 08
Web: http://www.ssi.se
Division of Waste Management and Environment
Contact: Gunnar Johansson, 46(8)729 72 54

The institute works mainly within the following fields: general supervision, research and development, and supervision of nuclear energy. The institute is responsible for supervision of all areas where radiation is present, with the exception of atomic energy. Hospitals, industry, and research facilities are under its responsibility as are certain products, such as smoke detectors, which contain small amounts of radioactive material. The institute is also responsible for key environmental issues such as the effects of radon in housing and at the workplace and injury caused by prolonged exposure to ultraviolet radiation (the sun or a solarium). Radon and UV radiation are the subject of two long-term

projects. Extensive research into the harmful effects of electrical and magnetic fields, such as power cables or electrical apparatus, is currently under way.

UNIVERSITIES

Chalmers University of Technlogy
Division for Environmental Sciences
S-412 96 Gothenburg
Phone: 46(31)772 10 00
Fax: 46(31)772 38 72
Web: http://www.chalmers.se
Contact: Ulf Andersson, 46(31)773 48 33; fax: 46(31)773 19 40

Gothenburg University
Department of Applied Environmental Sciences
S-413 90 Gothenburg
Phone: 46(31)773 10 00
Fax: 46(31)773 46 60
Web: http://www.gu.se
Contact: Åke Larsson, 46(31)773 38 24; fax: 46(31)773 29 84

The Department of Applied Environmental Sciences provides single courses within the areas of environmental protection, water and air quality, etc., a 1-year additional education within the municipal environmental protection administration, as well as commissioned education.

Karolinska Institute
Institute of Environmental Medicine (IEM)
P.O. Box 210
S-171 77 Stockholm
Phone: 46(8)728 64 00
Fax: 46(8)33 69 81
Web: http://www.imm.ki.se
Contact: Sten Orrenius, 46(8)728 75 90

The Institute of Environmental Medicine at Karolinska Institute is an interdisciplinary research organization and an expert voice within the fields of environmental medicine. In addition to its extensive research activities, IEM is also responsible for several teaching programs and for investigations and analyses pertaining to physical and chemical aspects of environmental medicine and health protection. IEM is a WHO Collaboration Center for Environmental Health Effects. The scientific work at IEM is carried out within 10 prioritized areas of interdisciplinary focus: air pollutants and lung diseases, metals, dioxins and other halogenated pollutants, indoor environment, tumor diseases, cardiovascular diseases, genetic and environment, mechanisms of cell killing and toxic cell injury, development of methods, and education and information

Education and Training in Toxicology at Karolinska Institute
Institute of Environmental Medicine
Toxicology Educational Center
Contact: Anders Bergendorff, 46(8)728 79 42; fax: 46(8)34 28 10

Karolinska Institute has several educational programs, one of which is toxicology. When the toxicology program was inititated in 1976 the main aim was to build up competence in toxicology in order to develop this science in Sweden. In Sweden there is a need for well-trained toxicologists (MSc in toxicology) who are qualified for tasks in scientific research and development, toxicity testing, and other investigational duties. There is a great need for people with general knowledge, e.g., those responsible for the handling of chemicals in companies and others who are only partly involved in toxicological problems in their profession.
Toxicology educational program:
Semester 1: Toxicology 1: Basic toxicology
Semester 2: Toxicology 2: In-depth studies
Semesters 3 and 4: Tox 2 continued: Toxicity test and specialization by examination project

Linköping University
S-581 83 Linköping
Phone: 46(13)28 10 00
Fax: 46(13)28 28 25
Web: http://www.liu.se
Faculty of Health Sciences
Division of Occupational and Environmental Medicine, Department of Health and Environment
Contact: Olav Axelson, 46(13)22 14 40; fax: 46(13)14 58 37

Research and development.

Luleå University of Technology
S-971 87 Luleå
Phone: 46(920)910 00
Fax: 46(920)913 99
Web: http://www.luth.se
Department of Chemical and Metallurgical Engineering
Contact: Bo Björkman, 46(920)912 92

In all civil engineering programs courses in environmental and natural resources are included. The programs including techniques for the structure of society, industrial working environment, and industrial chemistry contain a distinct environmental profile.

The Royal Institute of Technology
S-100 44 Stockholm

Phone: 46(8)790 60 00
Fax: 46(8)790 65 00
Web: http://www.kth.se
Department of Environmental Technology and Work Science
Contact: Ulf Ulfvarson, 46(8)790 60 55; fax: 46(8)10 83 77

The research concerns two main fields of environmental sciences, work science and environmental technology, and includes the border between these two areas of knowledge as well. The branches address the question of how disturbances to the environment, indoor and outdoor, in developed economies can be anticipated, quantified, evaluated, and controlled. The research is divided into the following four branches: man-made machine system; industrial development and change, especially concerning prevention of occupational accidents; chemical health risks in the working and ambient environments; and analysis of environmental systems.

Stockholm University
S-106 91 Stockholm
Phone: 46(8)16 20 00
Fax: 46(8)15 95 22
Web: http://www.su.se
Centre for Research on Natural Resources and the Environment
Contact: Jan Magnusson, 46(8)16 17 77

An interdisciplinary center at Stockholm University. The activities of the Centre for Research on natural resources and the environment are within environmental chemistry and environmental toxicology.

Environmental Chemistry and Ecotoxicology
Department of Environmental Chemistry
Wallenberg Laboratory
Fax: 46(8)15 25 61
Contact: Åke Bergman, 46(8)16 39 97

Umeå University
S-901 87 Umeå
Phone: 46(90)786 50 00
Fax: 46(90)786 54 88
Web: http://www.umu.se

Public Health and Environmental Studies
Contact: Ingemar Renberg, 46(90)786 60 29

The institute has a 4-year course in environmental studies which gives a good background for employment in many areas involving environmental work. There are also many single courses available, some for further education of professionals working in the environmental sector. The main direction of the research is studies of environmental changes, exotoxicological research, and environmental epidemiological research.

Center for Environmental Research
Contact: Mats Ahlberg, 46(90)10 67 67

The center is working for research cooperation between Umeå University, the National Defence Research Institute, the Swedish University of Agricultural Sciences, and the National Institute for Working Life. The center initiates, coordinates, and supports research projects in environmental sciences, it supports and develops a long-range build up of competence and the development of methods and applies research, and it informs of research results in the areas of environmental science.

University of Lund
P.O. Box 117
S-21100 Lund
Phone: 46(46)222 00 00
Fax: 46(46)222 47 20
Web: http://www.lu.se
Environmental Scientific Network
Contact: Barbro Berggård, 46(46)222 42 59

The aims of the Environmental Scientific Network are to initiate and support interdisciplinary collaboration between departments and scientists; to create favorable conditions for environmental research and teaching; to function as a contact organization between authorities, both nationally and internationally; to secure sources of external funding for environmental projects; to function as a knowledge bank in the area; to disseminate information on current environmental research; and to stimulate interdisciplinary exchange of information.

Department of Ecology
Ecotoxicology
Contact: Ann Södergren, 46(46)222 38 02

The research activities focus on the distribution of ecologically active pollutants in the environment, their transport, bioaccumulation, degradation, and biological and ecological effects. The fate of the pollutants is primarily studied in aquatic environments in relation to mechanisms and processes at interfaces of the ecosystem components. Special attention is devoted to the sediment/water, water/organisms, and water/air interfaces. The studied substances are usually lipophilic in character and have surface-active properties and include naturally occurring compounds as well as environmental pollutants. The effects of the pollutant exposure are investigated at the single species and population levels and the results are used to evaluate consequences for populations and ecosystems.

Uppsala University
P.O. Box 256
S-751 05 Uppsala
Phone: 46(18)471 00 00
Web: http://www.uu.se

Environmental Toxicology
Contact: Ingvar Brendt, 46(18)471 26 17; fax: 46(18)51 88 43

Biological effects and mechanisms of toxicity of environmental pollutants are studied in mammals, birds, and fish. An ultimate goal is to understand ecotoxicological properties of environmental pollutants and contribute to an improved environmental risk and safety assessment. Research groups working with mammals, birds, and fish provide possibilities for a comparative approach to examine species differences in biotransformation, sensitivity, and mechanism of action. Educational program: one year of graduate studies in ecotoxicology leads to MSc in ecotoxicology.

HOSPITALS

Karolinska Hospital
S-171 76 Stockholm
Department of Occupational Health
Phone: 46(8)517 70 00
Contact: Birgitta Kolmodin-Hedman, 46(8)517 73 723; fax: 46(8)517 37 66

Education, research, and development.

Lund University Hospital
S-221 85 Lund
Department of Occupational and Environmental Medicine
Phone: 46(46)17 31 85
Fax: 46(46)17 31 80
Contact: Staffan Skerfving, 46(46)17 31 70

Education, research, and development.

Malmö General Hospital
S-214 01 Malmö
Occupational and Environmental Medicine Unit
Contact: Palle Orbaek, 46(40)33 19 88; fax: 46(40)33 62 63
Department of Occupational Dermatology
Contact: Birgitta Gruvberger, 46(40)33 17 59

Education, research, and development.

Örebro Medical Center Hospital
S-701 85 Örebro
Department of Occupational and Environmental Medicine
Phone: 46(19)15 24 69
Fax: 46(19)12 04 04
Contact: Gunnar Ahlborg, Jr., 46(19)15 24 61

Education, research, and development.

Sahlgrenska Hospital
St. Sigfridsgatan 85 B
S-412 66 Gothenburg
Phone: 46(31)335 48 00
Fax: 46(31)40 97 28
Department of Occupational Medicine
Contact: Gunnar Thiringer, 46(31)335 48 92

Education, research, and development.

Sundsvall Hospital
S-851 86 Sundsvall
Department of Occupational and Environmental Medicine
Phone: 46(60)18 19 26
Fax: 46(60)18 19 80
Contact: Thor Nilsson, 46(60)18 19 27

Toxicological evaluations and investigations on occupational and environmental medicine.

University Hospital of Northern Sweden
S-901 85 Umeå
Department of Occupational and Environmental Medicine
Phone: 46(90)785 24 50
Fax: 46(90)785 24 56
Occupational Medicine
Contact: Bengt Järvholm, 46(90)785 32 41
Environmental Medicine
Contact: Gunnar Nordberg, (90)785 27 27

Education, research, and development.

Uppsala University Hospital
Akademiska Sjukhuset
S-751 85 Uppsala
Phone: 46(18)66 35 00
Department of Occupational and Environmental Medicine
Contact: Christer Edling, 46(18)66 36 44; fax: 46(18)51 99 78

Research and development.

OTHER ORGANIZATIONS

Swedish Environmental Research Institute
P.O. Box 21060
S-100 31 Stockholm
Phone: 46(8)729 15 00

Fax: 46(8)31 85 16
Web: http://www.ivl.se
Contact: Björn Lundberg, 46(8)729 15 11

The work of the Environmental Research Institute (IVL) is concerned with research, commissions, education, and giving advice. The research results, which are the institute's main products, also form the basis for activities in these areas.

IVL's cosponsored research programs
- Knowledge for a better environment
  - Life cycle analyses
  - Environmental strategies reaching over several sectors
  - Organic substances
  - Environmentally adapted transports
  - Environmentally adapted industry production
  - Environmentally adapted energy
  - Forestry and agriculture
  - Environmentally adopted technology
  - Global environmental threats
  - Acidification
  - Ground-level ozone
  - Metals
  - Environmental biotechnology
  - Waste technology
  - Sustainable city development
  - EU-adapted measuring techniques

Swedish Museum of Natural History
P.O. Box 50007
S-104 05 Stockholm
Phone: 46(8)666 40 00
Fax: 46(8)666 40 85
Contaminant Research Group
Contact: Mats Olsson, 46(8)666 41 11; fax: 46(8)15 20 13

Monitoring activities within the national Swedish contaminant program in marine biota are the joint efforts of the Contaminant Research Group at the Swedish Museum of Natural History (coordination, sample collection administration, sample preparation, recording of biological variables, minor additional analyses of organochlorines, storage of frozen biological tissues in the Environmental Speciment Bank for retrospective studies, data preparation, and statistical evaluation), the Institute of Applied Environmental Research at Stockholm University (analyses of organochlorines), and the Centre for Environmental Monitoring at the University of Agriculture (heavy metals). The monitoring program is financed by the Environmental Protection Agency in Sweden.

Swedish Poison Information Centre
S-171 76 Stockholm
Phone: 46(8)33 12 31

The Swedish Poison Information Center is a governmental authority headed by the National Board of Health and Welfare. It provides information over the telephone to private persons and assists in acute poisoning cases. The center also provides assistance to physicians.

Swedish Society of Toxicology
Institute of Environmental Medicine
P.O. Box 210
S-171 77 Stockholm
Contact: Annika Hanberg, 46(8)728 75 26

Members of the Swedish Society of Toxicology are professionals and students in the field of toxicology with a keen interest in the subject. The aim of the society is to promote the development of toxicology in Sweden and work for toxicological education and research through the arrangement of public meetings and scientific seminars and discussions and also to work for the accomplishment of toxicological research according to the latest discoveries. The society shall work for the exchange of information between members and between members and representatives of other scientific disciplines and other parts of the society as well as aim at cooperation between other closely related organizations nationally and internationally.

Swedish Toxicological Board
National Chemicals Inspectorate
P.O. Box 1384
S-171 27 Solna
Phone: 46(8)730 5700
Fax: 46(8)735 7698
Contact: Anna Lindberg, 46(8)730 63 83

The Swedish Toxicological Board is an expert advisory body for the environmental agencies in Sweden. The aims are harmonization and agreement on toxicological issues, with emphasis on risk analysis and interpretation and judgment of toxicological data.

LABORATORIES

The Swedish Board for Technical Accreditation (SWEDAC) is the national agency operating the Swedish accreditation system. An accreditation issued by SWEDAC proves that the competence of the certification body has been examined, assessed, and confirmed by an independent government body.

Akzo Nobel AB
P.O. Box 11551

S-100 61 Stockholm
(GLP-approved)
Phone: 46(8)743 40 00
Contact: Karl-Erland Stensiö, 46(8)743 42 25; fax: 46(8)642 83 99
Center for Analysis

Linköping University Hospital
S-581 85 Linköping
Contact: Monica Asperud, 46(13)22 32 57; fax: 46(13)22 32 40
Laboratory of Clinical Chemistry

Ryhov Regional Hospital
S-551 85 Jönköping
Phone: 46(36)32 23 45
Fax: 46(36)18 00 73
Contact: Anita Bredberg
Department of Clinical Chemistry

Sahlgrenska Hospital
S-413 45 Gothenburg
Phone: 46(31)60 40 83
Fax: 46(13)82 84 58
Contact: Lars Rymo
Central Laboratory of Clinical Chemistry

Swedish University of Agricultural Sciences
P.O. Box 7050
S-750 07 Uppsala
(GLP-approved)
Phone: 46(18)67 30 30
Fax: 46(18)30 27 53
Contact: Gunborg Alex
Department of Environmental Assessment

Taiwan

JEN-KUN LIN

BOOKS

Bureau of Environmental Protection (1984)
Collected Papers on Environmental Lead Poisoning
Department of Health, Executive Yian, Taipei

This book contains 21 papers presented at the Symposium on Environmental Lead Poisoning, which was organized and sponsored by the Bureau of Environmental Protection. The following aspects of lead poisoning were reported and discussed: current status of lead poisoning in Taiwan, lead pollution in some industrial and traffic areas, microdetermination of lead in serum and air samples, pharmacology of lead intoxication, and molecular mechanism of lead poisoning.

Chang, I. C. (1994)
Chemical Process Safety Management
Yang-Chih Book Co., Ltd., Taipei

This book provides fundamental information for chemical process safety, such as chemical toxicity and health hazard, fire and explosives, hazard identification, risk assessment, and safety management.

Chen, T. C., and Sheng, T. J. (1992)
Food Additives
Wen-Yuan Book Co., Ltd., Taipei

This book is a comprehensive treatise on food additives. It is divided into three main parts: introduction to food additives, chemical and physical properties of individual food additives, and special information on food additives, such as the food additive act, dosage, usage, manufacture, storage, transport, stability, and toxicity.

Chen, Z. Y., and Hsu, P. M. (1993)
Toxicological Chemistry
Da-Shing, Taipei

This book illustrates several toxicological aspects of generally used chemicals, namely description of chemicals, intoxication symptoms, antidotes and treatments, chemical analysis of toxicants, and overview of toxic compounds.

Cheng, L. Y., Chiang, W. C., Tang, C. C., and Young, T. H. (1980)
Industrial Toxicology, 2nd ed.
Lun-Yin Publishing Co., Taipei

This book provides general information for the diagnosis and control of occupational diseases, toxicology of heavy metals, toxicology of certain toxic organic compounds, pesticides, and solvents, and biohazards of radiation and biological preparations.

Cheng, P. K. (1989)
Nuclear Radiation and Detection
Asian-Eastern Book Co., Taipei

This book discusses several important aspects of radiation hazards, namely radiation protection, interaction of ionizing radiation with the biosphere, radiodetector, scintillation detection, semiconductance detection, and nucleonics.

Chinese Occupational Medical Association (1981)
Concise Occupational Medicine and Guidance for Diagnosis
COMA, Taipei

This book provides general descriptions of the symptoms of occupational diseases and their treatments.

Chueng, J. Y. (1995)
Essentials in the Protection of Public Health
Shu-Shing Publishing Co., Ltd., Taipei

This book is a concise treatise on the protection of public health. The book covers various areas of environmental sciences: environmental protection, public hazards, environmental assessment, air pollution protection, odor control, water protection, noise control, waste management, and global environmental protection.

Horng, K. C., Yang, M. T., and Tseng, C. M. (1994)
Industrial Safety and Health/Management and Practice
Yang-Chih Book Co., Ltd., Taipei

This book is a comprehensive treatise on industrial safety and health. Several areas of this discipline are covered, including the role of labor safety inspection, management system, self-safety examination, educa-

tion and training, physical examination, occupational hazards, and occupational safety.

Lee, C. Y., Ouyang, C., and Chang, C. C. (1973)
Snake Venoms
The Pharmacological Institute, College of Medicine, National Taiwan University, Taipei

This book is a collection of original papers dealing with the chemistry and pharmacology of snake venoms from Elapidae, Crotalidae, and Viperidae. The polypeptide neurotoxins and cardiotoxins from these venoms have been extensively investigated. The contribution of snake venom toxin for characterization of cholinergic receptor protein has been described. This book is certainly an indispensable reference for snake venom investigators.

Lee, Y.J. (1995)
Environmental Attitudes and Environmental Protection Behavior—Theory & Practice
Architectural Information Magazine, Ltd., Taipei

This book gives a detailed analysis on the environmental problems arising from the general population. The emphasis of this treatise is focused on environmental behavior, environmental policy, resident attitudes, and expert opinion.

Li, F.P. (1984)
Analytical Methods of Pesticides
Plant Protection Center, Taichung

Applicable TLC, HPLC, GLC, and various spectrophotometric methods are described for analysis of 86 popular formulated pesticides.

Liao, C. F. (Ed.) (1984)
***Essentials in American Food Inspection, Drug and Food Series,* No. 5.**
Food and Drug Bureau, Department of Health, Executive Yuan, Taipei

This book introduces the systems, principles, methods, and procedures of American food inspection.

Lin, J. K. (Ed.) (1975)
Cancer: The Tough Enemy of Mankind
Science Monthly, Taipei

This book concisely introduces the concepts of environmental carcinogenesis, analytical cancer epidemiology, mechanisms of carcinogen activation, cancer chemotherapy, and the importance of cancer prevention.

Lin, J. K. (1994)
Food and Cancer
Lien-Jing Publishing Co., Taipei

This book is written in Chinese and aimed at laypeople. A systematic discussion on the role of dietary factors in the etiology of human cancer is given. The intimate association of some dietary factor with the high incidence of human cancers is described. The importance of some anticancer factors in the daily diet is also described. The concept that reactive oxygen species may play important roles in the development of cancer, cardiovascular diseases, and aging is illustrated. This book has received the Golden Tripod Award from the Bureau of Cultural Communication, Executive Yuan, Republic of China.

Lin, J. K. (1995)
Biochemical Mechanisms of Carcinogenesis and Anticarcinogenesis
Laboratory for Cancer Research, Institute of Biochemistry, College of Medicine, National Taiwan University, Taipei

This book is a collection of original papers dealing with the biochemical and molecular mechanisms of carcinogenesis and anticarcinogenesis. The collection comprises four parts; analytical methods for cancer research, naturally occurring amines and N-nitroso compounds in environmental carcinogenesis, molecular mechanisms of chemical carcinogenesis, and biochemical and molecular mechanisms of anticarcinogenesis and cancer chemoprevention.

Lin, J. K. (1995)
Genetic Engineering and Cancer Medicine
Lien-Jing Publishing Co., Taipei

This book is a collection of 34 comprehensive papers dealing with the new developments in genetic engineering and cancer medicine. It is written in Chinese and aimed especially at high school and college students who are not majoring in medicine. The research works and contributions made by several Nobel prize winners are described. The evolutionary development of recombinant DNA technology in biomedical sciences is systematically introduced and discussed.

Lin-Shiau, S. Y. (1993)
Biochemical Pharmacology
Lien-Jing Publishing Co., Taipei

This book is written in Chinese and describes the biochemical and molecular mechanisms of drug actions. It seems that many drugs are inhibitors of signal transduction pathways. Recent developments in drug receptor biology and biochemistry are described. Furthermore, the molecular mechanisms of the toxicity induced by several drugs are concisely discussed.

Lin-Shiau, S. Y. (1995)
Modern Concepts in Biochemical Pharmacology
Lien-Jing Publishing Co., Taipei

This book is a collection of papers dealing with the toxicity and action mechanisms of several drugs. All papers are written in Chinese and suitable for laypeople.

Miao, S. L., Liu, Y. C., and Liu, C. Y. (1995)
Environmental Science Dictionary
Fishery Product Publishing Co., Taipei

This dictionary is a comprehensive treatise written in Chinese. It provides general information on environmental sciences. The contents include introduction to environmental sciences, environmental pollution and hazard, environmental protection, environmental assessment and monitoring, and environmental protection and management.

National Science Council (1985)
Collected Abstracts on Environmental Toxicology
National Science Council, Executive Yuan, Taipei

This booklet contains 29 abstracts dealing with various aspects of environmental toxicology and providing general information on the biological significance of air, water, ground, and food contaminants. These papers were presented by both American and Chinese scientists in the binational seminar on environmental toxicology, sponsored by the Coordination Council of North American Affairs and the American Institute in Taiwan, March 26–April 2, 1985.

Teng, W. C. (1996)
Biotechnology
Chiow-Chow Book Co., Ltd., Taipei

This book describes recent developments in biotechnology with special emphasis on the practical aspects of medical products, food supplements, agricultural products, energy products, gasoline derivatives, and new products used in pollution control.

Tsai, Y. M. (1993)
Modern Safety Management
Yang-Chih Book Co., Ltd., Taipei

This book covers the following areas: safety management, industrial hygiene, safety control, and psychology and behavior.

Tseng, H. H. (Ed.) (1983)
***Bacterial Food Poisoning, Drug and Food Series,* No. 2**
Food and Drug Bureau, Department of Health, Executive Yuan, Taipei

This book describes types of food poisoning, routes of pathogenic infection, and methods of prevention.

Tseng, H. H. (Ed.) (1984)
***Essentials in Food-Borne Diseases, Drug and Food Series,* No. 6**
Food and Drug Bureau, Department of Health, Executive Yuan, Taipei

In this book, food-borne diseases are systematically classified and discussed as follows: microbial diseases, parasitic diseases, fungal diseases, plant toxin-induced diseases, animal toxin-induced diseases, and toxic chemical-induced diseases.

Yu, L. T. (Ed.) (1983)
Handbook of Veterinary Drugs in the Republic of China
Veterinary Science Bimonthly, Taipei

This handbook covers 4066 imported drugs and 5898 homemade remedies that are generally used in the Republic of China. In each entry, a full description of its Chinese name, English name, composition, packaging, name of manufacturer, and the name of importer is given. For some items, a brief description of pharmacological properties is provided.

Yue, S. T., Chiou, L. H., and Loo, L. C. (1983)
***Drug Safety, Drug and Food Series,* No. 4**
Food and Drug Bureau, Department of Health, Executive Yuan, Taipei

This book contains 33 short papers describing the side effects of commonly used drugs. Such chronic toxicities as carcinogenicity, teratogenicity, and neurotoxicity of drugs are also described.

JOURNALS

Annual Report on the Prevention of Industrial Pollution (1971–)
Technological Instruction Group, Prevention of Industrial Pollution, Department of Economics, Executive Yuan, Taipei

The annual report publishes papers dealing with environmental protection, pollution prevention technology, control of toxic compound contaminants, new technology, and legislative information.

Annual Research and Inspection Report (1981–)
Food and Drug Bureau, Department of Health, Executive Yuan, Taipei

There are two kinds of papers published in this annual report: original research papers dealing with the methods of food and drug analysis and survey reports on the sanitary condition of foods and the active ingredients in the marketing of drug preparations.

Journal of Chinese Oncology Society (1984–)
Chinese Oncology Society, Taipei

This journal generally publishes papers dealing with cancer research, but sometimes it also publishes papers concerning toxicology.

Journal of Food and Drug Analysis (1992–)
National Laboratories of Foods and Drugs, Department of Health, Executive Yuan, Taipei

This journal publishes papers dealing with drug and food analysis. Papers describing the toxicities of drugs are also included.

Journal of Formosan Medical Association (1901–)
Formosan Medical Association, Taipei

This journal publishes papers dealing with clinical medical sciences, but occasionally it also publishes papers relating to toxicology.

Journal of Occupational Safety and Health (1992–)
Institute of Occupational Safety and health, Council of Labor Affairs, Executive Yuan, Taipei

This journal publishes papers covering the area of occupational safety and labor affairs. Original research papers are preferable, but condensed reports from research projects are sometimes acceptable.

Newsletter on Drug and Food (1970–)
Food and Drug Bureau, Department of Health, Executive Yuan, Taipei

This newsletter covers various aspects of drug and food inspection, namely, updated information on the development of drug and food analysis, side effects of drugs, toxic contaminants of foods, toxicological implication in drug metabolism, and new systems of drug and food control.

Newsletter on Occupational Safety and Health (1993–)
Institute of Occupational Safety and Health, Council of Labor Affairs, Executive Yuan, Taipei

This newsletter is a short communication among the workers in the industries and research institutes. Most news and announcements from the government are also included.

Newsletter on Science & Technology of Environmental Protection (1987–)
Committee for Environmental Sciences, National Science Council, Executive Yuan, Taipei

This newsletter reports the research and developments of the environmental sciences. Research papers dealing with environmental pollution and toxicant analysis are included.

The NTUH Drug Bulletin (1979–)
Department of Pharmacy, National Taiwan University Hospital, Taipei

This bulletin publishes abstracts selected from all kinds of medical journals and emphasizes the pharmacological and toxicological aspects of drugs.

Yearbook on Environmental Protection (1983–)
Bureau of Environmental Protection, Executive Yuan, Taipei

A general report on the progress, accomplishments, and ongoing projects of the Bureau of Environmental Protection during the previous fiscal year.

ORGANIZATIONS

Bureau of Environmental Protection
Department of Health, Executive Yuan, Taipei

This is a national poison control network for air pollution, environmental control, and industrial sanitation. Similar organizations are also set up in the city and provincial governments.

Food and Drug Bureau
Department of Health, Executive Yuan, Taipei

This is a governmental organization for food and drug inspection. The main role of this laboratory is to provide instrumental analysis and laboratory detection of chemical toxicants and biological toxins. National surveys on the concentrations of food additives in marketed foods are performed frequently.

Graduate Institute of Toxicology, College of Medicine, National Taiwan University
No. 1, Section 1, Jen-ai Road, Taipei

Six faculties whose research activities focus on air pollution, heavy metal toxicities, carcinogenicity of environmental toxicants, and cytochrome p450-mediated metabolism of environmental compounds.

Institute of Biochemistry, College of Medicine, National Taiwan University
No. 1, Section 1, Jen-ai Road, Taipei

Twelve faculties whose research activities emphasize environmental toxicology, chemical carcinogenesis, cancer chemoprevention, mutagen detection, mycotoxins, toxic proteins, and nutrition. The mechanisms of chemical activation of mutagens and carcinogens are investigated in microbial and mammalian cell systems. New mutagen testing methods have been developed by empolying the new tester strains of *Salmonella typhimurium* JK-1 and JK-2.

Institute of Public Health, College of Public Health, National Taiwan University
No. 1, Section 1, Jen-ai Road, Taipei

Sixteen faculties, some of which are involved in occupational diseases and environmental toxicology research.

Pharmacological Institute, College of Medicine, National Taiwan University
No. 1, Section 1, Jen-ai Road, Taipei

Eleven faculties whose research activities emphasize the pharmacological and toxicological actions of snake toxins. Various neurotoxins and cardiotoxins from snake venoms are isolated and their interactions with nervous transmission mechanisms are investigated at organismic, cellular, and molecular levels. The interaction of metal ions with the toxicity of snake toxins is also investigated. The immunotoxicity of heavy metal ions in neutrophils and macrophages is explored.

Taiwan Agricultural Chemicals and Toxic Substances Research Institute
No. 189, Chung Cheng Road, Wu-feng, Taichung Hsien

The objectives of this institute are to provide technical assistance to government in reinforcing pesticide regulations, to aid the pesticide industry technically to improve quality and reduce production costs, and to develop safe, economic, and effective ways of applying pesticides.

Toxicological Laboratory, Department of Forensic Medicine, College of Medicine, National Taiwan University Hospital
No. 1, Section 1, Jen-ai Road, Taipei

Six faculties whose research activities focus on pesticide intoxication and alcohol addiction. The analytical method for paraquat poisoning has been developed. Consultation on the side effects of drugs is provided.

The Toxicology Unit at Taipei Veterans General Hospital
No. 201, Section 2, Su-pi Road, Taipei

The ongoing toxicology programs in the unit are clinical consultations and patient care, clinical toxicology laboratory service, and poison and drug consultation center.

GRADUATE SCHOOLS

Biochemistry, National Yang-Ming Medical College
Su-Pi Road, Taipei
Degree: MS and PhD in biochemistry

The Graduate Institute of Clinical Medicine, College of Medicine, National Taiwan University
No. 1, Section 1, Jen-ai Road, Taipei
Degree: PhD in medical science

The Graduate Institute of Medicine, Chung-San Medical College
Da-Ching Street, Taichung, Taiwan
Degree: MS in medical science

The Graduate Institute of Medicine, Kao-hsiung Medical College
Su-Chuen-1-road, Kao-hsiung, Taiwan
Degree: MS and PhD in medical science

The Graduate Institute of Medicine, Taipei Medical College
Wu-Sing Street, Taipei
Degree: MS in medical science

Graduate Institute of Toxicology, College of Medicine, National Taiwan University
No. 1, Section 1, Jen-ai Road, Taipei
Degree: MS and PhD in toxicology

Institute of Biochemistry, College of Medicine, National Taiwan University
No. 1, Section 1, Jen-ai Road, Taipei
Degree: MS and PhD in biochemistry

Institute of Pharmaceutical Sciences, College of Medicine, National Taiwan University
No. 1, Section 1, Jen-ai Road, Taipei
Degree: MS and PhD in pharmaceutical science

Institute of Public Health, College of Public Health, National Taiwan University
No. 1, Section 1, Jen-ai Road, Taipei
Degree: MS and PhD in public health

Pharmacological Institute, College of Medicine, National Taiwan University
No. 1, Section 1, Jen-Ai Road, Taipei
Degree: MS and PhD in pharmacology

United Kingdom

CLAIRE STEED AND CARON HARTLEY

This is an interesting period for toxicology regulation and information in the United Kingdom. The European Union (EU) is playing an increasingly important role for example, with biotechnology playing an increasing part in introducing novel foods and products, regulators and assessors are having to modernize their outlook to take account of these changes.

ORGANIZATIONS

The following organizations are involved in the research into new chemicals which may be of benefit to consumers.

Beecham Pharmaceutical
Research Division
New Frontiers Science Park
Third Avenue
Harlow
Essex CM19 5AW

The Boots Company Plc.
Pennyfoot Street
Nottingham NG2 3AA

BP Research Centre
Occupational Health Unit
Chertsey Road
Sunbury-on-Thames
Middlesex TW16 7LN

Ciba Pharmaceuticals
Stamford Lodge
Altrincham Road
Wilmslow
Cheshire SK9 4LY

Fisons Plc.
Bakewell Road
Loughborough
Leicester AE11 0RH

Glaxo Wellcome
Research and Development
891-995 Greenford Road
Greenford
Middlesex UB6 0HE

Hoescht Marion Roussel
Walton Manor
Walton
Milton Keynes
Bucks MK7 7AJ

Imperial Chemical Industries Plc.
Central Toxicology Laboratory
Alderley Park
Nr Macclesfield
Cheshire SK10 4TJ

Lilly Research Centre
Erl Wood Manor
Windelsham
Surrey GU20 6PH

May & Baker Ltd.
Rainham Road South
Dagenham
Essex RM10 7XS

Pfizer Ltd.
Ramsgate Road
Sandwich
Kent CT13 9NJ

Proctor & Gamble
Newcastle Technical Centre
Whitley Road
Longbenton
Newcastle-upon-Tyne NE12 9TS

Roche Products Ltd.
40 Broadwater Road
Welwyn Garden City
Herts AL7 3AY

Shell Research Ltd.
Thornton Research Centre
Poole Lane
Ince
Chester
Cheshire CH1 3SH

Smith & Nephew Group Research Centre
York Science Park
Heslington
York YO1 5DF

Smithkline Beecham Pharmaceuticals UK
Mundells
Welwyn Garden City
Herts AL7 1EY

Unilever Environmental Safety Laboratory
Colworth House
Sharnbrook
Bedfordshire MK44 1LQ

Wyeth Laboratories
Huntercombe Lane South
Taplow
Maidenhead
Berks SL6 0PH

TESTING LABORATORIES

Laboratory of the Government Chemist
Queen's Road
Teddington
Middlesex TW11 0LY

Royal Marsden Hospital
Fulham Road
London SW3 6JJ

Water Research Centre Plc.
Huntercombe Lane South
Taplow
Maidenhead
Berks SL6 0PH

POISON CONTROL CENTERS

Poison control centers provide advice to medical professionals and members of the public on whether various substances are hazardous to health, including after a person has come into contact with a substance or if they are likely to be exposed to a chemical.

Medical Toxicology Unit
Avonley Road
New Cross
London SE14 5ER

Regional Drug and Poisons Information Service
Leeds General Infirmary
Great George Street
Leeds
West Yorkshire LS1 3EX

Regional Drug and Poisons Information Service
The Royal Hospitals
Belfast BT12 6BA

Regional Drug and Therapeutics Centre
Wolfson Unit
Claremont Place
Newcastle-upon-Tyne NE1 4LP

Scottish Poisons Information Bureau
The Royal Infirmary NHS Trust
Edinburgh
Midlothian EH3 9YW

Welsh National Poisons Unit
Ward West 5
Llandough Hospital
Penarth
Cardiff
South Glamorgan CF6 1XX

West Midlands Poisons Unit
City Hospital NHS Trust
Dudley Road
Birmingham B18 7QH

PROFESSIONAL ASSOCIATIONS

These bodies provide a focal point for toxicology professionals in the United Kingdom. They arrange meetings and publish journals and books to keep toxicologists up to date with changes in methods, techniques, and advances in the subject allowing for continuing professional development.

British Toxicology Society
c/o Institute of Biology
20 Queensbury Place
London SW7 2DZ

The Fund for the Replacement of Animals in Medical Experiments (FRAME)
Russell & Burch House
96-98 North Sherwood Street
Nottingham NG1 4EE

Institute of Biology
20 Queensbury Place
London SW7 2DZ

The Royal College of Pathologists
2 Carlton House Terrace
London SW1Y 5AF

Royal Pharmaceutical Society of Great Britain
1 Lambeth High Street
London SE1 7JN

Royal Society of Chemistry
Burlington House
Piccadilly
London W1V 0BN

The Royal Society of Medicine
1 Wimpole Street
London W1M 8AE

LIBRARIES

The following is a list of the most important providers of information pertaining to toxicology in the United Kingdom. They are able to provide articles from journals, serials, and books. Some may also offer a literature searching service.

Aberdeen University
Department of Environment and Occupational Medicine
University Medical School
Foresterhill
Aberdeen
Grampian AB9 2ZD

Association of Public Analysts
342 Coleford Road
Sheffield
South Yorkshire S9 5PH

BIBRA Toxicology International
Woodmansterne Road
Carshalton
Surrey SM5 4DS

BIBRA was founded jointly by industry and government in 1960 to promote research in toxicology. BIBRA is now an independent research organization financed by membership subscriptions, research grants, and contracts. It is an internationally recognized center for biological research and offers extensive advisory, consultative, and experimental services in numerous fields relevant to human health and safety. In January 1995, an alliance was launched between BIBRA and the Central Science Laboratory, an executive agency of MAFF, to exploit the complementary scientific expertise of the two organizations.

The British Library Document Supply Centre
Boston Spa
Wetherby
West Yorkshire LS23 7BQ

The British Medical Association
Nuffield Library
BMA House
Tavistock Square
London WC1H 9JP

Environment Protection Library
Room P3/001A
Romney House
2 Marsham Street
London SW1P 3EB

Fisons Plc. Pharmaceutical Division
Library and Information Department
R&D Laboratories
Bakewell Road
Loughborough
Leicestershire LE11 0RH

Forensic Science Service
Aldermaston
Reading
Berkshire RG7 4PN

The Health Aspects of Environment and Food Library
Department of Health
Room 530B Skipton House
80 London Road
London SE1 6LW

Hoescht–Roussel Pharmaceuticals Ltd.
Kingfisher Drive
Covingham
Swindon
Wiltshire SN3 5BZ

Huntingdon Research Centre
Huntingdon
Cambridgeshire PE18 6ES

ICI Central Toxicology Laboratory
Alderley Park
Macclesfied
Cheshire SK10 4TJ

Inveresk Research International
Elphinstone Research Centre
Fleets Road
Elphinstone
By Tranent
East Lothian EH33 2NE

Medical Toxicology Unit
Avonley Road
New Cross
London SE14 5ER

Medicines Control Agency Information Centre
Room 1208
Market Towers
Nine Elms Lane
London SW8 5NO

Merck, Sharp and Dohme Ltd.
Hertford Road
Hoddesdon
Hertfordshire EN11 9BU

Paint Research Association
Waldegrave Road
Teddington
Middlesex TW11 8LD

Reckitt & Coleman Products
Business Intelligence Unit
Dansom Lane
Hull
North Humberside HU8 7DS

The Royal Pharmaceutical Society of Great Britain
1 Lambeth High Street
London SE1 7JN

The Royal Pharmaceutical Society of Great Britain, Scotland
36 York Place
Edinburgh EH1 3HU

The Royal Society of Medicine
1 Wimpole Street
London W1M 8AE

Schering Agrochemicals Ltd.
Chesterford Park Research Station
Saffron Walden
Essex CB10 1XL

Smithkline Beecham Pharmaceuticals
Research & Development
The Frythe
Welwyn Garden City
Hertfordshire AL6 9AR

South West Water Services
Peninsula House
Rydon Lane
Exeter EX2 7HR

Sterling Winthrop Pharmaceuticals Research Division
Willowburn Avenue
Alnwick
Northumberland NE66 2JH

Surrey University
George Edwards Library
Guildford
Surrey GU2 5XH

WRC Medmenham
P.O. Box 16
Henley Road
Medmenham
Marlow
Buckinghamshire SL7 2HD

Yorkshire Water Services Ltd.
P.O. Box 201
Broadacre House
Vicar Lane
Bradford BD1 5PZ

ELECTRONIC INFORMATION SOURCES

The following is a list of electronic information sources available as CD-ROMs, via online hosts, or as programs for the personal computer.

Chemdata

Producer: AEA Technology, National Chemical Emergency Centre
Hosts/format: diskette
Time span: current

Chemical Safety Newsbase (CSNB)

Producer: Royal Society of Chemistry
Hosts/format: DATASTAR, DIALOG, ORBIT, QUESTEL, STN International, diskette Time span: 1981–

Derwent Crop Protection File (PESTDOC)

Producer: Derwent Information Ltd.
Hosts/format: ORBIT, QUESTEL, STN International, DATASTAR
Time span: 1968–

Derwent Crop Protection Registry

Producer: Derwent Information Ltd.
Hosts/format: ORBIT, QUESTEL
Time span: 1985–

DHSS-HEF

Producer: Department of Health
Hosts/format: DATASTAR
Time span: 1984–1993

Hazdata

Producer: AEA Technology, National Chemical Emergency Centre
Hosts/format: diskette
Time span: current

HSE-LINE

Producer: Health and Safety Executive
Hosts/format: DATASTAR, ORBIT, QUESTEL, CD-ROM
Time span: 1977–

PolTox III: CAB

Producer: CAB International
Hosts/format: CD-ROM
Time span: 1983–

Public Health and Tropical Medicine Data Base

Producer: CAB International, Bureau of Hygiene and Tropical Diseases
Hosts/format: DIMDI
Time span: 1984–

SIGLE—System for Information on Grey Literature in Europe

Producer: European Association for Grey Literature in Europe
Hosts/format: BLAISE-LINE, STN
Time span: 1980–

TOXBASE

Producer: Scottish Poisons Information Bureau
Hosts/format: Scottish Poisons Information Bureau
Time span: 1983–

TRAINING COURSES

Undergraduate Courses

Anglia University, Cambridge Campus

BSc (Hons) in environmental toxicology
Three-Year modular course

John Moores University, Liverpool

BSc (Hons) in applied biochemistry with toxicology
Three years or 4-year sandwich course

The School of Pharmacy, University of London
Toxicology Department
School of Pharmacy
29/39 Brunswick Square
London WC1N 1AX

BSc (Hons) in toxicology and pharmacology
Four-year sandwich course

University of Aberdeen
Department of Pharmacology
Marischal College
Aberdeen AB9 1AS

BSc (Hons) in pharmacology with toxicology
Four Years

University of East London
Division of Physiology and Pharmacology
London E15

BSc (Hons) in pharmacology
Three Years part-time (day release)

University of Hull
Department of Chemistry
Hull HU6 7RX

BSc in chemistry with analytical chemistry and toxicology
BSc in chemistry with bioorganic chemistry and toxicology
Three Years or 4-year sandwich course

University of Surrey
Department of Biochemistry
Guildford
Surrey GU5 2XH

BSc (Hons) in biochemistry (toxicology)
Four-year sandwich course

Postgraduate Courses

Brunel University, West London
Department of Biology
Uxbridge
Middlesex UB8 3PH

MSc in environmental pollution science
One year (or 2 years part-time)

Kings College London
Department of Biochemistry
The Strand
London WC2R 2LS

MSc in forensic science (1 term of toxicology)
One year

Newcastle University
Department of Occupational Health and Hygiene
Framlington Place
Newcastle upon Tyne NE2 4HH

MSc in occupational hygiene
One year

Royal Postgraduate Medical School University of London
Department of Clinical Pharmacology or Department of Histopathology
Du Cane Road
London W12 0NN

MSc in experimental pathology (toxicology)
One year

University of Birmingham
School of Biochemistry
P.O. Box 363
Birmingham B15 2TT

MSc in toxicology
MSc in occupational hygiene
One year or 2 years part-time

University College of Swansea
Department of Genetics
School of Biological Sciences
Singelton Park
Swansea SAC 8PP

MSc in Genetic Toxicology
One year

University of Glasgow
Department of Forensic Medicine and Science
8 University Gardens
Glasgow G12 8QQ

Diploma in forensic toxicology
One year
MSc in forensic toxicology
Two years (diploma in first year)

University of Hertfordshire, Hatfield
Division of Biological Sciences
Hatfield
Hertfordshire AL10 9AB

MSc in pharmacological biochemistry
Two years part-time

University of Leicester
Department of Pathology
Clinical Sciences Building
Leicester Royal Infirmary
P.O. Box 65
Leicester LE2 7LX

MSc in molecular pathology and toxicology

University of Portsmouth
School of Biological Sciences
Portsmouth

MSc in applied toxicology
One year

University of Strathclyde, Glasgow
Forensic Science Unit
204 George Square
Glasgow G1 1XW

MSc in forensic science
One year

University of Surrey
Department of Biochemistry
Guildford
Surrey GU5 2XH

MSc in toxicology
One year

Part-Time and Short Courses

Anglia University, Cambridge Campus

MSc in biomedical science
Three core modules and three specialist modules in toxicology
Two year part-time/day release

British Industrial Biological Research Association
Woodmansterne Road
Carshalton
Sutton
Surrey

Various short courses

North East Surrey College of Technology (NESCOT)
School of Applied Physiology
Faculty of Science and Technology
NESCOT
Reigate Road
Ewell
Epsom
Surrey KT 27 3DS

Advanced course following the syllabus for DIBT of Institute of Biology
Two years part-time

The Robens Institute, University of Surrey, Surrey
Course Administrator
Robens Institute
University of Surrey
Guildford
Surrey GU2 5XH

Modular training programme in toxicology
Each module lasts 5 days and leads to a postgraduate certificate in applied toxicology
Completion of 12 modules leads to postgraduate diploma in applied toxicology
Completion of 12 modules and a thesis or equivalent leads to an MSc in applied toxicology

St. Bartholomews Hospital Medical College, University of London
DH Department of Toxicology
Dominion House
59 Bartholomews Close
London EC1A 7ED

Advanced and foundation courses in toxicology
30 weeks part time
Principles of industrial toxicology: 120 hours full time
Risk assessment in toxicology: 40 hours full time
Toxicology and the clinic: 20 hours full time

Laboratory animal pathology and toxicology: 20 hours full time

University of Birmingham
School of Biochemistry
P.O. Box 363
Birmingham B15 2TT

Diploma in toxicological studies
Nine months
Various modular courses (5 weeks)

University College of Swansea
Department of Genetics
School of Biological Sciences
Singelton Park
Swansea SA2 8PP

Diploma in genetic toxicology
Nine months

University College, University of London
Department of Clinical Pharmacology
The Rayne Institute
5 University Street
London WC1E 6JJ

Various short courses

University of East London
Division of Physiology and Pharmacology
London E15

MSc in pharmacology
Two years part-time (day release)

University of Greenwich, London
School of Chemistry
Wellington Street
Woolwich
London SE18 6PF

MSc in chemical analysis (major in toxicology)
Seven terms part-time (2 or 3) years

University of Strathclyde, Glasgow
Forensic Science Unit
204 George Square
Glasgow G1 1XW

Diploma in forensic science
Nine months

Advanced Qualifications in Toxicology

There are two advanced qualifications in toxicology available in the United Kingdom. Theses are awarded by the Royal College of Pathologists and the Institute of Biology, respectively. Both require a number of years of relevant experience, evidence of a substantial contribution to toxicology in the form of research or equivalent, and a written and oral examination.

LEGISLATION

Novel Foods

Novel foods are foods or food ingredients which have not hitherto been consumed to a significant degree in the United Kingdom and/or have been produced by extensively modified or entirely new food production processes. A voluntary scheme for the safety assessment of novel foods currently operates in the United Kingdom with the safety assessments being carried out by the Advisory Committee on Novel Foods and Process (ACNFP).

A European Communities Regulation on Novel Foods and Food Ingredients puts the safety assessment of novel foods on a statutory footing. Under this scheme the ACNFP will still provide advice on the safety assessment of novel foods.

Pesticides

Pesticides are controlled under the *Food and Environmental Protection Act 1985 (FEPA)* and through the *Control of Pesticides Regulations 1986 (COPR)*. These regulations give ministers the power to control the import, sale, supply, storage, use, and advertisement of pesticides; to make information supplied in connection with the control of pesticides available to the public; and to enforce these provisions with powers of seizure, disposal, or remedial action. Under *FEPA* ministerial approval must be obtained from five government departments before a pesticide may be legally supplied, stored, or used. The pesticides fall into two types—agricultural and nonagricultural. The Pesticides Safety Directorate is the regulatory authority for agricultural pesticides. The Health and Safety Executive is the regulatory authority for nonagricultural pesticides. The statutory Advisory Committee on Pesticides, an independent body of scientific experts, provides advice on the safety assessment of all types of pesticides.

Food Contact Materials

Legislation exists to protect human health from any potentially harmful substances that might migrate from food packaging into food. The framework provisions are set out in the *Materials and Articles in Contact*

with Food Regulations 1987 (FCM) S.I. No. 1523 as amended by the *Food Safety Act 1990 S.I. No. 2487*. The Committee on Toxicity of Chemicals in Food, Consumer Products, and the Environment has provided the Department of Health with independent expert advice on the safety of food contact materials. Generally, the greater the extent of migration of chemical from packaging into food, the more toxicity information will be required.

Cosmetic Products

Cosmetic products are covered by an EU directive which was implemented in the United Kingdom as *The Cosmetic Products (Safety) Regulations* included in the *Consumer Protection Act*. The description ''cosmetic'' covers considerably more than merely decorative products and includes soaps, shampoos, toothpastes, deodorants, and sunscreens. There is no requirement for prior approval of products by any regulatory authority (unlike pesticides, for example).

There is a general requirement on suppliers that a cosmetic product should not be liable to cause damage to human health when it is applied under normal conditions of use. In addition, there are permitted lists of certain categories of ingredient for which only listed compounds can be used. In order for a compound to be included on these lists a package of toxicity data has to be provided to the expert European committee established by the European Commission (EC) under the terms of the Cosmetic Directive to provide expert advice in this area. The implementing United Kingdom regulations give lists of these compounds and they are update yearly. In addition, the EC directive gives a list of substances prohibited from use in cosmetics and substances which cosmetic products may only contain if the restrictions stated in the directive are observed.

Veterinary Products

The Veterinary Medicines Directorate takes the lead on toxicity relating to veterinary products and control of veterinary drugs mainly by the *Medicines Act 1968* in conjunction with EU legislation, principally the *Maximum Residue Levels Regulation 2377/90/EEC*. Animal feed additives are controlled by EU Directive *70/524* as converted into United Kingdom legislation.

GOVERNMENT DEPARTMENTS

The following is a list of government departments and agencies. If you are addressing a query to one of them, please state the general nature of the query on the envelope and it should be directed to the unit best suited to answer it.

Department of the Environment
2 Marsham Street
London SW1P 3EB

Department of Health
Skipton House
80 London Road
London SE1 6LW

Environment Agency
Hampton House
20 Albert Embankment
London SE1 3DY

Health and Safety Executive
Rose Court
Southwark Bridge Road
London SE1 9HS

Medicines Control Agency
Market Towers
1 Nine Elms Lane
London SW8

Ministry of Agriculture Fisheries and Food
Nobel House
17 Smith Square
London SW1P 3HX

Veterinary Medicines Directorate
Woodham Lane
New Haw
Addelstone
Surrey KT15 3NB

Uruguay

M. BURGER

BOOKS

Fogel, E., Burger, M., *et al.* (1992)
Patologia Toxicologica *(Pregrade Toxicology)*
Ed. Oficina del Libro AEM, Montevideo

Subjects include general concepts, symptoms, and treatments of poisoning. Nineteen chapters covering drugs, psychoactive drugs, drug abuse, analgesics, cardiovascular drugs, pesticides, metals, household products, food poisonings, plants and animal venoms, and analytical toxicology for toxicology emergencies. This book is oriented toward medical students.

Pronczuk, J., and Laborde, A. (1987)
Plantas Silvestres y (de) Cultivo. Riesgo de Intoxication Para el Hombre
Ed. Universidad de la Republica, Montevideo

Subjects include active ingredients of the principal plants causing poisonings in Uruguay, with photographs and a summary of statistical cases registered in the Poison Control Centre of Montevideo. This book helps medical toxicologists in the diagnosis of plant poisoning.

Burger, M., *et al.* (1989)
Plaguicidas en Medio Ambiente: Criterios de Riesgo
Ed. Universidad de la Republica, Montevideo

Emphasizes the groups of pesticides frequently used in Uruguay, in a special geographic area, Cuenca del Rio Santa Lucia. It provides the risk criteria to indicate which pesticides to study in soil water, and biota. This book is of use to environmental toxicologists.

DATA BANKS

Centro de Information y Asesoramiento Toxicologico (CIAT)
Poison Control Centre
Hospital de Clinicas ''Dr. Manuel Quintela'', Piso 7
Montevideo, C. P. 11600
Phone: 487 40 00, #1722 (emergency)
Fax: 598 2 487 0300
e-mail: hcciat@hc.edu.uy

Poison Control Centre uses several card indexes that have accumulated during the past 20 years. Indexes contain information on drugs, chemical products, household products, animals, and plants. The centre also uses Micromedex (Poisindex—Tomes and Drugdex). The most important data bank in the Poison Control Centre in INTOX, a software from IPCS/WHO.

ORGANIZATION

Scientific Society

Sociedad Uruguaya de Toxiologia y Ecotoxicologia (SUTE)
Hospital de Clinicas, Avda. Italia S/N, Piso 7
Montevideo, C. P. 11600

SUTE was founded in 1980. It is a multidisciplinary organization whose members include physicians, chemists, veterinarians, biologists, biochemists, agronomic engineers, and pharmacists. SUTE organizes monthly meetings. The lectures cover a wide variety of toxicological topics. SUTE also published a periodical journal, *Toxicologia* (ISSN:0258-185X) between 1986 and 1989. It has ceased publication.

EDUCATION

At the University of Uruguay there are several training programs in toxicology. The Department of Toxicology of the medical school gives training courses for the community (workers and others). This department also gives a postgraduat course (3 years) in clinical toxicology and a training course for foreign physicians who come from Latin America for 9 months. The Department of Toxicology of the chemistry school gives a training course in analytical toxicology for the students of chemistry and biochemistry. The Department of Toxicology of the veterinary school also gives a training course in veterinary toxicology for the students. Forensic toxicology is taught by the medical school's Department of Legal Medicine to the medical students in a 1-week course.

SCHOOLS

Catedra de Toxicologia
Facultad de Veterinaria, Universidad de la Republica
A. Lasplaces 1550
Montevideo

Departmento de Toxicologia
Facultad de Medicina, Universidad de la Republica
Hospital de Clinicas, Avda. Italia S/N, Piso 7
Montevideo

Departmento de Toxicologia
Facultad de Quimica, Universidad de la Republica
Avda. Gral. Flores 2124
Montevideo

RESEARCH LABORATORIES

Ministerio de Ganaderia, Agricultura y Pesca (MGAP)
Dilave–Rubino

MGAP tests pesticide residues, metals, and other contaminants in food.

Laboratorio All-Quimia
Chana 2373
Montevideo

Laboratorio All-Quimia concentrates on toxicologic emergencies.

Poison Control Center—Laboratory
Centro de Informacion y Asesoramiento Toxicologico (CIAT)
Hospital de Clinicas, Avda. Italia S/N, Piso 7
Montevideo

LEGISLATION/REGULATIONS

Ministry of Agriculture (Ministerio de Ganaderia, Agricultura y Pesca; MGAP)
Constituyente 1476
Montevideo

Legislative action on control of pesticides.

Ministry of Environment (Ministerio de Vivienda, Ordenamiento Territorial y Medio Ambiente)
Zabala 1427
Montevideo

Legislative action in environmental contaminants.

Ministry of Health (Ministerio de Salud Publica; MSAP)
Av. 18 de Julio 1892,
Montevideo, C.P. Montevideo

Legislative action in control of drugs and household products.

Poison Control Center
Centro de Information y Asesoramiento Toxicologico (CIAT)
Hospital de Clinicas, Avda. Italia S/N, Piso 7
Montevideo, C.P. 11600

The center participates in the regulation of drugs and pesticides with the respective ministries.

APPENDIX

1

Glossary of Terms Used in Toxicology (IUPAC Recommendations 1993)

INTERNATIONAL UNION OF PURE AND APPLIED CHEMISTRY

http://www.iupac.org
Clinical Chemistry Division
Commission on Toxicology

SYNOPSIS

The glossary contains definitions and explanatory notes, if needed, for more than 1200 terms frequently used in the multidisciplinary field of toxicology. The glossary is compiled primarily for chemists who find themselves working in toxicology or requiring a knowledge of the subject, especially for hazard and risk assessment. Many medical terms are included because of their frequent occurrence in the toxicological literature and because chemists would not normally be expected to be familiar with them. There are two annexes, one containing a list of abbreviations used in toxicology and one containing a list of abbreviations used by international bodies and by legislation relevant to toxicology and chemical safety.

PREFACE

The International Union of Pure and Applied Chemistry (IUPAC) established a Commission on Toxicology, within the framework of the Clinical Chemistry Section, in 1973. Like other IUPAC bodies, the commission was concerned with promoting worldwide ''regulation, standardization, or codification'' in relevant areas of chemistry. Over the years, toxicology has grown rapidly. A need has been recognized for globally acceptable definitions of terms used in toxicology and ecotoxicology and this glossary was commissioned with the objective of fulfilling that need.

The glossary is compiled primarily for chemists who find themselves working in toxicology or requiring a knowledge of the subject. Faced with an extensive literature and terms that are not always defined in accessible dictionaries, newcomers to the subject may have great difficulty in obtaining the background knowledge essential for their work. Furthermore, many toxicologists, whose previous experience has been limited to clinical and experimental toxicology, now have to assess possible environmental effects of chemicals and need to understand terms used in ecotoxicology. Equally, specialists in ecotoxicology often lack knowledge of the terms used in clinical and experimental toxicology. There are also regulators and managers who have to interpret toxicological information and therefore need ready access to internationally accepted definitions of relevant terms in common use.

Satisfying the requirements of the various groups now concerned with the generation or use of toxicological knowledge is a wide remit, and hence the terms to be included in this glossary have come from many disciplines. Many medical terms are included because of their frequent occurrence in the toxicological literature and because chemists would not normally be expected to be familiar with them. Major epidemiological terms are included for the same reason. Specialists in these and other areas may believe that such terms can be omitted because they are well defined elsewhere. While this glossary may err on the side of including peripheral terms, it is believed that some redundancy

of content is preferable to the difficulties currently presented to a newcomer to toxicology in having to consult several dictionaries in order to get started in subject.

The definitions given in this glossary are believed to reflect current usage and no attempt has been made to introduce new or ''preferred'' definitions. Obsolete terms such as ''cytochrome P448'' have been included because they are to be found in scientific articles which still have relevance. For some entries, alternative definitions are given because significant differences in usage have been recognized between disciplines or even between different languages in which similar words to the English terms are used.

More people than we can name in the Acknowledgments have contributed to this glossary and we are grateful for all the contributions that have helped to improve each version that has been produced. Inevitably, there will still be flaws, but we hope that the final version will be sufficiently close to achieving the original objectives to justify the very widespread support that this working party has enjoyed.

ACKNOWLEDGMENTS

The active collaboration of Professor Paolo Preziosi, President of the International Union for Toxicology (IUTOX), and of Professor Norman Aldridge, together with the support of IUTOX in the compilation of this glossary, has been particularly welcome and greatly appreciated by the working party.

The working party was fortunate in having scientific support from the International Programme on Chemical Safety, the International Register of Potentially Toxic Chemicals, and the United Nations Environment Programme which allowed IUPAC to use published and unpublished material. The working party acknowledges the support of the Royal Society of Chemistry, London, in permitting the use in the original drafts of definitions from its books, *Toxic Hazard Assessment of Chemicals* and *Risk Assessment of Chemicals in the Environment*, both edited by M. L. Richardson. The Regional Office for Europe of the World Health Organization also generously permitted incorporation of definitions from Environmental Health Publication 10, *Environmental Toxicology and Ecotoxicology* (J. H. Duffus, Ed.). We are particularly grateful to Prof. J. M. Last, the International Epidemiological Association, and Oxford University Press for permission to quote definitions from *A Dictionary of Epidemiology*, 2nd ed. We are also grateful to the Association of Clinical Biochemists Scientific Committee which kindly reviewed a draft of the glossary and annotated it with their suggestions.

The working party exchanged information with the IUPAC Commission on Biotechnology and a number of terms are found in both this glossary and the ''Glossary of Terms Used in Biotechnology'' prepared by that commission. In addition, helpful comments were received from the Commission on Agricultural Chemistry and from other commissions, such as the Commission on Water Chemistry.

For the first draft, the working party received financial assistance from the European Community Directorate General XI and from Ashton-Tate Ltd. in the form of a gift of software. IUPAC made funds available for the second and third drafts. For the preparation of the second draft, grants were received from the National Rivers Authority—Thames Region and from Albright & Wilson (European headquarters).

For the preparation of the third draft and assistance in traveling and subsistence, the working party is indebted to the IUPAC Committee on Chemical Industry (COCI) for their support. Additionally, support, both financial and moral, was given by the member companies CIBA-GEIGY, Lonza, Hoffman–La Roche, and Sandoz and the permanent staff of ECETOC. General thanks for financial support are due to Betz, Procter and Gamble—Belgium, ICI Agro-chemicals, Houseman Speciality Chemicals, Monsanto, and Rohm & Haas Italia.

Finally, the preparation of the glossary would not have been feasible without the efforts of Pauline Sim, Principal of Gascoigne Secretarial Services, High Wycombe, GB, who typed the first three draft copies, was responsible for the original compilation in alphabetical order of terms from many sources, and typed the several hundred letters needed to get the project started.

NOTES FOR THE USER OF THIS GLOSSARY

In compiling this glossary, it became clear that toxicologists have not conformed to the rules laid down by IUPAC in their current practice. For example, one of the IUPAC rules about abbreviations is that they should not be used as symbols for physical quantities, but by long tradition toxicologists have used the abbreviation LD_{50} and related abbreviations in just this way. The compilers of this glossary have accepted the prevailing toxicological usage but this is not to be taken as an indication that it has their approval and they recommend that some attempt should be made to improve on current usage to bring it into line with IUPAC rules. Similarly, the compilers recommend that, contrary to much current usage, toxic components (like other chemically definable components) in doses, dosages, and exposures should be expressed as amounts of substance, substance concentration, substance content, or a time integral of one of these. Thus, for example,

a pesticide should be expressed as amount of substance and not as its mass, including binding agents and other ingredients nor its volume, including solvent.

There is a need for translations of such terms as ''absolute lethal concentration'' into the recommended format for clinical chemistry with component, system, and kind of quantity with parenthetic specifications of each as necessary. Thus, ''absolute lethal concentration in air'' might become ambient-air-toxicant substance concentration (number fraction of organisms killed = 1). There is also a need for a careful revision of symbolic practices to bring them into line with ISO-31 [e.g., *c* (d killed = 1) for absolute lethal concentration instead of LC_{100}].

Throughout the glossary the following abbreviations are used to indicate the relationships between terms:

AN	antonym, opposite
BT	broader term
NT	narrower term
PS	partial synonym
RT	related term
SN	exact synonym

ENTRIES

abiological See SN **abiotic**

abiotic Not associated with living organisms.
SN **abiological.**

abiotic transformation Process in which a substance in the environment is modified by nonbiological mechanisms.
IPCS (1989)
RT **biotransformation.**

absolute lethal concentration (LC_{100}) Lowest concentration of a substance in an environmental medium which kills 100% of test organisms or species under defined conditions. This value is dependent on the number of organisms used in its assessment.
WHO (1979)

absolute lethal dose (LD_{100}) Lowest amount of a substance which kills 100% of test animals under defined conditions. This value is dependent on the number of organisms used in its assessment.

absorbed dose (of radiation) Energy imparted to matter in a suitably small element of volume by ionizing radiation divided by the mass of that element of volume. The SI unit for absorbed dose is joule per kilogram (J kg^{-1}) and its special name is gray (Gy).
ISO (1972)
RT **ionizing radiation**

absorbed dose (of a substance) Amount of a substance absorbed into an organism or into organs and tissues of interest.

absorption (biological) Process of active or passive transport of a substance into an organism: In the case of a mammal or human being, this is usually through the lungs, gastrointestinal tract, or skin.

absorption (in colloid and surface chemistry) Process whereby, when two phases are brought into conact, a particular component is transferred from one phase to the other.
PAC (1972)

absorption (of radiation) Phenomenon in which radiation transfers some or all of its energy to matter which it traverses.
ISO (1972)

absorption coefficient (in biology) Ratio of the absorbed amount (uptake) of a substance to the administered amount (intake): For exposure by way of the respiratory tract, the coefficient is the ratio of the absorbed amount to the amount of the substance (usually particles) deposited (adsorbed) in the lungs.
IRPTC (1982)
RT **absorbed dose**
SN **absorption factor**

abuse (of drugs, substances, solvents, etc.) Improper use of drugs or other substances.
RT **''glue sniffing,'' solvent abuse,'' solvent sniffing''**

acaricide Substance intended to kill mites, ticks, or other Acaridae.

acceptable daily intake (ADI) Estimate of the amount of a substance in food or drinking water, expressed on a body mass basis (usually mg/kg body weight), which can be ingested daily over a lifetime by humans without appreciable health risk. For calculation of the daily intake per person, a standard body mass of 60 kg is used. ADI is normally used for food additives (tolerable daily intake is used for contaminants).
WHO (1991)
RT **tolerable daily intake**

acceptable daily intake (ADI) not allocated See SN **no acceptable daily intake allocated**

acceptable residue level of an antibiotic Acceptable concentration of a residue which has been established for an antibiotic found in human or animal foods.

acceptable risk Probability of suffering disease or injury which is considered to be sufficiently small to be ''negligible.''
PS **tolerable risk**
RT **accepted risk, negligible risk, risk *de minimis***

accepted risk Probability of suffering disease or injury which is accepted by an individual.

accidental exposure Unintended contact with a substance or change in the physical environment (including radiation) resulting from an accident.

acclimatization (biological)
1. Processes, including selection and adaptation, by which a population of microorganisms develops the ability to degrade a substance or develops a tolerance to it.
2. In animal tests—allowing an animal to adjust to its environment prior to undertaking a study.

accumulation Successive additions of a substance to a target organism, organ, or part of the environment, resulting in an increasing amount or concentration of the substance in the organism, organ, or environment.
WHO (1989a)

accuracy Quantity referring to the differences between the mean of a set of results or an individual result and the value which is accepted as the true or correct value for the quantity measured. Gold *et al.* (1987)
RT **precision**

acidosis Pathological condition in which the hydrogen ion substance concentration of body fluids is above normal and hence the pH of blood falls below the reference interval.
AN **alkalosis**

action level
1. Concentration of a substance in air, soil, water, or other defined medium at which specified emergency countermeasures, such as the seizure and destruction of contaminated materials, evacuation of the local population, or closing down the sources of pollution, are to be taken.
2. Concentration of a pollutant in air, soil, water, or other defined medium at which some kind of preventive action (not necessarily of an emergency nature) is to be taken.

activation See NT **bioactivation**

acute
1. Short-term, in relation to exposure or effect. In experimental toxicology, ''acute'' refers to studies of 2 weeks or less in duration (often less than 24 hr).
   AN **chronic**
2. In clinical medicine, sudden and severe, having a rapid onset.

acute effect Effect of short duration and occurring rapidly (usually in the first 24 hr or up to 14 days) following a single dose or short exposure to a substance or radiation.

acute toxicity
1. Adverse effects occurring within a short time (usually up to 14 days) after administration of a single dose (or exposure to a given concentration) of a test substance or after multiple doses (exposures), usually within 24 hr.
2. Ability of a substance to cause adverse effects within a short time of dosing or exposure.

AN **chronic toxicity**

acute toxicity test Experimental animal study to determine what adverse effects occur in a short time (usually up to 14 days) after a single dose of a substance or after multiple doses given in up to 24 hr.
RT **limit test, median lethal dose (LD_{50})**

adaptation
1. Change in an organism, in response to changing conditions of the environment (specifically chemical), which takes place without any irreversible disruptions of the given biological system and without exceeding normal (homeostatic) capacities of its response.
2. Process by which an organism stabilizes its physiological condition after an environmental change.

RT **acclimatization**

added risk Difference between the incidence of an adverse effect in a treated group (of organisms or a group of exposed humans) and a control group (of the same organisms or the spontaneous incidence in humans).
IRIS (1986)

addiction Surrender and devotion to the regular use of a medicinal or pleasurable substance for the sake of relief, comfort, stimulation, or exhilaration which it affords; often with craving when the drug is absent.
PS **dependence**

additive effect Consequence which follows exposure to two or more physicochemical agents which act jointly but do not interact: Commonly, the total effect is the simple sum of the effects of separate exposure to the agents under the same conditions. Substances of simple similar action may show dose or concentration addition.
RT **antagonism, combined effect of poisons, potentiation, synergism**

adduct New chemical species AB, each molecular entity of which is formed by direct combination of two separate molecular entities A and B in such a way that there is no change in connectivity of atoms within their moieties A and B. Stoichiometries other than 1:1 are also possible. An intramolecular adduct

can be formed when A and B are groups contained within the same molecular entity.
Gold *et al.* (1987)

adenocarcinoma Malignant tumor originating in glandular epithelium or forming recognizable glandular structures.
RT **adenoma**

adenoma Benign tumor occurring in glandular epithelium or forming recognizable glandular structures.
RT **adenocarcinoma**

adjuvant
1. In pharmacology, a substance added to a drug to speed or increase the action of the main component.
2. In immunology, a substance (such as aluminium hydroxide) or an organism (such as bovine tuberculosis bacillus) which increases the response to an antigen.

administration (of a substance) Application of a known amount of a substance to an organism in a reproducible manner and by a defined route.

adrenergic See SN **sympathomimetic**

adsorption Enrichment (positive adsorption or briefly adsorption) of one or more components in an interfacial layer.
Gold *et al.* (1987)

adverse effect Change in morphology, physiology, growth, development, or life span of an organism which results in impairment of functional capacity or impairment of capacity to compensate for additional stress or increase in susceptibility to the harmful effects of other environmental influences.
After IPCS (1978)

adverse event Occurrence which causes an adverse effect.

aerobe Organism which needs molecular oxygen for respiration and hence for growth and life.
After Nagel *et al.* (1991).

aerobic Requiring molecular oxygen.

aerodynamic diameter (of a particle) Diameter of a spherical particle of unit density which has the same settling velocity in air as the particle in question.
IPCS (1987)

aerosol Dispersion of liquid or solid material in a gas.
Gold *et al.* (1987)

aetiology
1. Science dealing with the cause or origin of disease.
2. In individuals, the cause or origin of disease.

RT **epidemiology**

after-effect of a poison Ability of a poison to produce a change in an organism after cessation of contact.

age sensitivity Quantitative and qualitative age dependence of an effect.
IRPTC (1982)

agonist Substance which binds to cell receptors normally responding to naturally occurring substances and which produces a response of its own.
AN **antagonist**

air pollution The presence of substances in the atmosphere resulting either from human activity or from natural processes, in sufficient concentration, for a sufficient time and in circumstances such as to interfere with comfort, health, or welfare of persons or to harm the environment.
ISO (1980)
BT **pollution**

air pollution control system
1. Network of organizations which monitor air pollution.
2. Group of measures or processes used to minimize or prevent air pollution.

RT **air pollution, pollution**

albuminuria The presence of albumin, derived from plasma, in the urine.
RT **microalbuminuria, proteinuria**

algicide Substance intended to kill algae.

alkalosis Pathological condition in which the hydrogen ion substance concentration of body fluids is below normal and hence the pH of blood rises above the reference interval.
AN **acidosis**

alkylating agent Substance which introduces an alkyl substituent into a compound.

allele One of several alternate forms of a gene which occur at the same relative position (locus) on homologous chromosomes and which become separated during meiosis and can be recombined following fusion of gametes.
Nagel *et al.* (1991)
RT **gametes, meiosis**

allergen Antigenic substance capable of producing immediate hypersensitivity.
RT **allergy, antigen, hypersensitivity**

allergy Symptoms or signs occurring in sensitized individuals following exposure to a previously encountered substance (allergen) which would otherwise not cause such symptoms or signs in nonsensitized individuals. The most common forms of allergy are rhinitis, urticaria, asthma, and contact dermatitis.
RT **immune response, hypersensitivity**

all-or-none effect See SN **quantal effect**
RT **stochastic effect**

alopecia Baldness; the absence or thinning of hair from areas of skin where it is usually present.

alveol/us (pulmonary), -i(pl.), **-ar**(adj.) Terminal air sac of the lung where gas exchange occurs.

ambient Surrounding (applied to environmental media such as air, water, sediment, or soil).

ambient monitoring Continuous or repeated measurement of agents in the environment to evaluate ambient exposure and health risk by comparison with appropriate reference values based on knowledge of the probable relationship between exposure and resultant adverse health effects.
After Berlin *et al.* (1984)
RT **biological monitoring, environmental monitoring, monitoring**

ambient standard See SN **environmental quality standard.**

Ames test *In vitro* test for mutagenicity using mutant strains of the bacterium *Salmonella typhimurium* which cannot grow in a given histidine-deficient medium: Mutagens can cause reverse mutations which enable the bacterium to grow on the medium. The test can be carried out in the presence of a given microsomal fraction (S-9) from rat liver to allow metabolic transformation of mutagen precursors to active derivatives.

amplification (of genes) See **gene amplification.**

anabolism Biochemical processes by which smaller molecules are joined to make larger molecules.
AN **catabolism**

anaemia Condition in which there is a reduction in the number of red blood cells or amount of hemoglobin per unit volume of blood below the reference interval for a similar individual of the species under consideration, often causing pallor and fatigue.

anaerobe Organism which does not need molecular oxygen for life. Obligate (strict) anaerobes grow only in the absence of oxygen. Facultative anaerobes can grow either in the presence or in the absence of molecular oxygen.
Nagel *et al.* (1991)
AN **aerobe**

anaerobic Not requiring molecular oxygen.

analgesic Substance which relieves pain, without causing loss of consciousness.

analog metabolism Process by which a normally nonbiodegradable compound is biodegraded in the presence of a structurally similar compound which can induce the necessary enzymes.

analytic study (in epidemiology) Hypothesis testing method of investigating the association between a given disease or health state or other dependent variable and possible causative factors. In an analytic study, individuals in the study population are classified according to the absence or presence (or future development) of specific disease and according to attributes which may influence disease occurrence. Attributes may include age, race, sex, other disease(s), genetic, biochemical, and physiological characteristics, economic status, occupation, residence, and various aspects of the environment or personal behavior. Three types of analytic study are cross-sectional (prevalence), cohort (prospective), and case control (retrospective).
Last (1988)

anaphylaxis Severe allergic reaction occurring in a person or animal exposed to an antigen or hapten to which they have previously been sensitized.
RT **antigen, hapten**

anaplasia Loss of normal cell differentiation, a feature characteristic of most malignancies.
RT **malignancy**

anemia See **anaemia.**

anesthetic Substance which produces loss of feeling or sensation: general anesthetic produces loss of consciousness; local or regional anesthetic renders a specific area insensible to pain.

aneuploid Cell or organism with missing or extra chromosomes or parts of chromosomes.

anoxia Strictly total absence of oxygen but sometimes used to mean decreased oxygen supply in tissues.

antagonism Combined effect of two or more factors which is smaller than the solitary effect of any one of those factors. In bioassays, the term may be used when a specified response is produced by exposure to either of two factors but not by exposure to both together.
RT **synergism**

antagonist
1. Substance that reverses or reduces the effect induced by an agonist.
2. Substance that attaches to and blocks cell receptors that normally bind naturally occurring substances.

AN **agonist**

anthelmint(h)ic Substance intended to kill parasitic intestinal worms, such as helminths.
SN **antihelminth**

anthracosis (coal miners' pneumoconiosis) Form of pneumoconiosis caused by accumulation of carbon

deposits in the lungs due to inhalation of smoke or coal dust.

anthropogenic Caused by or influenced by human activities.

antiadrenergic See SN **sympatholytic**

antibiotic Substance produced by, and obtained from, certain living cells (especially bacteria, yeasts, and molds), or an equivalent synthetic substance, which is biostatic or biocidal at low concentrations to some other form of life, especially pathogenic or noxious organisms.

antibody Protein molecule produced by the immune system (an immunoglobulin molecule) which can bind specifically to the molecule (antigen or hapten) which induced its synthesis.
RT **antigen, hapten, immunoglobulin**

anticholinergic
1. (adj.) Preventing transmission of parasympathetic nerve impulses.
2. (n.) Substance which prevents transmission of parasympathetic nerve impulses.

anticholinesterase See SN **cholinesterase inhibitor**

anticoagulant Substance which prevents clotting.

antidote Substance capable of specifically counteracting or reducing the effect of a potentially toxic substance in an organism by a relatively specific chemical or pharmacological action.

antigen Substance or a structural part of a substance which causes the immune system to produce specific antibody or specific cells and which combines with specific binding sites (epitopes) on the antibody or cells.
After Nagel *et al.* (1991)
RT **antibody, epitope**

antihelminth See SN **anthelmint(h)ic.**

antimetabolite Substance, structurally similar to a metabolite which competes with it or replaces it, and so prevents or reduces its normal utilization.

antimycotic Substance used to kill a fungus or to inhibit its growth.
SN **fungicide**

antipyretic Substance which relieves or reduces fever.

antiresistant Substance used as an additive to a pesticide formulation in order to reduce the resistance of insects to the pesticide.
IRPTC (1982)

antiserum Serum containing antibodies to a particular antigen either because of immunization or after an infectious disease.

aphasia Loss or impairment of the power of speech or writing, or of the ability to understand written or spoken language or signs, due to a brain injury or disease.

aphicide Substance intended to kill aphids.
BT **insecticide**

aphid Common name for a harmful plant parasite in the family Aphididae: Some species are vectors of plant virus diseases.

aplasia Lack of development of an organ or tissue or of the cellular products from an organ or tissue.

apoptosis Physiological process of programmed tissue death (and disintegration) associated with normal development in animals.
RT **necrosis**

arboricide Substance intended to kill trees and shrubs.

area source Widespread origin of emissions.
RT **point source**

argyria Pathological condition characterized by grayish or black pigmentation of tissues (such as skin, retina, mucous membranes, and internal organs) caused by the accumulation of metallic silver due to reduction of a silver compound which has entered the organism during (prolonged) administration or exposure.
SN **argyrosis**

argyrosis See SN **argyria.**

arrhythmia Any variation from the normal rhythm of the hearbeat.

arteriosclerosis Hardening and thickening of the walls of the arteries.

arthralgia Pain in a joint.

arthralgia saturnia Pain in a joint resulting from lead poisoning.

arthritis Inflammation of a joint, usually accompanied by pain and often by changes in structure.

artifact Finding or product of experimental or observational techniques that is not properly associated with the system being studied.

asbestosis From of pneumoconiosis caused by inhalation of asbestos fibers.
BT **pneumoconiosis**

ascaricide Substance intended to kill roundworms (Ascaridae).

asphyxia Condition resulting from insufficient intake of oxygen: Symptoms include breathing difficulty, impairment of senses, and, in the extreme, convulsions, unconsciousness, and death.

asphyxiant Substance that blocks the transport or use of oxygen by living organisms.

assay
1. Process of quantitative or qualitative analysis of a component of a sample.
2. Results of a quantitative or qualitative analysis of a component of a sample.

assessment of exposure See NT **biological assessment of exposure.**

asthenia Weakness; lack or loss of strength.

asthma Chronic respiratory disease characterized by bronchoconstriction, excessive mucus secretion, and edema of the pulmonary alveoli, resulting in difficulty in breathing out, wheezing, and cough.

astringent
1. Adj.: Causing contraction, usually locally after topical application.
2. N.: Substance causing cells to shrink, thus causing tissue contraction or stoppage of secretions and discharges; such substances may be applied to skin to harden and protect it.

ataxia Unsteady or irregular manner of walking or movement caused by loss or failure of muscular coordination.

atherosclerosis Pathological condition in which there is thickening, hardening, and loss of elasticity of the walls of blood vessels, characterized by a variable combination of changes of the innermost layer consisting of local accumulation of lipids, complex carbohydrates, blood and blood components, fibrous tissue, and calcium deposits. In addition, the outer layer becomes thickened and there is fatty degeneration of the middle layer.

atrophy Wasting away of the body or of an organ or tissue.

attenuation (in genetics) Regulation of gene expression in bacteria by premature termination of transcription of a biosynthetic operon.

attractant Substance used to attract animals with the aim of killing or sterilizing them.
BT **pheromone**

attributable risk Difference between the risk of exhibiting a certain adverse effect in the presence of a substance and the same risk in the absence of the substance.
Last (1988)
BT **risk**

autoimmune disease Pathological condition resulting when an organism produces antibodies or specific cells which bind to constituents of its own tissues (autoantigens) and cause tissue injury: Examples of such disease include rheumatoid arthritis, myasthenia gravis, and scleroderma.
RT **allergy, antibody, antigen, hypersensitivity, immune response**

autophagosome Membrane-bound body (secondary lysosome) in which parts of the cell are digested.

autopsy Postmortem examination of the organs and body tissue to determine cause of death or pathological condition.
RT **biopsy**
SN **necropsy**

auxotroph Organism unable to synthesize an organic molecule which is required for its growth: When the compound is given to the organism with the other nutrients it requires, growth of the organism may occur.

auxotrophy Inability of a microorganism to synthesize a particular organic compound required for its growth.
Nagel *et al.* (1991)

avicide Substance intended to kill birds.

axenic animal See SN **germ-free animal**

back-mutation Process which reverses the effect of a mutation which had inactivated a gene; thus it restores the wild phenotype.
RT **phenotype**

bactericide Substance intended to kill bacteria.

bagassosis Lung disease caused by the inhalation of dust from sugarcane residues.

base pairing Linking of the complementary pair of polynucleotide chains of nucleic acids by means of hydrogen bonds between complementary purine and pyrimidine bases, adenine with thymine or uracil, and cytosine with guanine.

B cell See **B lymphocyte**

benefit Advantage to or improvement in condition of an individual or a population.

benign
1. Of a disease, producing no persisting harmful effects.
2. Tumor which does not invade other tissues (metastasize), having lost growth control but not positional control.

AN **malignant**

berylliosis See SN **beryllium disease.**

beryllium disease Serious and usually permanent lung damage resulting from chronic inhalation of beryllium.

bias Deviation of results or inferences from the truth, or processes leading to such deviation. Any trend

in the collection, analysis, interpretation, publication, or review of data which can lead to conclusions which are systematically different from the truth. The following are among the ways in which deviation from the truth can occur.

1. Systematic (one-sided) variation of measurements from the true values
   SN **systematic error**
2. Variation of statistical summary measures (means, rates, measures of association, etc.) from their true values as a result of systematic variation of measurements, other flaws in data collection, or flaws in study design or analysis.
3. Deviation of inferences from the truth as a result of flaws in study design, data collection, or the analysis or interpretation of results.
4. A tendency of procedures (in study design, data collection, analysis, interpretation, review, or publication) to yield results or conclusions which depart from the truth.
5. Prejudice leading to the conscious or unconscious selection of study procedures which depart from the truth in a particular direction or to one-sidedness in the interpretation of results.

Last (1988)

biased sample Any sample which is not a random sample.
AN **random sample**
BT **sample**
RT **stratified sample, systematic sample**

bilirubin Orange-yellow pigment ($C_{33}H_{36}O_6N_4$), a breakdown product of hem-containing proteins (hemoglobin, myoglobin, and cytochromes), which circulates in the blood plasma bound to albumin or as water-soluble glucuronides and is excreted in the bile by the liver.

bioaccumulation Progressive increase in the amount of a substance in an organism or part of an organism which occurs because the rate of intake exceeds the organism's ability to remove the substance from the body.
PS **bioconcentration, biomagnification**

bioaccumulation potential Ability of living organisms to concentrate a substance obtained either directly from the environment or indirectly through its food.
IPCS (1987)

bioactivation Any metabolic conversion of a xenobiotic to a more toxic derivative.
PS **activation**
BT **biotransformation**

bioassay Procedure for estimating the concentration or biological activity of a substance (vitamin, hormone, plant growth factor, antibiotic, etc.) by measuring its effect on an organism compared to an appropriate standard preparation.
Nagel *et al.* (1991)
BT **assay**

bioavailability

1. Extent to which a substance to which the body is exposed (by ingestion, inhalation, injection, or skin contact) reaches the systemic circulation, and the rate at which this occurs.
   SN **biological availability, physiological availability**
2. Pharmacokinetic term relating systemic exposure from extravascular exposure (ev) to that following intravenous exposure (iv) by the equation:

$$F = AUC_{ev} \cdot D_{iv} \,/\, AUC_{iv} \cdot D_{ev}$$

where F is the bioavailability, AUC_{ev} and AUC_{iv} are the areas under the plasma concentration time curve following extravascular and intravenous administration, and D_{ev} and D_{iv} are the administered extravascular and intravenous doses.

biochemical mechanism Reaction or series of reactions, usually enzyme-catalyzed, associated with a specific physiological event in a living organism.

biochemical (biological) oxygen demand (BOD) Substance concentration of oxygen taken up through the respiratory activity of microorganisms growing on organic compounds present when incubated at a specified temperature (usually 20°C) for a fixed period (usually 5 days). It is regarded as a measure of that organic pollution of water which can be degraded biologically but includes the oxidation of inorganic material such as sulfide and iron(II). The empirical test used in the laboratory to determine BOD also measures the oxygen used to oxidize reduced forms of nitrogen unless their oxidation is prevented by an inhibitor such as allyl thiourea.
Nagel *et al.* (1991)
RT **chemical oxygen demand**

biocid/e (n.), **-al** (adj.) Substance intended to kill living organisms.

bioconcentration Process leading to a higher concentration of a substance in an organism than in environmental media to which it is exposed.
After WHO (1979)
PS **bioaccumulation, biomagnification**

bioconcentration factor (BCF) Measure of the tendency for a substance in water to accumulate in fish tissue or in tissues of other organisms. The equilibrium concentration of a substance in fish can be estimated by multiplying the concentration of the substance in the surrounding water by the fish

bioconcentration factor for that chemical. This parameter is an important determinant for human intake by the aquatic food ingestin route.
After USEPA (1986)

bioconversion See SN **biotransformation**

biodegradation Breakdown of a substance catalyzed by enzymes *in vitro* or *in vivo*. This may be characterized for purposes of hazard assessment as
1. Primary: Alteration of the chemical structure of a substance resulting in loss of a specific property of that substance.
2. Environmentally acceptable: Biodegradation to such an extent as to remove undesirable properties of the compound. This often corresponds to primary biodegradation but it depends on the circumstances in which the products are discharged into the environment.
3. Ultimate: Complete breakdown of a compound to either fully oxidized or reduced simple molecules (such as carbon dioxide/methane, nitrate/ammonium, and water).

It should be noted that the products of biodegradation can be more harmful than the substance degraded.
RT **biotransformation**

bioelimination Removal, usually from the aqueous phase, of a test substance in the presence of living organisms by biological processes supplemented by physicochemical reactions.

bioequivalen/ce (n.), **-t**(adj.) Relationship between two preparations of the same drug in the same dosage form that have a similar bioavailability.

biological absorption See **absorption, biological.**

biological acclimatization See **acclimatization, biological.**

biological assessment of exposure
1. Assessment of exposure to a substance by the analysis of specimens taken in the environment such as foodstuffs, plants, animals, biological material in air or water samples, or biological material from exposed subjects. When human samples are analyzed, they are usually urine and blood; other possible samples include expired air, feces, saliva, bile, hair, and biopsy or autopsy material. When other organisms are being considered, the whole organism may be analyzed as well as selected tissues such as fat in pigs or birds. In these samples, the content(s) of the substance(s) or metabolite(s) is determined and, on this basis, the exposure level (concentration in the air and absorbed amount of the substance) or the probability of health impairment due to exposure is derived.
2. Biochemical changes in the components of an organism, such as changes in enzyme activity or in the excretion of metabolic intermediates, can also be used for this purpose if they show a relationship to the exposure.

BT **biological monitoring, monitoring**

biological cycle Complete circulatory process through which a substance passes in the biosphere. It may involve transport through the various media (air, water, and soil), followed by environmental transformation, and carriage through various ecosystems.
WHO (1979)
RT **biosphere, ecosystem**

biological effect monitoring (BEM) Continuous or repeated measurement of early biological effects of exposure to a substance to evaluate ambient exposure and health risk by comparison with appropriate reference values based on knowledge of the probable relationship between ambient exposure and biological effects.
BT **biological monitoring, environmental monitoring**

biological half-life or half-time ($t_{1/2}$) Time required for the amount of a substance in a biological system to be reduced to one-half, predominantly by biological processes, when the rate of removal is approximately exponential.
Gold, *et al.* (1987)

biological monitoring Continuous or repeated measurement of potentially toxic substances or their metabolites or biochemical effects in tissues, secreta, excreta, expired air, or any combination of these in order to evaluate occupational or environmental exposure and health risk by comparison with appropriate reference values based on knowledge of the probable relationship between ambient exposure and resultant adverse health effects.
NT **biological effect monitoring**
BT **environmental monitoring, monitoring**
RT **biological assessment of exposure**

biological oxygen demand See SN **biochemical oxygen demand.**

biological preparation Compound derived from living organisms and their products for use in medicine or as a pesticide, etc.
SN **biological, biopreparation**

biological specimen
1. Organ, tissue (including blood), or secretion or excretion product taken from an organism as a sample reflecting the state of the whole organism.
2. Organism taken as a sample reflecting the state of a population or its environment.

biomagnification Sequence of processes in an ecosystem by which higher concentrations are attained in organisms at higher trophic levels (at higher levels in the food web); at its simplest, a process leading to a higher concentration of a substance in an organism than in its food.
SN **ecological magnification**
RT **bioaccumulation, bioconcentration**

biomarker
1. Parameter that can be used to identify a toxic effect in an individual organism and can be used in extrapolation between species.
2. Indicator signaling an event or condition in a biological system or sample and giving a measure of exposure, effect, or susceptibility.

biomass
1. Total amount of biotic material, usually expressed per unit surface area or volume, in a medium such as water.
   WHO (1979)
2. Material produced by the growth of microorganisms, plants, or animals.
   Nagel *et al.* (1991)

biomineralization Complete conversion of organic substances to inorganic derivatives by living organisms, especially microorganisms.

biomonitoring See SN **biological monitoring.**

biopsy Excision of a small piece of living tissue for microscopic or biochemical examination; usually performed to establish a diagnosis.
RT **autopsy**

biosphere Portion of Earth which supports and includes life.

biostatic Arresting the growth or multiplication of living organisms.

biota All living organisms as a totality.

biotransformation Any chemical conversion of substances that is mediated by living organisms or enzyme preparations derived therefrom.
Nagel *et al.* (1992)

blood substitution See SN **exchange transfusion.**

B lymphocyte Type of lymphocyte which synthesizes and secretes antibodies in response to the presence of a foreign substance or one identified by it as foreign. The protective effect can be mediated to a certain extent by the antibody alone (contrast T lymphocyte).
RT **immune response, lymphocyte, T lymphocyte**

body burden Total amount of substance of a chemical present in an organism at a given time.

bolus
1. Single dose of a substance, originally a large pill.
2. Dose of a substance administered by a single rapid intravenous injection.
3. Concentrated mass of food ready to be swallowed.

brady- Prefix meaning slow as in bradycardia or bradypnoea.

bradycardia Abnormal slowness of the heartbeat.
AN **tachycardia**

bradypnoea Abnormally slow breathing.
AN **tachypnoea**

breathing zone Space within a radius of 0.5 m from a person's face.
IRPTC (1982)

British anti-Lewisite (BAL) See SN **2,3-dimercaptopropan-1-ol.**

bronchoconstriction Narrowing of the air passages through the bronchi of the lungs.
AN **bronchodilation**

bronchodilation Expansion of the air passages through the bronchi of the lungs.
AN **bronchoconstriction**

bronchospasm Intermittent violent contraction of the air passages of the lungs.

builder Material which enhances or maintains the cleaning efficiency of a surfactant, in a detergent, principally by inactivating water hardness; complex phosphates (especially sodium tripolyphosphate, i.e., pentasodium triphosphate), sodium carbonate, and sodium silicate are the builders most commonly used.

byssinosis Pneumoconiosis caused by inhalation of dust and associated microbial contaminants and observed in cotton, flax, and hemp workers.

bystander exposure Liability of members of the general public to come in contact with substances arising from operations or processes carried out by other individuals in their vicinity.

calcification Process in which organic tissue becomes hardened by deposition of calcium salts within its substance.

calibration material See SN **reference material.**

cancer Disease resulting from the development of a malignancy.
RT **carcinogen, carcinogenesis, carcinogenic, carcinogenicity, carcinoma, malignant, malignancy**

carboxyhemoglobin Compound which is formed between carbon monoxide and hemoglobin in the blood of animals and which is incapable of transporting oxygen.

carcinogen (n.), **-ic**(adj.) Agent (chemical, physical, or biological) which is capable of increasing the incidence of malignant neoplasms; the induction of benign neoplasms may in some circumstances contribute to the judgment that an agent is carcinogenic.
IARC (1987)

carcinogen/esis (n), **-etic** (adj.) Induction, by chemical, physical, or biological agents, of malignant neoplasms.
WHO (1989a)

carcinogenicity Process of induction of malignant neoplasms by chemical, physical, or biological agents.

carcinogenicity, classification according to IARC Classification based on the weight of the evidence and not on potency as follows:

1. Sufficient evidence: Causal relationship has been established between exposure to the agent and human cancer: a positive relationship has been observed between exposure to the agent and cancer in studies in which chance, bias, and confounding could be ruled out with reasonable confidence.
2. Limited evidence: Positive association has been observed between exposure to the agent and cancer for which a causal interpretation is considered to be credible, but chance, bias, or confounding could not be ruled out with reasonable confidence.
3. Inadequate evidence: Available studies are of insufficient quality, consistency, or statistical power to permit a conclusion regarding the presence or absence of a causal association.
4. Evidence suggesting lack of carcinogenicity: There are several adequate studies covering the full range of doses to which human beings are known to be exposed which are mutually consistent in not showing a positive association between exposure to the agent and any studied cancer at any observed level of exposure. A conclusion of ''evidence suggesting lack of carcinogenicity'' is inevitably limited to the cancer sites, circumstances, and doses of exposure and length of observation covered by the available studies. In addition, the possibility of a very small risk at the levels of exposure studied can never be excluded.
5. Overall evaluation: Total body of evidence is taken into account; the agent is described according to the wording of one of the following categories, and the designated group is given. The categorization of an agent is a matter of scientific judgment, reflecting the strength of the evidence derived from studies in humans and in experimental animals and from other relevant data.

Group 1: The agent is carcinogenic to humans. This category is used only when there is sufficient evidence of carcinogenicity in humans.

Group 2: This category includes agents for which, at one extreme, the degree of evidence of carcinogenicity in humans is almost sufficient, as well as agents for which, at the other extreme, there are no human data but for which there is experimental evidence of carcinogenicity. Agents are assigned to either 2A (probably carcinogenic) or 2B (possibly carcinogenic) on the basis of epidemiological, experimental, and other relevant data.

Group 2A: The agent is probably carcinogenic to humans. This category is used when there is limited evidence of carcinogenicity in humans and sufficient evidence of carcinogenicity in experimental animals. Exceptionally, an agent may be classified into this category solely on the basis of limited evidence of carcinogenicity in humans or of sufficient evidence of carcinogenicity in experimental animals strengthened by supporting evidence from other relevant data.

Group 2B: The agent is possibly carcinogenic to humans. This category is generally used for agents for which there is limited evidence in humans in the absence of sufficient evidence in experimental animals. It may also be used when there is inadequate evidence of carcinogenicity in humans or when human data are nonexistent but there is sufficient evidence of carcinogenicity in experimental animals. In some instances, an agent for which there is inadequate evidence or no data in humans but limited evidence of carcinogenicity in experimental animals together with supporting evidence from other relevant data may be placed in this group.

Group 3: The agent is not classifiable as to its carcinogenicity to humans. Agents are placed in this category when they do not fall into any other group.

Group 4: The agent is probably not carcinogenic to humans. This category is used for agents for which there is evidence suggesting lack of carcinogenicity in humans together with evidence suggesting lack of carcinogenicity in experimental animals. In some circum-

stances, agents for which there is inadequate evidence of or no data on carcinogenicity in humans but evidence suggesting lack of carcinogenicity in experimental animals, consistently and strongly supported by a broad range of other relevant data, may be classified in this group.

IARC (1987)

carcinogenicity test Long-term (chronic) test designed to detect any possible carcinogenic effect of a test substance.

carcinoma Malignant tumor of an epithelial cell.

SN **epithelioma**

cardiotoxic Chemically harmful to the cells of the heart.

carryover

1. Transfer in farming and agricultural processing of a component from one system, such as soil or feed, to another system, such as a plant, animal, or human being: Carryover is expressed as the concentration of a component in the second system divided by the concentration in the first.
2. Process in analytical studies by which materials are carried into a reaction mixture in which they do not belong.

case control study A study which starts with the identification of persons with the disease (or other outcome variable) of interest, and a suitable control (comparison or reference) group persons without the disease. The relationship of an attribute to the disease is examined by comparing the diseased and nondiseased with regard to how frequently the attribute is present or, if quantitative, the levels of the attribute, in the two groups.

SN **case comparison study, case history study, case referent study, retrospective study**

Last (1988)

catabolism

1. Reactions involving the oxidation of organic substrates to provide chemically available energy (e.g. ATP) and to generate metabolic intermediates.

   Nagel *et al.* (1991)
2. Generally, process of breakdown of complex molecules into simpler ones, often providing biologically available energy.

AN **anabolism**

catatonia Schizophrenia marked by excessive, and sometimes violent, motor activity and excitement or by generalized inhibition.

cathartic See SN **laxative.**

SN **purgative**

ceiling value (CV) United States term in occupational exposure indicating the airborne concentration of a potentially toxic substance which should never be exceeded in a worker's breathing zone.

cell line Defined unique population of cells obtained by culture from a primary implant through numerous generations.

cell-mediated hypersensitivity State in which an individual reacts with allergic effects caused by the reaction of antigen-specific T lymphocytes following exposure to a certain substance (allergen) after having been exposed previously to the same substance or chemical group.

RT **allergy, antigen, immunoglobulin E-mediated hypersensitivity**

cell-mediated immunity Immune response mediated by antigen-specific T lymphocytes.

cell strain Cells having specific properties or markers derived from a primary culture or cell line.

censored data Sample observations for which the complete distribution is not known: for example, a cohort study in which some persons cannot be followed to the predetermined end of the study (''right-censored data'') or environmental assay data in which some results are less than the sample detection limit (''left-censored data'').

After Last (1988)

certified reference material Reference material provided by a certifying body such as a National Standards Organization or Metrological Laboratory or by an international body which confirms its purity and analytical values by technically valid procedures and provides a certificate detailing the relevant information.

BT **reference material**

chain of custody Sequence of responsibility for a substance from the manufacturer to the distributor, to the user, or to the person(s) ultimately responsible for waste disposal. This term is also used in controlled transmission of samples from collection to analysis, especially of samples of materials used for medicolegal or forensic purposes.

chelation therapy Treatment with a chelating agent to enhance the elimination or reduce the toxicity of a metal ion.

chemical aetiologic agent See SN **toxic substance.**

chemical conversion Change from one state or chemical structure to another.

PS **conversion**

chemical etiologic agent See SN **toxic substance.**

chemical oxygen demand (COD) Substance concentration of available oxygen (derived from a chemical oxidizing agent) required to oxidize the organic (and inorganic) matter in wastewater.
After Nagel *et al.* (1992)
RT **biochemical oxygen demand**

chemical safety Practical certainty that there will be no exposure of organisms to toxic amounts of any substance or group of substances: This implies attaining an acceptably low risk of exposure to potentially toxic substances.
Duffus (1986)
RT **practical certainty**

chemical species Set of chemically identical atomic or molecular structural units in a solid array or of chemically identical molecular entities that can explore the same set of molecular energy levels on the time scale of the experiment. For example, two conformational isomers may interconvert sufficiently slowly to be detectable by separate nuclear magnetic resonance spectra and hence be considered to be separate chemical species on a time scale governed by the radiofrequency of the spectrometer used. On the other hand, in a slow chemical reaction the same mixture of conformers may behave as a single chemical species, i.e., there is a virtually complete equilibrium population of the total set of molecular energy levels belonging to the two conformers. Except where the context requires otherwise, the term is taken to refer to a set of molecular entities containing isotopes in their natural abundance. The wording of the definition given is intended to embrace both cases such as graphite, sodium chloride, or a surface oxide in which the basic structural units are not capable of a separate existence and those cases in which they are capable of doing so.
Gold *et al.* (1987)

chemical toxicology See BT **toxicology.**

chemobiokinetics See NT **toxicokinetics.**

chemophobia Irrational fear of chemicals.

chemosis Chemically induced swelling around the eye caused by edema of the conjunctiva.

chemosterilizer Substance used to sterilize mites, insects, rodents, or other animals.

chloracne Acne-like eruption caused by exposure to certain chlorinated organic substances such as polychlorinated biphenyls or 2,3,7,8-tetrachlorodibenzo-*p*-dioxin.

cholinesterase inhibitor Substance which inhibits the action of acetylcholinesterase (EC 3.1.1.7) and related enzymes which catalyze the hydrolysis of choline esters: Such a substance causes hyperactivity in parasympathetic nerves.

cholinomimetic See SN **parasympathomimetic.**

chromatid Either of two filaments joined at the centromere which make up a chromosome.

chromatin Stainable complex of DNA and proteins present in the nucleus of a eukaryotic cell.
RT **eukaryote**

chromosomal aberration Abnormality of chromosome number or structure.

chromosome Self-replicating structure consisting of DNA complexed with various proteins and involved in the storage and transmission of genetic information; the physical structure that contains the genes.
Nagel *et al.* (1991)
RT **chromatid**

chronic effect Consequence which develops slowly and has a long-lasting course (often but not always irreversible).
After WHO (1979)
AN **acute effect**

chronic exposure Continued exposures occurring over an extended period of time or a significant fraction of the test species, the group of individuals' or of the population's life time.
AN **acute exposure**

chronic toxicity
1. Adverse effects following chronic exposure.
2. Effects which persist over a long period of time whether or not they occur immediately upon exposure or are delayed.

IRIS (1986)
AN **acute toxicity**

chronic toxicity test Study in which organisms are observed during the greater part of the life span and in which exposure to the test agent takes place over the whole observation time or a substantial part thereof.
WHO (1978a)
AN **acute toxicity test**
SN **long-term test**

chronotoxicology Study of the influence of biological rhythms on the toxicity of substances.

circulation of substances in the environment Movement of xenobiotic substances in the environment with air flow, river current, soil, water, etc.
IRPTC (1982)
RT **biological cycle**

cirrhosis
1. Liver disease defined by histological examination and characterized by increased fibrous tissue, ab-

normal physiological changes such as loss of functional liver cells, and increased resistance to blood flow through the liver (portal hypertension).
2. Interstitial fibrosis of an organ.

clastogen Agent causing chromosome breakage and/or consequent gain, loss, or rearrangement of pieces of chromosomes.

clastogenesis Occurrence of chromosomal breaks and/or consequent gain, loss, or rearrangement of pieces of chromosomes.

clearance
1. Volume of blood or plasma or mass of an organ effectively cleared of a substance by elimination (metabolism and excretion) in a given time interval: Clearance is expressed in units of volume or mass per unit of time. Total clearance for a component is the sum of the clearances of each eliminating organ or tissue for that component.
2. In pulmonary toxicology, clearance refers specifically to removal of any inhaled substance which deposits on the lining surface of the lung: Lung clearance is expressed in volume or mass of lung cleared per unit time.
3. In renal toxicology, clearance refers to the quantification of the removal of a substance by the kidneys by the processes of filtration and secretion: Clearance is calculated by relating the rate of renal excretion to the plasma concentration.

RT **elimination**

clon/e(n), **-al** (adj.)
1. Population of genetically identical cells or organisms having a common ancestor.
2. To produce such a population.
3. Recombinant DNA molecules all carrying the same inserted sequence.

Nagel *et al.* (1991)

clonic Pertaining to alternate muscular contraction and relaxation in rapid succession.
IRIS (1986)
RT **tonic**

cluster sampling
1. A method of sampling in which the population is divided into aggregates (or clusters) of items bound together in a certain manner. A sample of these clusters is taken at random and all the items which constitute them are included in the sample.
2. A sampling method in which each unit selected is a group of persons (all persons in a city block, a family, etc.) rather than an individual.

WHO (1989a)

cocarcinogen Chemical, physical, or biological factor which intensifies the effect of a carcinogen.

Codex Alimentarius Collection of internationally adopted food standards drawn up by the Codex Alimentarius Commission, the principal body implementing the joint FAO/WHO Food Standards Programme.
IPCS (1987a)

cohort Component of the population born during a particular period and identified by period of birth so that its characteristics (such as causes of death and numbers still living) can be ascertained as it enters successive time and age periods. The term ''cohort'' has broadened to describe any designated group of persons followed or traced over a period of time, as in the term cohort study (prospective study).
Last (1988)

cohort analysis Tabulation and analysis of morbidity or mortality rates in relationship to the ages of a specific group of people (cohort), identified by their birth period, and followed as they pass through different ages during part or all of their life span. In certain circumstances, such as studies of migrant populations, cohort analysis may be performed according to duration of residence in a country rather than year of birth in order to relate health or mortality experience to duration of exposure.
Last (1988)

cohort study Method of epidemiological study in which subsets of a defined population can be identified that are, have been, or in the future may be exposed or not exposed, or exposed in different degrees, to a factor or factors hypothesized to influence the probability of occurrence of a given disease or other outcome. Alternative terms for such a study—follow-up, longitudinal, and prospective study—describe an essential feature of the method: observation of the population for a sufficient number of person-years to generate reliable incidence or mortality rates in the population subsets. This generally means studying a large population, study for a prolonged period (years), or both.
SN **concurrent study, follow-up study, incidence study, longitudinal study, prospective study**
Last (1988)

combined effect of poisons Simultaneous or successive effect of two or more poisons on the organism by the same route of exposure.
IRPTC (1982)
RT **additive effect, antagonism, independent effects of poisons, potentiation, summation, synergism**

cometabolism Process by which a normally nonbiodegradable substance is biodegraded only in the presence of an additional carbon source.
RT **analog metabolism**

comparison group See SN **control group.**

compartment Part of the body considered as an independent system for purposes of assessment of distribution and clearance of a substance. The body is composed of a large number of organs, tissues, cells, cell organelles, and fluids, any one of which could be referred to as a compartment. In kinetic considerations, a compartment often refers collectively to the organs, tissues, cells, and fluids for which the rates of uptake and subsequent distribution and elimination are sufficiently similar to preclude kinetic resolution.
After WHO (1979)

compensation Adaptation of an organism to changing conditions of the environment (especially chemical) is accompanied by the emergence of stresses in biochemical systems which exceed the limits of normal (homeostatic) mechanisms. Compensation is a temporary concealed pathology which later on can be manifested in the form of explicit pathological changes (decompensation).
SN **pseudoadaptation**
RT **acclimatization, adaptation**

competent authority In the context of European Communities Directive 79/831/EEC, the Sixth Amendment to the European Community's Directive 67/548/EEC relating to the Classification, Packaging and Labeling of Dangerous Substances, official government organization or group receiving and evaluating notifications of new substances.

competent bacteria Culture of bacteria (or yeast) treated in such a way that their ability to take up DNA molecules without transduction or conjugation has been enhanced.

complete mineralization Complete breakdown of a complex organic compound to carbon dioxide, water, oxides, and oxidative inorganic products such as nitrate or sulfate.

comprehensive effect of poisons Simultaneous or successive effect made on an organism by poisons entering from different media, air, water, or food or through the skin.

concentration (amount-of-substance concentration) $c = n/v$ Derived kind of quantity defined as the amount of substance (n) of a component specified by an elementary entity divided by the volume (V) of the system containing the component. The fundamental unit is mol m^{-3} but practical units are mol dm^{-3} or mol L^{-1} (not molarity).
After Gold *et al.* (1987)
RT **absolute lethal concentration, lethal concentration, maximum tolerable concentration, median effective concentration, median lethal concentration, median narcotic concentration, minimum lethal concentration, threshold concentration**

concentration–effect curve Graph of the relation between exposure concentration and the magnitude of the resultant biological change.
RT **dose–effect curve**
SN **exposure effect curve**

concentration–effect relationship Association between exposure concentration and the magnitude of the resultant continuously graded change, either in an individual or in a population.
RT **dose–effect relationship**

concentration–response curve Graph of the relation between exposure concentration and the proportion of individuals in a population responding with a quantal effect.
RT **dose–response curve, response**

concentration–response relationship Association between exposure concentration and the incidence of a defined biological effect in an exposed population.
RT **dose–response relationship, response**

concord/ance (n.), **-ant** (adj.) Pairs or groups of individuals of identical phenotype: in twin studies, a condition in which both twins exhibit or fail to exhibit a trait under investigation.
Last (1988)
RT **phenotype**

concurrent study See SN **cohort study.**

concurrent validity Measurement and its criterion refer to the same point in time; for example, a visual inspection of a wound for evidence of infection validated against bacteriological examination of a specimen taken at the same time.
Last (1988)

confounding
1. Situation in which the effect of two processes are not distinguishable from one another: The distortion of the apparent effect of an exposure on risk brought about by the association of other factors which can influence the outcome.
2. Relationship between the effects of two or more causal factors as observed in a set of data, such that it is not logically possible to separate the contribution which any single causal factor has made to an effect.
3. Situation in which a measure of the effect of an exposure on risk is distorted because of the association of exposure with other factor(s) which influence the outcome under study.

Last (1988)

confounding variable Changing factor that can cause or prevent the outcome of interest, is not an intermediate variable, and is not associated with the factor under investigation: Such a variable must be controlled in order to obtain an undistorted estimate of the effect of the study factor on risk.
SN **confounder**
Last (1988)

congener Substance which by structure, function, or origin is similar to another.

conjugate
1. Derivative of a substance formed by its combination with compounds such as acetic acid, glucuronic acid, glutathione, glycine, and sulfuric acid.
RT **phase 2 reaction**
2. Material produced by attaching two or more substances together; for example, conjugates of antibody with fluorochromes, radioisotopes, or enzymes.

conjunctiva Mucous membrane which covers the eyeball and lines the undersurface of the eyelid.

conjunctivitis Inflammation of the conjunctiva.

conservative assessment of risk Assessment of risk which assumes the worst possible case scenario and therefore gives the highest possible value for risk: Risk management decisions based on this value will maximize safety.

construct validity Extent to which the measurement corresponds to theoretical concepts (constructs) concerning the phenomenon under study; for example, if on theoretical grounds, the phenomenon should change with age, a measurement with construct validity would reflect such a change.
Last (1988)

contact dermatitis Inflammatory condition of the skin resulting from dermal exposure to an allergen (sensitizer) or an irritating (corrosive, defatting) substance.

containment Process by which possible release, discharge, or spill of a toxic substance during normal use or after an accident is prevented by appropriate action.

contaminant
1. Minor impurity present in a substance.
2. Extraneous material inadvertently added to a sample prior to or during chemical or biological analysis.
3. In some contexts, as in relation to gas cleaning equipment, used as a synonym for ''pollutant,'' especially on a small scale.
4. Unintended component in food that may pose a hazard to the consumer.

PS **pollutant**

content validity Extent to which the measurement incorporates the domain of the phenomenon under study; for example, a measurement of functional health status should embrace activities of daily living, occupational, family, and social functioning, etc.
Last (1988)

contraindication Any condition which renders some particular line of treatment improper or undesirable.

control group Selected group, identified as a rule before a study is done, which comprises humans, animals, or other species that do not have the disease, intervention, procedure, or whatever is being studied, but in all other respects is as nearly identical to the test group as possible.
After Last (1988)
SN **comparison group**

control, matched Control (individual, group, or case) selected to be similar to a study individual or group, or case, in specific characteristics: Some commonly used matching variables are age, sex, race, and socioeconomic status.
After WHO (1989a)

conversion See NT **chemical conversion, biotransformation.**

core grade Quality rating, based on standard evaluation criteria established by the U.S. Office of Pesticide Programs regulatory agencies, given to toxicological studies after submission by registrants.
IRIS (1986)

corrosive Causing a surface-destructive effect on contact; in toxicology, this normally means causing visible destruction of the skin, eyes, or the lining of the respiratory tract or the gastrointestinal tract.

count mean diameter Mean of the diameters of all particles in a population.
WHO (1989a)

count median diameter Calculated diameter in a population of particles in a gas or liquid phase above which there are as many particles with larger diameters as there are particles below it with smaller diameters.
WHO (1989a)

crackles See SN **crepitations.**

crepitations Abnormal respiratory sounds heard on auscultation of the chest, produced by passage of air through passages which contain secretion or exudate or which are constricted by spasm or a thickening of their walls; more usually referred to as crepitations or rhonchi (auscultation is the process of listening for sounds within the body by ear unassisted or using a stethoscope).
SN **crackles, râles**

criterion Validated set of data used as a basis for judgment.
WHO (1989a)

criterion validity Extent to which the measurement correlates with an external criterion of the phenomenon under study.
Last (1988)

critical concentration (for a cell or organ) Concentration of a potentially toxic substance at which undesirable (or adverse) functional changes, reversible or irreversible, occur in the cell or organ.

critical effect For deterministic effects, the first adverse effect which appears when the threshold (critical) concentration or dose is reached in the critical organ. Adverse effects, such as cancer, with no defined threshold concentration are often regarded as critical. Decision on whether an effect is critical is a matter of expert judgment.
After WHO (1989a)

critical end point Toxic effect used by the USEPA as the basis for a reference dose.
Barnes and Dourson (1988)
RT **reference dose**

critical group Part of a target population most in need of protection because it is most susceptible to a given toxicant.
WHO (1979)

critical organ
1. In toxicology: Organ which first attains the critical concentration (of a potentially toxic substance) in specified circumstances of exposure and for a given population.
2. In radiation biology: Organ the damage of which (by radiation) results in the greatest injury to the individual (or his/her descendants). The injury may result from inherent radiosensitivity or indispensability of the organ, from high dose, or from a combination of all three.
ICRP (1965)

critical organ concentration (of a substance) Mean concentration in the critical organ at the time the most sensitive type of cell reaches the critical concentration.
RT **critical concentration, critical organ**

critical period (of development) Stage of development of an organism that is of particular importance in the life cycle if the normal full development of some anatomical, physiological, metabolic, or psychological structure or function is to be attained: Such a period may be associated with very high susceptibility to specific potentially toxic substances.

critical study Investigation yielding the no-observed-adverse-effect level that is used by the USEPA as the basis of the reference dose.
Barnes and Dourson (1988)
RT **reference dose**

cross-product ratio See SN **odds ratio.**

cross-sectional study (of disease prevalence and associations) Study which examines the relationship between diseases (or other health-related characteristics) and other variables of interest as they exist in a defined population at one particular time. Disease prevalence rather than incidence is normally recorded in a cross-sectional study and the temporal sequence of cause and effect cannot necessarily be determined.
After Last (1988)
SN **disease frequency survey, prevalence study**
RT **morbidity survey**

cumulative effect Overall adverse change which occurs when repeated doses of a harmful substance or radiation have biological consequences which are mutually enhancing.
SN **functional accumulation**

cumulative incidence, cumulative incidence rate Number and proportion of a group of people who experience the onset of a health-related event during a specified time interval; this interval is generally for all members of the group but, as in lifetime incidence, it may vary from person to person without reference to age.
Last (1988)

cumulative incidence ratio Value obtained by dividing the cumulative incidence rate in the exposed population by the cumulative incidence rate in the unexposed population.
Last (1988)

cumulative median lethal dose Estimate of the total administered amount of a substance which is associated with the death of half a population of animals when the substance is administered repeatedly in doses which are generally fractions of the median lethal dose. The estimate may vary with the chosen size of the fraction (0.1, 0.2, etc.) and with the period of time over which effects are observed. It is a calculated quantity generally obtained by interpolation of available dose–response data relating the total administered amount to the response in the corresponding group of experimental animals.
BT **median lethal dose**

cutaneous Pertaining to the skin.
SN **dermal**

cyanogenic Compounds able to produce cyanide, e.g., the cyanogenic glycosides such as amygdalin in peach and apricot stones.

cyanosis Bluish coloration, especially of the skin and mucous membranes and fingernail beds, caused by abnormally large amounts of reduced hemoglobin in the blood vessels as a result of deficient oxygenation.

cytochrome Hemoprotein whose characteristic mode of action involves transfer of reducing equivalents associated with a reversible change in oxidation state of the heme prosthetic group: strictly, members of the cytochrome P450 family is not cytochromes but heme-thiolate proteins.
Palmer and Reedijk (1991)

cytochrome P420 Inactive derivative of cytochrome P450 found in microsomal preparations.
RT **cytochrome P448, cytochrome P450, endoplasmic reticulum, microsome, monooxygenase, phase 1 reactions**

cytochrome P448 Obsolete term for cytochrome P450 I, A1, and A2, one of the major families of the cytochromes P450 hemoproteins. During the monooxygenation of certain substances, often a detoxification process, these isoenzymes may produce intermediates which initiate mutations, chemical carcinogenesis, immunotoxic reactions, and other forms of chemical toxicity.
RT **cytochrome P420, cytochrome P450, endoplasmic reticulum, microsome, monooxygenase, phase 1 reactions**

cytochrome P450 Hemoproteins which form the major part of the enzymes concerned with the monooxygenation of many endogenous and exogenous substrates. The term includes a large number of isoenzymes which are coded for by a superfamily of genes. Endogenous substrates of these enzymes include cholesterol, steroid hormones, and the eicosenoids; the exogenous substrates are xenobiotics. Strictly, members of the cytochrome P450 family are not cytochromes but are hem-thiolate proteins.
Guengerich (1988)
SN **mixed function oxidase**
RT **cytochrome P420, cytochrome P448, endoplasmic reticulum, microsome, monooxygenase, phase 1 reactions, xenobiotics**

cytogenetics Branch of genetics which correlates the structure and number of chromosomes as seen in isolated cells with variation in genotype and phenotype.
RT **phenotype**

cytoplasm Fundamental substance of matrix of the cell (within the plasma membrane) which surrounds the nucleus, endoplasmic reticulum, mitochondria, and other organelles.

cytotoxic Causing damage to cell structure or function.

death rate Estimate of the proportion of a population which dies during a specified period. The numerator is the number of persons dying during the period; the denominator is the size of the population, usually estimated as the midyear population. The death rate in a population is generally calculated by the formula: 10^n (number of deaths during a specified period) / (number of persons at risk of dying during the period). This rate is an estimate of the person–time death rate, the death rate per 10^n person-years; usually, $n = 3$. If the rate is low, it is also a good estimate of the cumulative death rate. This rate is also called the crude death rate.
Last (1988)
PS **mortality, mortality rate**

decompensation Explicit pathophysiological changes following compensation for adverse effects.

decontamination Process of rendering harmless (by neutralization, elimination, removal, etc.) a potentially toxic substance in the natural environment, laboratory areas, the workplace, other indoor areas, clothes, food, water, sewage, etc.

defoliant Substance used for removal of leaves by its toxic action on living plants.

dehydrogenase Enzyme which catalyzes oxidation of compounds by removing hydrogen.

delayed effect Consequence occurring after a latent period following the end of exposure to a toxic substance or other harmful environmental factor.
SN **latent effect**

denaturation
1. Addition of methanol or acetone to alcohol to make it unfit for drinking.
2. Change in molecular structure of proteins so that they cannot function normally, often caused by splitting of hydrogen bonds following exposure to reactive substances or heat.

denitrification Reduction of nitrates to nitrities, nitrous oxides, or dinitrogen (N_2) catalyzed by facultative aerobic soil bacteria under anaerobic conditions.
Nagel *et al.* (1991)

dental flurosis Variety of tooth enamel malformations due to excessive fluoride exposure during dental development.

deoxyribonucleic acid (DNA) Constituent of chromosomes which stores the hereditary information of an organism in the form of a sequence of purine

and pyrimidine bases: This information relates to the synthesis of proteins and hence it is a determinant of all physical and functional activities of the cell, and consequently of the whole organism.
RT **ribonucleic acid (RNA)**

dependence
1. A psychic craving for a drug or other substance which may or may not be accompanied by a physical dependency.
2. Reliance on a drug or other substance to maintain health.

PS **addiction**

depilatory Substance causing loss of hair.

deposition
1. Process by which a substance arrives at a particular organ or tissue site, for example, the deposition of particles on the ciliated epithelium of the bronchial airways.
2. Process by which a substance sediments out of the atmosphere or water and settles in a certain place.

PS **accumulation**

dermal Pertaining to the skin.
SN **cutaneous**

dermal irritation Skin reaction resulting from a single or multiple exposure to a physical or chemical entity at the same site, characterized by the presence of inflammation; it may result in cell death.

dermatitis Inflammation of the skin: Contact dermatitis is due to local exposure and may be caused by irritation, allergy, or infection.

descriptive epidemiology Study of the occurrence of disease or other health-related characteristics in populations, including general observations concerning the relationship of disease to basic characteristics such as age, sex, race, occupation, and social class; it may also be concerned with geographic location. The major characteristics in descriptive epidemiology can be classified under the headings individuals, time, and place.
IPCS (1987)

desensitization Suppression of sensitivity of an organism to an allergen to which the organism has been exposed previously.

desiccant
1. Drying agent.
2. In agriculture, a substance used for drying up plants and facilitating their mechanical harvesting.

desorption Opposite of adsorption; a decrease in the amount of adsorbed substance.
Gold *et al.* (1987)

desquamation Shedding of an outer layer of skin in scales or shreds.

detoxification
1. Process, or processes, of chemical modification which make a toxic molecule less toxic.
2. Treatment of patients suffering from poisoning in such a way as to promote physiological processes which reduce the probability or severity of harmful effects.

detoxification by hemosorption perfusion Passage of a patient's blood through a set of columns filled with a hemosorbent (activated charcoal, ion-exchange resin, etc.): The purpose of the operation is to remove a toxic substance from the organism, particularly in an emergency.
RT **hemoperfusion, hemosorption**

detriment Estimated measure of the expected harm or loss associated with an adverse event, usually in a manner chosen to facilitate meaningful addition over different events. It is generally the integrated product of arbitrary values of risk and hazard and is often expressed in terms such as costs in U.S. dollars, loss in expected years of life, or loss in productivity, and it is needed for numerical exercises such as cost–benefit analysis.

developmental toxicity Adverse effects on the developing organism (including structural abnormality, altered growth, and functional deficiency or death) resulting from exposure prior to conception (in either parent), during prenatal development, or postnatally up to the time of sexual maturation.
IRIS (1986)
RT **embryotoxicity, teratogenicity**

diaphoresis Profuse perspiration.

diaphoretic Causing profuse perspiration.
SN **sudorific**

2,3-dimercaptopropanol Metal chelator which has been used in the treatment of arsenic, antimony, gold, mercury, and lead poisoning.
SN **British anti-Lewisite, dimercaprol**

dimercaprol See SN **2,3-dimercaptopropanol.**

diploid Chromosome state in which the chromosomes are present in homologous pairs. Normal human somatic (nonreproductive) cells are diploid (they have 46 chromosomes), whereas reproductive cells, with 23 chromosomes, are haploid.
RT **haploid, meiosis, mitosis**

discharge See SN **emission.**

discharge (effluent, emission) standard or release limit Maximum amount of a pollutant released

from a given source to a specified medium which is acceptable in specified circumstances.
WHO (1979)

discordance (genetic) Any difference in a character between individuals due to genetic differences such as may occur in dizygotic twins or between matched pairs in a case cohort study.
AN **concordance**

disease Literally, *dis-ease,* lack of *ease;* pathological condition that presents a group of symptoms peculiar to it and which establishes the condition as an abnormal entity different from other normal or pathological body states.

discontinuous effect See SN **intermittent effect.**

disposition Natural tendency shown by an individual or group of individuals, including any tendency to acquisition of specific diseases, often due to hereditary factors.

dissipation Reduction in the amount of a pesticide or other compound which has been applied to plants, soil, etc. (used when it is not clear whether this is by mineralization degradation, binding, or leaching).

distributed source See SN **area source.**
RT **point source**

distribution
1. Dispersal of a substance and its derivatives throughout the natural environment.
2. Dispersal of a substance within an organism, including metabolism, storage, and excretion.
3. Final location of a substance within an organism after dispersal.

diuresis Excretion of urine, especially in excess.

diuretic Agent which increases urine production.
SN **micturitic**

dosage Dose expressed as a function of the organism being dosed and time, for example, mg/(kg body weight)/day.
See **dose**

dose Total amount of a substance administered to, taken, or absorbed by an organism.
NT **absolute lethal dose, cumulative median lethal dose, lethal dose, maximum tolerable dose, maximum tolerated dose, median effective dose, median lethal dose, median narcotic dose, minimum lethal dose, noneffective dose, organ dose, threshold dose, toxic dose**

dose–effect curve Graph of the relation between dose and the magnitude of the biological change produced measured in appropriate units.
RT **concentration–effect curve**

dose–effect relationship Association between dose and the magnitude of a continuously graded effect, in an individual, a population, or experimental animals.
RT **concentration–effect relationship**

dose-related effect Situation in which the magnitude of a biological change is related to the dose.
AN **non-dose-related effect**

dose–response curve Graph of the relation between dose and the proportion of individuals in a population responding with an all-or-none effect.
RT **concentration–response curve, response**

dose–response relationship Association between dose and the incidence of a defined biological effect in an exposed population.
RT **concentration–response relationship, response**

Draize test Evaluation of materials for their potential to cause dermal or ocular irritation and corrosion following local exposure, generally using the rabbit model (almost exclusively the New Zealand White), although other animal species have been used.

drug Any substance which when absorbed into a living organism may modify one or more of its functions. The term is generally accepted for a substance taken for a therapeutic purpose, but it is also commonly used for abused substances.
After WHO (1978a)
SN **medicine, pharmaceutical**

duplicate portion sampling method (diet/food) Method frequently used for the same purposes as the total diet study technique. Test persons consume their ordinary diet but for each meal they prepare for subsequent analysis a duplicate portion of all food as prepared, served, and consumed.
SN **duplicate diet study**

duplicate (replicate) samples (in chemistry) Two (or multiple) samples taken under the same or comparable conditions.
PAC (1990)

dysarthria Imperfect articulation of speech due to neuromuscular damage.

dysfunction Abnormal, impaired, or incomplete functioning of an organism, organ, tissue, or cell.

dysplasia Abnormal development of an organ or tissue identified by morphological examination.

dyspnoea Difficult or labored breathing.

ecogenetics Study of the influence of hereditary factors on the effects of xenobiotics on individual organisms.
PS **pharmacogenetics, toxicogenetics**
RT **polymorphism**

ecology Branch of biology which studies the interactions between living organisms and all factors (including other organisms) in their environment: Such interactions encompass environmental factors which determine the distributions of living organisms.
IPCS (1987)

ecosystem Grouping of organisms (microorganisms, plants, and animals) interacting together, with and through their physical and chemical environments, to form a functional entity.
IPCS (1987)

ecotoxicology Study of the toxic effects of chemical and physical agents on all living organisms, especially on populations and communities within defined ecosystems; it includes transfer pathways of these agents and their interactions with the environment.

ectohormone See SN **pheromone.**

ectoparasiticide Substance intended to kill parasites living on the exterior of the host.
IRIS (1986)

eczema Acute or chronic skin inflammation with erythema, papules, vesicles, pustules, scales, crusts, or scabs, alone or in combination, of varied etiology.

edema See SN **oedema.**

effective concentration (EC) Concentration of a substance that causes a defined magnitude of response in a given system: EC_{50} is the median concentration that causes 50% of maximal response.
RT **lethal concentration**

effective dose (ED) Dose of a substance that causes a defined magnitude of response in a given system: ED_{50} is the median dose that causes 50% of maximal response.
BT **dose**
RT **lethal dose**

effluent Fluid, solid, or gas discharged from a given source into the external environment.
RT **emission**

elimination Expulsion of a substance or other material from an organism (or a defined part thereof), usually by a process of extrusion or exclusion, sometimes after metabolic transformation.
WHO (1979)
RT **clearance**

elimination half-life or half-time Period taken for the plasma concentration of a substance to decrease by half.
BT **biological half-life or half-time ($t_{1/2}$).**

eliminator (of a poison) Substance that contributes to the elimination of a poison from an organism.

embryo
1. Stage in the developing mammal at which the characteristic organs and organ systems are being formed: For humans, this involves the stages of development from the second to the eighth week (inclusive postconception).
2. In birds, the stage of development from the fertilization of the ovum up to hatching.
3. In plants, the stage of development within the seed.

embryotoxicity
1. Production by a substance of toxic effects in progeny in the first period of pregnancy between conception and the fetal stage.
2. Any toxic effect on the conceptus as a result of prenatal exposure during the embryonic stages of development: These effects may include malformations and variations, malfunctions, altered growth, prenatal death, and altered postnatal function.
   After USEPA (1989)

RT **developmental toxicity, teratogenicity**

embryotropic effect Change in the embryo and the regulation of its development.

emesis Vomiting.

emission Release of a substance from a source, including discharges to the wider environment.
SN **discharge, effluent, release**
RT **immission**

emission and exposure control Technical and administrative procedures and specifications applied for the monitoring, reduction, or elimination of emissions from a source or exposure to a target.
After WHO (1989a)

emission standard Quantitative limit on the emission or discharge of a substance from a source, usually expressed in terms of a time-weighted average concentration or a ceiling value.
PS **discharge standard**
RT **limit value**

endemic Present in a community or among a group of people; said of a disease prevailing continually in a region.

endocrine Pertaining to hormones or to the glands that secrete hormones directly into the bloodstream.

endoplasmic reticulum Intracellular complex of membranes in which proteins and lipids, as well as molecules for export, are synthesized and in which the biotransformation reactions of the monooxygenase enzyme systems occur: may be isolated as microsomes following cell fractionation procedures.

RT **cytochrome P420, cytochrome P448, cytochrome P450, microsome, monooxygenase, phase 1 reactions**

endothelial Pertaining to the layer of flat cells lining the inner surface of blood and lymphatic vessels, and the surface lining of serous and synovial membranes.

enteritis Intestinal inflammation.

enterohepatic circulation Cyclical process involving intestinal reabsorption of a substance that has been excreted through the bile followed by transfer back to the liver, making it available for biliary excretion again.
After WHO (1979)

environment Aggregate, at a given moment, of all external conditions and influences to which a system under study is subjected.
ISO (1975)

environmental damage Adverse effects to the natural environment.

environmental exposure level (EEL) Level (concentration or amount or a time integral of either) of a substance to which an organism or other component of the environment is exposed in its natural surroundings.

environmental fate Destiny of a chemical or biological pollutant after release into the natural environment.

environmental health Human welfare and its influence by the environment, including technical and administrative measures for improving the human environment from a health point of view.
After WHO (1989a)
PS **environmental medicine, environmental hygiene**
RT **occupational hygiene**

environmental health criteria documents Critical publications of IPCS containing reviews of methodologies and existing knowledge—expressed, if possible, in quantitative terms—of selected substances (or groups of substances) on identifiable, immediate, and long-term effects on human health and welfare.
IPCS (1987)

environmental health impact assessment Estimate of the adverse health effects or risks likely to follow from a proposed or expected environmental change or development.

environmental hygiene Practical control measures used to improve the basic environmental conditions affecting human health, for example, clean water supply, human and animal waste disposal, protection of food from biological contamination, and housing conditions, all of which are concerned with the quality of the human environment.
After WHO (1979)
SN **environmental sanitation**

environmental impact assessment (EIA) Appraisal of the possible environmental consequences of a past, ongoing, or planned action, resulting in the production of an environmental impact statement or ''finding of no significant impact'' (FONSI).
RT **environmental impact statement**

environmental impact statement (EIS) Report resulting from an environmental impact assessment.
RT **environmental impact assessment**

environmental monitoring Continuous or repeated measurement of agents in the environment to evaluate environmental exposure and possible damage by comparison with appropriate reference values based on knowledge of the probable relationship between ambient exposure and resultant adverse effects.
RT **biological effect monitoring, biological monitoring, reference value**

environmental protection
1. Actions taken to prevent or minimize adverse effects to the natural environment.
2. Complex of measures including monitoring of environmental pollution and development and practice of environmental protection principles (legal, technical, and hygienic), including risk assessment, risk management, and risk communication.

environmental quality objective (EQO) Overall state to be aimed for in a particular aspect of the natural environment; for example, ''water in an estuary such that shellfish populations survive in good health.'' Unlike an environmental quality standard, the EQO is usually expressed in qualitative and not quantitative terms.
RT **environmental quality standard**

environmental quality standard (EQS) Amount concentration or mass concentration of a substance that should not be exceeded in an environmental system, often expressed as a time-weighted average measurement over a defined period.
SN **ambient standard**
RT **limit value**

environmental sanitation See SN **environmental hygiene.**

environmental transformation Chemical transformation of substances resulting from interactions in the environment.

enzootic Present in a community or among a group of animals; said of a disease prevailing continually in a region.

epidemiology Study of the distribution and determinants of health-related states or events in populations and the application of this study to control of health problems.
Last (1988)

epigastric Pertaining to the upper-middle region of the abdomen.

epigen/esis(n.), **-etic**(adj.) Changes in an organism brought about by alterations in the expression of genetic information without any change in the genome itself: The genotype is unaffected by such a change but the phenotype is altered.
RT **mutation, phenotype, transformation, tumor**

epileptiform Occurring in severe or sudden spasms, as in convulsion or epilepsy.

epithelioma Any tumor derived from epithelium.
NT **carcinoma**

epithelium Cells covering the internal and external surfaces of the body.

epitope Any part of a molecule that acts as an antigenic determinant: A macromolecule can contain many different epitopes, each capable of stimulating production of a different specific antibody.
Nagel *et al.* (1991)

equivalent diameter (of a particle) Diameter of a spherical particle of the same density as a particle under investigation that, relative to a given phenomenon or property, would behave in the same way as the particle under investigation.
ISO (1979)
RT **aerodynamic diameter**

erythema Redness of the skin produced by congestion of the capillaries.

eschar Slough or dry scab on an area of skin that has been burnt.

estimated daily intake (EDI) Prediction of the daily intake of a residue of a potentially harmful agent based on the most realistic estimation of the residue levels in food and the best available food consumption data for a specific population: Residue levels are estimated taking into account known uses of the agent, the range of contaminated commodities, the proportion of a commodity treated, and the quantity of home-grown or imported commodities. The EDI is expressed in mg residue per person.
WHO (1989b)

estimated exposure concentration (EEC) Measured or calculated amount or mass concentration of a substance to which an organism is likely to be exposed, considering exposure by all sources and routes.

estimated exposure dose (EED) Measured or calculated dose of a substance to which an organism is likely to be exposed, considering exposure by all sources and routes.
IRIS (1986)

estimated maximum daily intake (EMDI) Prediction of the maximum daily intake of a residue of a potentially harmful agent based on assumptions of average food consumption per person and maximum residues in the edible portion of a commodity, corrected for the reduction or increase in residues resulting from preparation, cooking, or commercial processing. The EMDI is expressed in mg residue per person.
WHO (1989b)

etiology See **aetiology.**

eukaryote Cell or organism with the genetic material packed in a membrane-surrounded structurally discrete nucleus and with well-developed cell organelles. The term includes all organisms except archaebacteria, eubacteria, and cyanobacteria (until recently classified as cyanophyta or blue-green algae).
Nagel *et al.* (1991)
AN **prokaryote**

European Inventory of Existing Chemical Substances (EINECS) List of all substances supplied either singly or as components in preparations to persons in a member state of the European Community on any occasion between January 1, 1971 and September 18, 1981.

eutrophic Describes a body of water with a high concentration of nutrient salts and a high or excessive rate of biological production.

eutrophication Adverse change in the chemical and biological status of a body of water following depletion of the oxygen content caused by decay of organic matter resulting from high primary production as a result of enhanced input of nutrients.

excess lifetime risk Additional or excess risk incurred over the lifetime of an individual by exposure to a toxic substance.
IRIS (1986)
BT **risk**
RT **hazard**

excess rate See SN **rate difference.**

exchange transfusion Method of active artificial elimination of toxicity consisting in complete replacement of blood of the patient by donor blood.

excipient Any more or less inert substance added to a drug to give suitable consistency or form to the drug.
RT **vehicle**

excretion Discharge or elimination of an absorbed or endogenous substance or of a waste product, and/or their metabolites, through some tissue of the body and its appearance in urine, feces, or other products normally leaving the body. Excretion of chemical compounds from the body occurs mainly through the kidney and the gut. Volatile compounds may be largely eliminated by exhalation. Excretion by perspiration and through hair and nails may also occur. Excretion by the gastrointestinal tract may take place by various routes, such as the bile, the shedding of intestinal cells, and transport through the intestinal mucosa.
After WHO (1989a)
RT **clearance, elimination**

excretion rate Amount of substance (and/or its metabolites) or fraction that is excreted per unit time. It should be noted that according to this definition excretion does not include the passing of a substance through the intestine without absorption. When discussing the total amount of a substance in feces (including the unabsorbed part), it is preferable to speak about fecal substance content (mol/kg) or mass content (kg/kg).

exogenous Resulting from causes or derived from materials external to an organism.
AN **endogenous**

exogenous substance See SN **xenobiotic.**

experimental model ecosystem See SN **microcosm.**

explant Living tissue removed from its normal environment and transferred to an artificial medium for growth.

exposed Subject to a factor that is under study in the environment, for instance, an environmental hazard.
AN **nonexposed, unexposed**

exposed group (sometimes abbreviated to exposed) in epidemiology Group whose members have been exposed to a supposed cause of a disease or health state of interest or possess a characteristic that is a determinant of the health outcome of interest.
Last (1988)

exposure
1. Concentration, amount, or intensity of a particular physical or chemical agent or environmental agent that reaches the target population, organism, organ, tissue, or cell, usually expressed in numerical terms of substance concentration, duration, and frequency (for chemical agents and microorganisms) or intensity (for physical agents such as radiation).
2. Process by which a substance becomes available for absorption by the target population, organism, organ, tissue, or cell by any route.

exposure assessment Process of measuring or estimating concentration (or intensity), duration, and frequency of exposures to an agent present in the environment or, if estimating hypothetical exposures, that might arise from the release of a substance, or radionuclide, into the environment.
RT **risk assessment**

exposure control See BT **emission and exposure control.**

exposure–effect relationship See NT **concentration–effect relationship, dose–effect relationship.**

exposure limit General term defining an administrative substance concentration or intensity of exposure that should not be exceeded.
IPCS (1987)
RT **discharge limit**

exposure ratio In a case control study, the value obtained by dividing the rate at which persons in the case group are exposed to the risk factor (or to the protective factor) by the rate at which persons in the control group are exposed to the risk factor (or to the protective factor) of interest.
After Last (1988)

exposure–response relationship See RT **concentration–response relationship, dose–response relationship.**

exposure test Determination of the level, concentration, or uptake of a potentially toxic compound and/or its metabolite(s) in biological samples from an organism (blood, urine, hair, etc.) and the interpretation of the results to estimate the absorbed dose or degree of environmental pollution; or the measuring of biochemical effects, usually not direct adverse effects of the substance, and relating them to the quantity of substance absorbed or to its concentration in the environment.
IRPTC (1982)
RT **biological monitoring, biological assessment of exposure**

external validity Generalizability of the results of a particular study beyond the limits of the population actually studied.
IPCS (1987)
BT **validity**

extra risk Probability that an agent produces an observed response, as distinguished from the probabil-

ity that the response is caused by a spontaneous event unrelated to the agent.
IRIS (1986)
BT **risk**

extraneous residue limit (ERL) Refers to a pesticide residue or contaminant arising from environmental sources (including former agricultural uses) other than the use of a pesticide or contaminant substance directly or indirectly on the commodity. It is the maximum concentration of a pesticide residue or contaminant that is recommended by the Codex Alimentarius Commission to be legally permitted or recognized as acceptable in or on food, agricultural commodity, or animal feed. The mass content is expressed in milligrams of pesticide residue or contaminant per kilogram of commodity.
After Codex Alimentarius Commission (1986a)

extrapolation Calculation, based on quantitative observations in exposed test species or *in vitro* test systems, of predicted dose–effect and dose–response relationships for a substance in humans and other biota including interspecies extrapolations and extrapolation to susceptible groups of individuals: The term may also be used for qualitative information applied to species or conditions that are different from the ones in which the original investigations were carried out.

fecundity
1. Ability to produce offspring frequently and in large numbers.
2. In demography, the physiological ability to reproduce.

PS **fertility**

feromone See SN **pheromone.**

fertility Ability to conceive and to produce offspring: For litter-bearing species the number of offspring per litter is used as a measure of fertility. Reduced fertility is sometimes referred to as subfertility.
USEPA (1989)
RT **fecundity**

fertility toxicant Produces abnormalities of male or female reproductive functions or impairs reproductive capacity.
USEPA (1986)
RT **developmental toxicity, reproductive toxicant**

fertilizer Substance applied to soil or hydroponic systems for improving the root nutrition of plants with the aim of increasing crop yields and/or controlling production.

fetotoxicity Toxicity to the fetus.
RT **embryotoxicity, teratogenicity**

fetus (often incorrectly foetus) Young mammal within the uterus of the mother from the visible completion of characteristic organogenesis until birth: In humans, this period is usually defined as from the third month after fertilization until birth (prior to this, the young mammal is referred to as an embryo).
Oxford English Dictionary (1991)
RT **embryo**

fibrosis Abnormal formation of fibrous tissue.

fiducial limit Form of confidence limit given as a stated probability; for example, $P = 0.95$: In toxicology the terms fiducial limits and confidence limits are generally considered to be synonymous.
Brown (1988)

first-pass effect Biotransformation of a substance in the liver after absorption from the intestine and before it reaches the systemic circulation.

fixed dose procedure Acute toxicity test in which a substance is tested initially at a small number (three or four) predefined doses to identify which produces evident toxicity without lethality: The test may be repeated at one or more higher or lower defined discriminating doses to satisfy the criteria.
NT **limit test**

fluorosis Adverse effects of fluoride, as in dental or skeletal fluorosis.

foci (singular focus) Small groups of cells distinguishable, in appearance or histochemically, from the surrounding tissue: indicative of an early stage of a lesion that may lead to the formation of a neoplastic nodule.

foetus See **fetus.**

follow-up study Investigation in which individuals or populations, selected on the basis of whether they have been exposed to risk, have received a specified preventive or therapeutic procedure, or possess a certain characteristic, are followed to assess the outcome of exposure, the procedure, or effect of the characteristic, for example, occurrence of disease.
Last (1988)
SN **cohort study**

food additive Any substance not normally consumed as a food by itself and not normally used as a typical ingredient of the food, whether or not it has nutritive value, the intentional addition of which to food for a technological (including organoleptic) purpose in the manufacture, processing, preparation, treatment, packing, packaging, transport, or holding of such food results or may be reasonably expected to result (directly or indirectly) in it or its by-products becoming a component of or otherwise

affecting the characteristics of such foods. The term does not include ''contaminants'' or substances added to food for maintaining or improving nutritional qualities.
Codex Alimentarius Commission (1983)

food allergy Hypersensitivity reaction to substances in the diet to which an individual has previously been sensitized.
RCP (1984)
BT **allergy, hypersensitivity**

food chain Sequence of transfer of matter and energy in the form of food from organism to organism in ascending or descending trophic levels.
WHO (1979)

food intolerance Physiologically based reproducible, unpleasant (adverse) reaction to a specific food or food ingredient that is not immunologically based.
RCP (1984)
RT **food allergy**

food web Network of food chains.

forced diuresis Method of stimulating diuresis based on performing hydrational therapy, sometimes with parallel introduction of diuretics, with the aim of achieving increased clearance of a toxic substance in urine.

foreign substance (foreign compound) See SN **xenobiotic.**

frame shift mutation Point mutation involving either the deletion or the insertion of one or two nucleotides in a gene: By the frame shift mutation, the normal reading frame used when decoding nucleotide triplets in the gene is altered.
After Nagel *et al.* (1991)

fumigant Substance that is vaporized in order to kill or repel pests.

fungicide Substance intended to kill fungi.

fungus preparation Substance obtained from fungi that has an insecticidal effect reflecting the pathogenicity of the fungi for insects.
IRPTC (1982)

gamete Reproductive cell (either sperm or egg) containing a haploid set of chromosomes.
RT **zygote**

gametocide Substance intended to kill gametes.

gastrointestinal Pertaining or communicating with the stomach and intestine.

gavage Administration of materials directly into the stomach by esophageal intubation.

gene Structurally a basic unit of hereditary material; an ordered sequence of nucleotide bases that encodes one polypeptide chain (following transcription to mRNA).
SN **cistron**

gene amplification Production of extra copies of a chromosomal sequence found either as intra- or extrachromosomal DNA; With respect to a plasmid, it refers to the increase in the number of plasmid copies per cell induced by a specific treatment of transformed cells.

genetic polymorphism Condition in which a genetic character occurs in more than one form, resulting in the coexistence of more than one morphological type in a given population.

genetic toxicology Study of substances that can produce adverse heritable changes.

genome Complete set of chromosomal and extrachromosomal genes of an organism, a cell, an organelle, or a virus: complete DNA component of an organism.
Nagel *et al.* (1991)

genotoxicity Ability to cause damage to genetic material. Such damage may be mutagenic and/or carcinogenic.

genotype Genetic constitution of an organism as revealed by genetic or molecular analysis; the complete set of genes, both dominant and recessive, possessed by a particular organism, cell, organelle, or virus.
After Nagel *et al.* (1991)

germ-free animal Animal grown under sterile conditions in the period of postnatal development: Such animals are usually obtained by cesarean operation and kept in special sterile boxes in which there are no viable microorganisms (sterile air and food and water are supplied).
IRPTC (1982)
SN **axenic animal**
BT **gnotobiont, gnotobiote**

germinal aplasia Complete failure of gonad development.

glomerular Pertaining to a tuft or cluster, as of a plexus of capillary blood vessels or nerve fibers, especially referring to the capillaries of the glomeruli of the kidney.

''glue sniffing'' Solvent abuse using plastic cement or other solvent-based adhesives.
BT **''solvent sniffing''**
RT **addiction, dependence, solvent abuse**

gnotobiont See SN **gnotobiote.**
NT **germ-free animal**

gnotobiota Specially and entirely known microfauna and microflora of a specially reared laboratory animal.
RT **gnotobiote**

gnotobiot/e (n.), -ic (adj.) Specially reared laboratory animal whose microflora and microfauna are specifically known in their entirety.
NT **germ-free animal**

gonadotropic Pertaining to effects on sex glands and on the systems that regulate them.

good agricultural practice (GAP) in the use of pesticides Nationally authorized safe uses of pesticides under actual conditions necessary for effective and reliable pest control. It encompasses a range of levels of pesticide applications up to the highest authorized use, applied in a manner that leaves a residue which is the smallest amount practicable. Authorized safe uses include nationally registered or recommended uses that take into account public and occupational health and environmental safety considerations. Actual conditions include any stage in the production, storage, transport, distribution, and processing of food commodities and animal feed.
Codex Alimentarius Commission (1989)

good laboratory practice (GLP) principles Fundamental rules incorporated in national regulations concerned with the process of effective organization and the conditions under which laboratory studies are properly planned, performed, monitored, recorded, and reported.
RT **quality assurance, quality control**

good manufacturing practice (GMP) principles Fundamental rules incorporated in national regulations concerned with the process of effective organization of production and ensuring standards of defined quality at all stages of production, distribution, and marketing; minimization of waste and its proper disposal are part of this process.

graded effect Consequence that can be measured on a graded scale of intensity or severity and its magnitude related directly to the dose or concentration of the substance producing it.
After WHO (1989a)
AN **all-or-none effect, quantal effect**
RT **stochastic effect**

granuloma Granular growth or tumor, usually of lymphoid and epithelial cells.

ground treatment of plants Dusting or spraying of plants with pesticides by hand, by special machines, or by apparatus fixed to tractors or driven by them.
IRPTC (1982)

guideline for exposure limits Scientifically judged quantitative value (a concentration or number) of an environmental constituent that ensures esthetically pleasing air, water, or food and from which no adverse effect is expected concerning noncarcinogenic end points or that gives an acceptably low estimate of lifetime cancer risk from those substances which are proven human carcinogens or carcinogens with at least limited evidence of human carcinogenicity.

guideline value Quantitative measure (a concentration or a number) of a constituent of an environmental medium that ensures esthetically pleasing air, water, or food and does not result in a significant risk to the user.

guides to air quality Sets of atmospheric concentrations and exposure times that are associated with specific effects of varying degrees of pollution on man, animals, vegetation, and the environment in general.
WHO (1979)

guides to environmental quality Sets of concentrations, numbers, and exposure times that are associated with the specific effects of factors in environmental media on man, animals, vegetation, and the environment in general.
After WHO (1979)

guinea pig maximization test (Magnusson and Kligman test) Widely used skin test for screening possible contact allergens: considered to be a useful method to identify likely moderate and strong sensitizers in humans.

half-life (half-time) ($t_{1/2}$) Time in which the concentration of a substance will be reduced by half, assuming a first-order elimination process or radioactive decay.

haploid (monoploid) State in which a cell contains only one set of chromosomes.
RT **diploid, gamete, meiosis**

hapten Low-molecular-weight molecule that contains an antigenic determinant (epitope) that may bind to a specific antibody but which is not itself antigenic unless complexed with an antigenic carrier such as a protein or cell; once bound, it can cause the sensitization of lymphocytes, possibly leading to allergy or cell-mediated hypersensitivity.
After Nagel *et al.* (1991)
RT **allergy, antigen, antibody, cell-mediated hypersensitivity, epitope**

harm Damage or adverse effect to a population, species, individual organism, organ, tissue, or cell.
SN **adverse effect**

harmful occupational factor Component of the work environment the effect of which on a worker under certain conditions leads to ill health or reduction of working ability.

harmful substance Substance that, following contact with an organism, can cause ill health or adverse

effects either at the time of exposure or later in the life of the present and future generations.
SN **noxious substance**

hazard Set of inherent properties of a substance, mixture of substances, or a process involving substances that, under production, usage, or disposal conditions, make it capable of causing adverse effects to organisms or the environment, depending on the degree of exposure; in other words, it is a source of danger.
RT **risk**

hazard assessment Determination of factors controlling the likely effects of a hazard such as the dose–effect and dose–response relationships, variations in target susceptibility, and mechanism of toxicity.
RT **exposure assessment, hazard evaluation, hazard identification, risk assessment, risk characterization, risk estimation, risk evaluation, risk identification, risk perception**

hazard communication standard U.S. OSHA standard requiring all employers to inform employees of the hazard of substances in the workplace and the steps necessary to avoid harm.

hazard evaluation Establishment of a qualitative or quantitative relationship between hazard and benefit, involving the complex process of determining the significance of the identified hazard and balancing this against identifiable benefit: This may subsequently be developed into a risk evaluation.
RT **exposure evaluation, hazard assessment, hazard identification, risk assessment, risk characterization, risk estimation, risk evaluation, risk identification, risk perception**

hazard identification Determination of substances of concern, their adverse effects, target populations, and conditions of exposure, taking into account toxicity data and knowledge of effects on human health, other organisms, and their environment.
WHO (1988)

hazard quotient (HQ) Ratio of toxicant exposure (estimated or measured) to a reference value regarded as corresponding to a threshold of toxicity: If the total hazard quotient from all toxicants to a target exceeds unity, the combination of toxicants may produce (will produce under assumptions of additivity) an adverse effect.
RT **hazard, pollutant, toxic substance**

hazardous production factor Production factor the effect of which on a worker under certain conditions results in injury or some impairment of health.
IRPTC (1982)
SN **hazard at work, hazardous occupational factor**

health
1. State of complete physical, mental, and social well-being and not merely the absence of disease or infirmity.
   WHO (1978b)
2. State of dynamic balance in which an individual's or a group's capacity to cope with the circumstances of living is at an optimal level.
3. State characterized by anatomical, physiological, and psychological integrity; ability to perform personally valued family, work, and community roles; ability to deal with physical, biological, psychological, and social stress; a feeling of well-being; and freedom from the risk of disease and untimely death.
   Last (1988)

health-based exposure limit Maximum concentration or intensity of exposure that can be tolerated without significant effect (based on only scientific and not economic evidence concerning exposure levels and associated health effects).
ACGIH (1985) de Koning (1987)

health hazard Any factor or exposure that may adversely affect health.
Last (1988)

health surveillance Periodic medicophysiological examinations of exposed workers with the objective of protecting health and preventing occupationally related disease.
Berlin *et al.* (1984)
RT **biological monitoring, biomarker, monitoring**

healthy worker effect Epidemiological phenomenon observed initially in studies of occupational diseases: Workers usually exhibit lower overall disease and death rates than the general population due to the fact that the old, severely ill, and disabled are ordinarily excluded from employment. Death rates in the general population may be inappropriate for comparison if this effect is not taken into account.
WHO (1989a)

hematemesis Vomiting of blood.

hematoma Localized accumulation of blood, usually clotted, in an organ, space, or tissue due to a failure of the wall of a blood vessel.

hematuria The presence of blood in the urine.

hemodialysis Use of an artificial kidney to remove toxic compounds from the blood by passing it through a tube of semipermeable membrane. The tube is bathed in a dialyzing solution to restore the normal chemical composition of the blood while permitting diffusion of toxic substances from the blood.

hemoglobinuria The presence of free hemoglobin in the urine.

hemolysin Substance that damages the membrane of erythrocytes causing the release of hemoglobin.

hemolysis Release of hemoglobin from erythrocytes, and its appearance in the plasma.

hemoperfusion Passing blood through a column of charcoal or adsorbent resin for the removal of drugs or toxins.

hemosiderin Iron-containing pigment that is formed from hemoglobin released during the disintegration of red blood cells and that accumulates in individuals who have ingested excess iron.

hepatic Pertaining to the liver.

hepatotoxic Poisonous to liver cells.

Henry's law constant At constant temperature and pressure, the ratio of the partial pressure of a gas above a liquid to its molal solubility in the liquid and therefore a measure of its partition between the gas phase and the solute phase.

herbicide Substance intended to kill plants.

histogenic origin Germ cell layer of the embryo from which a given adult tissue develops.

histology Study (usually microscopic) of the anatomy of tissues and their cellular and subcellular structure.

histopathology Microscopic pathological study of the anatomy and cell structure of tissues in disease to reveal abnormal or adverse structural changes.

homeostasis Normal, internal stability in an organism maintained by coordinated responses of the organ systems that automatically compensate for environmental changes.

homology Degree of identity existing between the nucleotide sequences of two related but not complementary DNA or RNA molecules; 70% homology means that on the average 70 of every 100 nucleotides are identical in a given sequence. The same term is used in comparing the amino acid sequences of related proteins.

hormesis Stimulatory effect of small doses of a potentially toxic substance that is inhibitory in larger doses.

hormone Substance formed in one organ or part of the body and carried in the blood to another organ or part where it selectively alters functional activity.

human ecology Interrelationship between humans and the entire environment—physical, biological, socioeconomic, and cultural—including the interrelationships between individual humans or groups of humans and other human groups or groups of other species.

human equivalent dose Human dose of an agent that is believed to induce the same magnitude of a toxic effect that the known animal dose has induced. IRIS (1986)

hydrophilic/ (adj.), **-ity** (n.) Describing the character of a molecule or atomic group which has an affinity for water.

hydrophobic/ (adj.), **-ity**(n.) Describing the character of a molecule or atomic group which is insoluble in water or resistant to wetting or hydration.

hygiene Science of health and its preservation.

hyper- Prefix meaning above or excessive: When used with the suffix ''-emia'' it refers to blood and with the suffix ''-uria'' refers to urine; for example ''hyperbilirubinemia.''

hyperalimentation Ingestion or administration of nutrients in excess of optimal amounts.

hyperbilirubinemia Excessive concentration of bilirubin in the blood.

hypercalcemia Excessive concentration of calcium in the blood.

hyperemia Excessive amount of blood in any part of the body.

hyperglycemia Excessive concentration of glucose in the blood.

hyperkalemia Excessive concentration of potassium in the blood.

hypernatremia Excessive concentration of sodium in the blood.

hyperparathyroidism Abnormally increased parathyroid gland activity that affects, and is affected by, plasma calcium concentration.

hyperplasia Abnormal multiplication or increase in the number of normal cells in a tissue or organ.
RT **hypertrophy, neoplasia**

hyperreactivity Term used to describe the responses of (effects on) an individual to (of) an agent when they are qualitatively those expected but quantitatively increased.

hyperreflexia Exaggeration of reflexes.

hypersensitivity State in which an individual reacts with allergic effects following exposure to a certain substance (allergen) after having been exposed previously to the same substance.
PS **allergy**
RT **cell-mediated hypersensitivity, sensitization**

hypersusceptibility Excessive reaction following exposure to a given amount or concentration of a sub-

stance compared with the large majority of other exposed subjects.
RT **idiosyncrasy**

hypertension Persistently high blood pressure in the arteries or in a circuit, for example, pulmonary hypertension or hepatic portal hypertension.

hypertrophy Excessive growth in bulk of a tissue or organ through increase in size but not in number of the constituent cells.
RT **hyperplasia**

hypervitaminosis Condition resulting from the ingestion of an excess of one or more vitamins.

hypo- Prefix meaning under, deficient: When used with the suffix ''-emia'' it refers to blood and with the suffix ''-uria'' refers to urine; for example ''hypocalcemia.''

hypocalcemia Abnormally low calcium concentration in the blood.

hypokalemia Abnormally low potassium concentration in the blood.

hyponatremia Abnormally low sodium concentration in the blood.

hypovolemic Pertaining to an abnormally decreased volume of circulating fluid (plasma) in the body.

hypoxemia Deficient oxygenation of the blood.

hypoxia
1. Abnormally low oxygen content or tension.
2. Deficiency of oxygen in the inspired air, in blood, or in tissues, short of anoxia.

iatrogenic Any adverse condition resulting from medical treatment.
NT **nosocomial**

icterus Excess of bile pigment in the blood and consequent deposition and retention of bile pigment in the skin and the sclera.
RT **hyperbilirubinemia, jaundice**

idiosyncrasy Genetically based unusually high sensitivity of an organism to the effect of certain substances.
RT **hypersusceptibility, pharmacogenetics**

immediately dangerous to life or health concentration (IDLHC) According to the U.S. NIOSH, the maximum exposure concentration from which one could escape within 30 minutes without any escape-impairing symptoms or any irreversible health effects.

immission Environmental concentration of a pollutant resulting from a combination of emissions and dispersals (often synonymous with exposure).

immune complex Product of an antigen–antibody reaction that may also contain components of the complement system.
Roitt *et al.* (1989)

immune response Selective reaction of the body to substances that are foreign to it, or that the immune system identifies as foreign, shown by the production of antibodies and antibody-bearing cells or by a cell-mediated hypersensitivity reaction.
RT **antibody, autoimmune disease, cell-mediated hypersensitivity**

immunochemistry Study of biochemical and molecular aspects of immunology, especially the nature of antibodies, antigens, and their interactions.

immunogen See SN **antigen.**

immunoglobulin Family of closely related glycoproteins capable of acting as antibodies and present in plasma and tissue fluids; immunoglobulin E is the source of antibody in many hypersensitivity (allergic) reactions.
RT **allergy, antibody, hypersensitivity**

immunoglobulin E-mediated hypersensitivity State in which an individual reacts with allergic effects caused fundamentally by the reaction of antigen-specific immunoglobulin E following exposure to a certain substance (allergen) after having been exposed previously to the same substance.
RT **allergy, antibody, antigen, cell-mediated hypersensitivity, hypersensitivity, immunoglobulin**

immunopotentiation Enhancement of the capacity of the immune system to produce an effective response.

immunosuppression Reduction in the functional capacity of the immune response; may be due to
1. Inhibition of the normal response of the immune system to an antigen.
2. Prevention, by chemical or biological means, of the production of an antibody to an antigen by inhibition of the processes of transcription, translation, or formation of tertiary structure.

immunosurveillance Mechanisms by which the immune system is able to recognize and destroy malignant cells before the formation of an overt tumor.

immunotoxic Poisonous to the immune system.

incidence Number of occurrences of illness commencing, or of persons falling ill, during a given period in a specific population: usually expressed as a rate, with the denominator being the average number of persons in the specified population during a defined period or the estimated number of persons at the midpoint of that period. The basic

distinction between ''incidence'' and ''prevalence'' is that whereas incidence refers only to new cases, prevalence refers to all cases, irrespective of whether they are new or old. When the terms incidence and prevalence are used, it should be stated clearly whether the data represent the numbers of instances of the disease recorded or the numbers of persons ill.
WHO (1989a)

incidence rate Measure of the frequency with which new events occur in a population. The value is obtained by dividing the number of new events that occur in a defined period by the population at risk of experiencing the event during this period, sometimes expressed as person-time.
After Last (1988)

incremental unit risk estimate For an air pollutant, this is the additional lifetime cancer risk occurring in a hypothetical population in which all individuals are exposed continuously from birth throughout their lifetimes to a concentration of 1 μg per cubic meter ($\mu g/m^3$) of the pollutant in the air they breathe.
WHO (1987)

indirect exposure
1. Exposure to a substance in a medium or vehicle other than the one originally receiving the substance.
2. Exposure of people to a substance by contact with a person directly exposed.

RT **bystander exposure, paraoccupational exposure**

individual monitor See SN **personal sampler.**

individual protective device (IPD) Device for individual use for protection of the whole body, eyes, respiratory pathways, or skin of workers against hazardous and harmful production factors.
IRPTC (1982)
SN **personal protective device (PPD), personal protective equipment (PPE)**

individual risk Probability that an individual person will experience an adverse effect.

inducer Substance that causes induction.
RT **induction**

induction Increase in the rate of synthesis of an enzyme in response to the action of an inducer or environmental conditions: often the substrate of the induced enzyme or a structurally similar substance (gratuitous inducer) that is not metabolized.
After Nagel *et al.* (1991)

induction period Time from the onset of exposure to the appearance of signs of disease.
SN **latent period**

inhalation Act of drawing in of air, vapor, gas, and any suspended particulates into the lung.

inherently biodegradable Class of compounds for which there is unequivocal evidence of biodegradation (primary or ultimate) in any test of biodegradability.
RT **biodegradation**

inhibitory concentration (IC) Concentration of a substance that causes a defined inhibition of a given system: IC_{50} is the median concentration that causes 50% inhibition.
RT **effective concentration, lethal concentration**

inhibitory dose (ID) Dose of a substance that causes a defined inhibition of a given system: ID_{50} is the median dose that causes 50% inhibition.
RT **effective dose, lethal dose**

initiator
1. Agent that induces a change in a chromosome or gene that leads to the induction of tumors after a second agent, called a promoter, is administered to the tissue.
   RT **promoter**
2. Substance that starts a chain reaction; an initiator is consumed in a reaction, in contrast to a catalyst.
   Gold *et al.* (1987)

insecticide Substance intended to kill insects.

intake Amount of a substance that is taken into the body, regardless of whether or not it is absorbed: The total daily intake is the sum of the daily intake by an individual from food, drinking water, and inhaled air.

integral indicator of toxic effect Parameter (such as body weight or temperature) characterizing the overall changes in the general state of the organism exposed to a toxic substance.
IRPTC (1982)

interfacial layer Region of space comprising and adjoining the phase boundary within which properties of matter are significantly different from the values in the adjoining bulk phases.
PS **surface layer**

intermittent effect Biological change that comes and goes at intervals.
SN **discontinuous effect**

internal validity Selection and comparison of index and comparison groups in such a manner that, apart from sampling error, the observed differences between these groups with respect to dependent variables under study may be attributed only to the hypothesized effect under investigation.
IPCS (1987)

interpretation (of data or findings) Evaluation of the observations from an investigation or study in order to determine their significance for human health, for the environment, or for both.

interspecies dose conversion Process of extrapolating from the doses of one animal species to another, for example, from rodent dose to human equivalent.

interstitial pneumonia Chronic form of pneumonia involving increase of the interstitial tissue and decrease of the functional lung tissue.

intervention study Epidemiological investigation designed to test a hypothesized cause–effect relationship by modifying a supposed causal factor in a population.
Last (1988)

intestinal reabsorption Absorption further down the intestinal of a substance or substances that have been absorbed before and subsequently excreted into the intestinal tract, usually through the bile.
WHO (1979)

intoxication
1. Poisoning: pathological process with clinical signs and symptoms caused by a substance of exogenous or endogenous origin.
   RT **exogenous, endogenous**
2. Drunkenness following consumption of beverages containing ethanol or other compounds affecting the central nervous system.

in vitro In glass, referring to a study in the laboratory usually involving isolated organ, tissue, cell, or biochemical systems.
AN ***in vivo***

in vivo In the living body, referring to a study performed on a living organism.
AN ***in vitro***

ionizing radiation Any radiation consisting of directly or indirectly ionizing particles or a mixture of both or photons with energy higher than the energy of photons of ultraviolet light or a mixture of both such particles and photons.
Gold *et al.* (1987)

irreversible alteration Change from normal structure or function that persists or progresses after cessation of exposure of the organism.

irritant
1. (n.) Substance that causes inflammation following immediate, prolonged, or repeated contact with skin, mucous membrane, or other biological material. A substance capable of causing inflammation on first contact is called a primary irritant.
2. (adj.) Causing inflammation following immediate, prolonged, or repeated contact with skin, mucous membrane, or other tissues.

ischemia Local deficiency of blood supply and hence oxygen to an organ or tissue owing to constriction of the blood vessels or to obstruction.

isotonic Denoting a fluid exerting the same osmotic pressure or water potential as another fluid with which it is being compared.

itai–itai disease Illness observed in Japan possibly resulting from the ingestion of cadmium-contaminated rice: damage occurs to the renal and skeletoarticular systems, the latter being very painful (''itai'' means pain in Japanese).

jaundice Pathological condition characterized by deposition of bile pigment in the skin and mucous membranes, including the conjunctivae, resulting in yellow appearance of the patient or animal.
RT **hyperbilirubinaemia, icterus**

joint effect Simultaneous or successive effect of factors of diverse types (chemical, physical, and biological) on an organism.
RT **additive effect, antagonism, combined effect of poisons, potentiation, synergism**

lachrymator See **lacrimator.**

lacrimator Substance that irritates the eyes and causes the production of tears or increases the flow of tears.

larvicide Substance intended to kill larvae.

laryngospasm Reflex spasmodic closure of the sphincter of the larynx, particularly the glottic sphincter.

larynx Main organ of voice production; the part of the respiratory tract between the pharynx and the trachea.

lassitude Weakness; exhaustion.

latent effect See SN **delayed effect.**

latent period Delay between exposure to a disease-causing agent and the appearance of manifestations of the disease: also defined as the period from disease initiation to disease detection.
Last (1988)
SN **latency**

lavage Irrigation or washing out of a hollow organ or cavity such as the stomach, intestine, or the lungs.

laxative Substance that causes evacuation of the intestinal contents.
SN **cathartic, purgative**

lesion
1. Area of pathologically altered tissue.

2. Injury or wound.
3. Infected patch of skin.

lethal Deadly; fatal; causing death.

lethal concentration Concentration of a potentially toxic substance in an environmental medium that causes death following a certain period of exposure (denoted by LC).
WHO (1979)
RT **effective concentration, lethal dose**

lethal dose Amount of a substance or physical agent (radiation) that causes death when taken into the body by a single absorption (denoted by LD).
RT **effective dose, lethal concentration**

lethal synthesis Metabolic formation of a highly toxic compound from one that is relatively nontoxic (bioactivation), often leading to death of affected cells.
SN **suicide metabolism**

leukemia Progressive, malignant disease of the blood-forming organs, characterized by distorted proliferation and development of leukocytes and their precursors in the bone marrow and blood.

leukopenia Reduced concentration of leukocytes in the blood.

lgK_{OW} See SN **lgP_{ow}**.

lgP_{OW} Logarithm of base 10 of the partition coefficient of a substance between octanol and water: an empirical measure for lipophilicity used for calculating bioaccumulation, fish toxicity, membrane adsorption and penetration, etc.
RT **lipophilicity, octanol–water partition coefficient, partition coefficient**
SN **lgK_{OW}**

life-long exposure Subjection to a potentially toxic substance during the whole lifetime.

limacide Substance intended to kill mollusca, including the gastropod mollusc, *Limax*.

limit recommended See **recommended limit.**

limit test Acute toxicity test in which, if no ill effects occur at a preselected maximum dose, no further testing at greater exposure levels is required.
Brown (1988)
RT **fixed dose test**

limit value (LV) Limit concentration at or below which member states of the European Community must set their environmental quality standard and emission standard for a particular substance according to community directives.
NT **threshold limit value**

limited evidence According to the U.S. EPA's guidelines for carcinogen risk assessment, ''limited evidence'' is a collection of facts and accepted scientific inferences that suggests that an agent may be causing an effect, but this suggestion is not strong enough to be considered established fact.
IRIS (1986)
RT **carcinogenicity, classification according to IARC**

linearized multistage model Sequence of steps in which (i) a multistage model is fitted to tumor incidence data, (ii) the maximum linear term consistent with the data is calculated, (iii) the low-dose slope of the dose–response function is equated to the coefficient of the maximum linear term, and (iv) the resulting slope is then equated to the upper bound of potency.
BT **multistage model**

lipophilic/(adj.), **-ity**(n.) Having an affinity for fat and high lipid solubility: A physicochemical property which describes a partitioning equilibrium of solute molecules between water and an immiscible organic solvent, favoring the latter, and which correlates with bioaccumulation.
RT **bioaccumulation, bioaccumulation factor, bioconcentration, octanol–water partition coefficient**
SN **hydrophobicity**
AN **hydrophilicity, lipophobicity**

lipophobic/(adj.), **-ity**(n.) Having a low affinity for fat and a high affinity for water.
RT **bioaccumulation, bioaccumulation factor, bioconcentration, octanol–water partition coefficient**
SN **hydrophilicity**
AN **hydrophilicity, lipophilicity**

liposome Originally a lipid droplet in the endoplasmic reticulum of a fatty liver. Now applied to an artificially formed lipid droplet, small enough to form a relatively stable suspension in aqueous media and with potential use in drug delivery.

local effect Circumscribed change occurring at the site of contact between an organism and a toxicant.
RT **systemic effect**

logit transformation Mathematical transformation that relates response to a stated dose or concentration of a toxicant to the response in the absence of the toxicant by the formula:

$$\text{Logit} = \lg [B/(B_0 - B)]$$

where B is the response to the stated dose or concentration and B_0 is the response in the absence of the toxicant. Plotting the logit function against the logarithm of base 10 of the dose or concentration usually gives a linear relationship.

long-term effect See SN **chronic effect.**

long-term exposure Continuous or repeated exposure to a substance over a long period of time, usually of several years in man and of the greater part of the total life span in animals or plants.
IRPTC (1982)
SN **chronic exposure**

lowest lethal concentration found See SN **minimum lethal concentration.**

lowest-observed-adverse-effect-level (LOAEL) Lowest concentration or amount of a substance, found by experiment or observation, which causes an adverse alteration of morphology, functional capacity, growth, development, or life span of a target organism distinguishable from normal (control) organisms of the same species and strain under defined conditions of exposure.
RT **adverse effect, lowest-observed-effect-level, no-observed-adverse-effect-level, no-observed-effect-level**

lowest-observed-effect-level (LOEL) Lowest concentration or amount of a substance, found by experiment or observation, that causes any alteration in morphology, functional capacity, growth, development, or life span of target organisms distinguishable from normal (control) organisms of the same species and strain under the same defined conditions of exposure.
RT **adverse effect, lowest-observed-adverse-effect-level, no-observed-adverse-effect-level, no-observed-effect-level**

lymphocyte Animal cell that interacts with a foreign substance or organism, or one which it identifies as foreign, and initiates an immune response against the substance or organism. There are two groups of lymphocytes—B lymphocytes and T lymphocytes.
NT **B lymphocyte, immune response, T lymphocyte**

lymphoma General term comprising tumors and conditions allied to tumors arising from some or all of the cells of lymphoid tissue.

lysimeter Laboratory column of selected representative soil or a protected monolith of undisturbed field soil with which it is possible to sample and monitor the movement of water and substances.

lysosome Membrane-bound cytoplasmic organelle containing hydrolytic enzymes.

macrophage Large (10- to 20-mm diameter) ameboid and phagocytic cell found in many tissues, especially in areas of inflammation; macrophages are derived from blood monocytes and play an important role in host defense mechanisms.

macroscopic (gross) pathology Study of changes associated with disease that are visible to the naked eye without the need for a microscope.

Mad Hatter syndrome See SN **mercurialism.**

Magnusson and Kligman test See SN **guinea pig maximization test.**

mainstream smoke (tobacco smoking) Smoke that is inhaled.
WHO (1989a)
RT **sidestream smoke**

malaise Vague feeling of bodily discomfort.

malignancy Population of cells showing both uncontrolled growth and a tendency to invade and destroy other tissues; a malignancy is life-threatening.
RT **cancer, metastasis, tumor**

malignant
1. Tending to become progressively worse and to result in death if not treated.
2. In cancer, cells showing both uncontrolled growth and a tendency to invade and destroy other tissues.

AN **benign**

mania Emotional disorder (mental illness) characterized by an expansive and elated state (euphoria), rapid speech, flight of ideas, decreased need for sleep, distractability, grandiosity, poor judgment, and increased motor activity.

margin of exposure (MOE), margin of safety (MOS) Ratio of the no-observed-adverse-effect-level (NOAEL) to the theoretical or estimated exposure dose (EED) or concentration (EEC).
RT **therapeutic index**

mass mean diameter Diameter of a particle with a mass equal to the mean mass of all the particles in a population.

mass median diameter Diameter of a particle with the median mass of all the particles in a population.
IAEA (1978)

material safety data sheet (MSDS) Compilation of information required under the U.S. OSHA Hazard Communication Standard on the identity of hazardous substances, health and physical hazards, exposure limits, and precautions.
PS **hazard communication standard, safety data sheet**

maximum allowable (admissible, acceptable) concentration (MAC) Regulatory value defining the concentration that if inhaled daily (in the case of work people for 8 hr with a working week of 40 hr; in the case of the general population 24 hr) does not, in the present state of knowledge, appear capable of causing appreciable harm; however long delayed during the working life or during subsequent life or in subsequent generations.
RT **permissible exposure limit, threshold limit value**

maximum average daily concentration of an atmospheric pollutant Highest of the average daily concentrations recorded at a definite point of measurement during a certain period of observation.
IRPTC (1982)
SN **peak daily average concentration of an air pollutant**

maximum contaminant level (MCL) Under the Safe Drinking Water Act (USA), primary MCL is a regulatory concentration for drinking water which takes into account both adverse effects (including sensitive populations) and technological feasibility (including natural background levels): Secondary MCL is a regulatory concentration based on ''welfare,'' such as taste and staining, rather than health, but it also takes into account technical feasibility. MCL Goals (MCLG) under the Safe Drinking Water Act do not consider feasibility and are zero for all human and animal carcinogens.

maximum exposure limit (MEL) Occupational exposure limit legally defined in the United Kingdom under COSHH as the maximum concentration of an airborne substance, averaged over a reference period, to which employees may be exposed by inhalation in any circumstances and set on the advice of the HSC Advisory Committee on Toxic Substances.
RT **ceiling value**

maximum permissible concentration (MPC) See SN **maximum allowable concentration.**

maximum permissible daily dose Maximum daily dose of substance whose penetration into a human body during a lifetime will not cause diseases or health hazards that can be detected by current investigation methods and will not adversely affect future generations.

maximum permissible level (MPL) Level, usually a combination of time and concentration, beyond which any exposure of humans to a chemical or physical agent in their immediate environment is unsafe.
RT **maximum allowable concentration**

maximum residue limit (MRL) for pesticide residues Maximum contents of a pesticide residue (expressed as mg/kg fresh weight) recommended by the Codex Alimentarius Commission to be legally permitted in or on food commodities and animal feeds. MRLs are based on data obtained following good agricultural practice, and foods derived from commodities that comply with the respective MRLs are intended to be toxicologically acceptable.
Codex Alimentarius Commission (1989)

maximum residue limit (MRL) for veterinary drugs Maximum contents of a drug residue (expressed as mg/kg or μg/kg fresh weight) recommended by the Codex Alimentarius Commission to be legally permitted or recognized as acceptable in or on food commodities and animal feeds. The MRL is based on the type and amount of residue considered to be without any toxicological hazard for human health as expressed by the acceptable daily intake (ADI) or on the basis of a temporary ADI that uses an additional uncertainty factor. It also takes into account other relevant public health risks as well as food technological aspects.
Codex Alimentarius Commission (1989)

maximum tolerable concentration (MTC) Highest concentration of a substance in an environmental medium that does not cause death of test organisms or species (denoted by LC_0).
WHO (1979)

maximum tolerable dose (MTD) Highest amount of a substance that, when introduced into the body, does not kill test animals (denoted by LD_0).

maximum tolerable exposure level (MTEL) Maximum amount or concentration of a substance to which an organism can be exposed without leading to an adverse effect after prolonged exposure time.

maximum tolerated dose (MTD) High dose used in chronic toxicity testing that is expected on the basis of an adequate subchronic study to produce limited toxicity when administered for the duration of the test period. It should not induce (i) overt toxicity (e.g., appreciable death of cells or organ dysfunction), (ii) toxic manifestations that are predicted materially to reduce the life span of the animals except as the result of neoplastic development, or (iii) 10% or greater retardation of body weight gain compared with that of control animals. In some studies, toxicity that could interfere with a carcinogenic effect is specifically excluded from consideration.

mean life Average lifetime of a molecular, atomic, or nuclear system in a specified state. For an exponentially decaying system, it is the average time for the number of molecules, atoms, or nuclei in a specified state to decrease by a factor of e, the base of natural logarithms.
ISO (1972)
SN **mean time**
RT **turnover time**

mean time See SN **mean life.**

median effective concentration (EC_{50}) Statistically derived concentration of a substance in an environ-

mental medium expected to produce a certain effect in 50% of test organisms in a given population under a defined set of conditions.

median effective dose (ED_{50}) Statistically derived dose of a chemical or physical agent (radiation) expected to produce a certain effect in 50% of test organisms in a given population or to produce a half-maximal effect in a biological system under a defined set of conditions.

median lethal concentration (LC_{50}) Statistically derived concentration of a substance in an environmental medium expected to kill 50% of organisms in a given population under a defined set of conditions.

median lethal dose (LD_{50}) Statistically derived dose of a chemical or physical agent (radiation) expected to kill 50% of organisms in a given population under a defined set of conditions.

median lethal time (TL_{50}) Statistically derived average time interval during which 50% of a given population may be expected to die following acute administration of a chemical or physical agent (radiation) at a given concentration under a defined set of conditions.

median narcotic concentration (NC_{50}) Statistically derived concentration of a substance in an environmental medium expected to cause narcotic conditions in 50% of a given population under a defined set of conditions.

median narcotic dose (ND_{50}) Statistically derived dose of a substance expected to cause narcosis in 50% of test animals under a defined set of conditions.

meiosis

1. Process of ''reductive'' cell division, occurring in the production of gametes, by means of which each daughter nucleus receives half the number of chromosomes characteristic of the somatic cells of the species.
   RT **chromosome, diploid, gamete, haploid**
2. See **miosiss.**

mercurialism Chronic poisoning caused by the excessive use of mercury, by breathing its vapor, or by exposure in mining or smelting processes.
SN **Mad Hatter syndrome**

mesocosm See RT **microcosm.**

mesothelioma Malignant tumor of the mesothelium of the pleura, pericardium or peritoneum, that may be caused by exposure to asbestos fibers and some other fibers.
BT **tumor**
RT **malignant**

metabolic activation Biotransformation of a substance of relatively low toxicity to a more toxic derivative.
BT **activation, biotransformation**
NT **lethal synthesis**
SN **bioactivation**

metabolic half-life (half-time) Time required for one-half of the quantity of a substance in the body to be metabolically transformed into a derivative or to be eliminated.
SN **metabolic half-time**
RT **clearance, elimination**

metabolic model Analysis and theoretical reconstruction of the way in which the body deals with a specific substance, showing the proportion of the intake that is absorbed, the proportion that is stored and in what tissues, the rate of breakdown in the body and the subsequent fate of the metabolic products, and the rate at which it is eliminated by different organs as unchanged substance or metabolites.
WHO (1989a)

metabolic transformation Biochemical transformation of a substance that takes place within an organism.
SN **biotransformation**

metabolism Sum total of all physical and chemical processes that take place within an organism; in a narrower sense, the physical and chemical changes that take place in a given substance within an organism. It includes the uptake and distribution within the body of chemical compounds, the changes (biotransformation) undergone by such substances, and the elimination of the compounds and of their metabolites.
WHO (1989a)
RT **biotransformation**

metabolite Any intermediate or product resulting from metabolism.
After Nagel *et al.* (1991)
RT **biotransformation**

metaplasia Abnormal transformation of an adult, fully differentiated tissue of one kind into a differentiated tissue of another kind.
RT **hyperplasia, neoplasia**

metastasis

1. Movement of bacteria or body cells, especially cancer cells, from one part of the body to another, resulting in change in location of a disease or of its symptoms from one part of the body to another.
2. Growth of pathogenic microorganisms or of abnormal cells distant from the site of their origin in the body.

methemoglobinemia The presence of methemoglobin (oxidized hemoglobin) in the blood in greater than normal proportion.

methemoglobin-forming substance Substance capable of oxidizing directly or indirectly the iron(II) in hemoglobin to iron(III) to form methemoglobin, a derivative of hemoglobin that cannot transport oxygen.

microalbuminuria Chronic presence of albumin in slight excess in urine.

microcosm Artificial test system that simulates major characteristics of the natural environment for the purposes of ecotoxicological assessment: Such a system would commonly have a terrestrial phase (with substrate, plants, and herbivores) and an aquatic phase (with vertebrates, invertebrates, and plankton). The term ''mesocosm'' implies a more complex and larger system than the term ''microcosm,'' but the distinction is not clearly defined.
SN **experimental model ecosystem**

micromercurialism Effects of exposure to mercury detected at the lowest exposure levels producing a measurable reaction.
RT **mercurialism**

microsome Artifactual spherical particle, not present in the living cell, derived from pieces of the endoplasmic reticulum present in homogenates of tissues or cells. Microsomes sediment from such homogenates when centrifuged at 100,000*g* and higher: The microsomal fraction obtained in this way is often used as a source of monooxygenase enzymes.
RT **cytochrome P420, cytochrome P448, cytochrome P450, endoplasmic reticulum, monooxygenase, phase 1 reactions**

micturitic See SN **diuretic.**

Minamata disease Neurological disease caused by ingestion of methylmercury-contaminated fish, first seen at Minamata Bay in Japan.

mineralization Complete conversion of organic substances to inorganic derivatives.

minimum lethal concentration (LC_{min}) Lowest concentration of a toxic substance in an environmental medium that kills individual organisms or test species under a defined set of conditions.
WHO (1979)
SN **lowest lethal concentration found**

minimum lethal dose (LD_{min}) Lowest amount of a substance that, when introduced into the body, may cause death to individual species of test animals under a defined set of conditions.

miosis Abnormal contraction of the pupil of the eye to less than 2 mm. Alternative spelling (obsolete): meiosis.

miscible Liquid substances capable of mixing without separation into two phases; refers to liquid mixtures.

mitochondri/on (pl -a) Eukaryote cytoplasmic organelle that is bounded by an outer membrane and an inner membrane; the inner membrane has folds called cristae that are the center of ATP synthesis in oxidative phosphorylation in the animal cell and supplement ATP synthesis by the chloroplasts in photosynthetic cells. The mitochondrial matrix within the inner membrane contains ribosomes, many oxidative enzymes, and a circular DNA molecule that carries the genetic information for many of these enzymes.

mitogen Substance that induces lymphocyte transformation or, more generally, mitosis and cell proliferation.
RT **transformation**

mitosis Process by which a cell nucleus divides into two daughter nuclei, each having the same genetic complement as the parent cell: Nuclear division is usually followed by cell division.
After Nagel *et al.* (1991)

mixed function oxidase See SN **monooxygenase.**

modifying factor (MF) As used by the USEPA, an uncertainty factor that is greater than zero and less than or equal to 10; the magnitude of the factor depends on the professional assessment of scientific uncertainties of a study or database not explicitly treated with the standard uncertainty factors (e.g., the completeness of the overall database and the number of animals tested); the default value for the factor is 1.
IRIS (1986)
BT **uncertainty factor**

molluscicide Substance intended to kill molluscs.
SN **limacide**

monitoring Continuous or repeated observation, measurement, and evaluation of health and/or environmental or technical data for defined purposes, according to prearranged schedules in space and time, using comparable methods for sensing and data collection. Evaluation requires comparison with appropriate reference values based on knowledge of the probable relationship between ambient exposure and adverse effects.
NT **ambient monitoring, biological effect monitoring, biological monitoring, environmental monitoring, health surveillance, personal monitoring**

After Berlin *et al.* (1984), WHO (1980), and Zielhuis and Henderson (1986)

monoclonal Pertaining to a specific protein from a single clone of cells, all molecules of this protein being the same.

monoclonal antibody Antibody produced by cloned cells derived from a single lymphocyte.
BT **antibody**
RT **polyclonal antibody**

monooxygenase Enzyme that catalyzes reactions between an organic compound and molecular oxygen in which one atom of the oxygen molecule is incorporated into the organic compound and one atom is reduced to water; involved in the metabolism of many natural and foreign compounds giving both unreactive products of different or increased toxicity from that of the parent compound. Such enzymes are the main catalysts of phase 1 reactions in the metabolism of xenobiotics by the endoplasmic reticulum or by preparations of microsomes.
SN **mixed function oxidase**
RT **cytochrome P420, cytochrome P448, cytochrome P450, endoplasmic reticulum, microsome, phase 1 reactions**

morbidity Any departure, subjective or objective, from a state of physiological or psychological well-being: in this sense, ''sickness,'' ''illness,'' and ''morbid condition'' are similarly defined and synonymous. The WHO Expert Committee on Health Statistics noted in its Sixth Report (1959) that morbidity could be measured in terms of three units:
1. Proportion of persons who were ill.
2. The illnesses (periods or spells of illnesses) that these persons experienced.
3. The duration (days, weeks, etc.) of these illnesses.

Last (1988)
NT **disease**

morbidity rate Term used loosely to refer to incidence or prevalence rates of disease.
IPCS (1987)

morbidity survey Method for the estimation of the prevalence and/or incidence of a disease or diseases in a population: A morbidity survey is usually designed simply to ascertain the facts as to disease distribution and not to test a hypothesis.
Last (1988)

mordant Substance that fixes a dyestuff in or on a material by combining with the dye to form an insoluble compound, used to fix or intensify stains in a tissue or cell preparation.

mortality Death as studied in a given population or subpopulation. The word mortality is often used incorrectly instead of mortality rate.
IPCS (1987)

mortality rate See SN **death rate.**

mortality study Investigation dealing with death rates or proportion of deaths attributed to specific causes as a measure of response.
IPCS (1987)

multigeneration study
1. Toxicity test in which two or three generations of the test organism are exposed to the substance being assessed.
2. Toxicity test in which only one generation is exposed and effects on subsequent generations are assessed.

multiple (or multiphasic) screening Procedure that has evolved by combining single screening tests and is the logical corollary of mass screening. Where much time and effort have been spent by a population in attending for a single test such as mass radiography, it is natural to consider the economy of offering other tests at the same time. Multiple (or multiphasic) screening implies the administration of a number of tests, in combination, to large groups of people.
WHO (1989a)
BT **screening**

multistage cluster sampling Cluster sampling with more than two stages, each sampling being made on aggregates (or clusters) in which the clusters already obtained by the preceding sampling have been divided.
ISO (1977)

multistage model Dose–response model for cancer death estimation of the form

$$P(d) = 1 - \exp[-(q_0 + q_1 d^1 + q_2 d^2 + \cdots + q(k)^{d^k})]$$

where $P(d)$ is the probability of cancer death from a continuous dose rate, d, the q's are constants, and k is the number of dose groups (or, if less than the number of dose groups, k is the number of biological stages believed to be required in the carcinogenesis process). With the multistage model, it is assumed that cancer is initiated by cell mutations in a finite series of steps. A one-stage model is equivalent to a one-hit model.

multistage sampling Type of sampling in which the sample is selected by stages, with the sampling units at each stage being subsampled from the larger units chosen at the previous stage.
ISO (1977)

murine Of or belonging to the family of rats and mice (*Muridae*).

mutagen Any substance that can induce heritable changes (mutations) of the genotype in a cell as a consequence of alterations or loss of genes or chromosomes (or parts thereof).

mutagenesis Introduction of heritable changes (mutations) of the genotype in a cell as a consequence of alterations or loss of genes or chromosomes (or parts thereof).
After Nagel *et al.* (1991)

mutagenicity Ability of a physical, chemical, or biological agent to induce heritable changes (mutations) in the genotype in a cell as a consequence of alterations or loss of genes or chromosomes (or parts thereof).

mutation Any relatively stable heritable change in genetic material that may be a chemical transformation of an individual gene (gene or point mutation), altering its function, or a rearrangement, gain, or loss of part of a chromosome that may be microscopically visible (chromosomal mutation); mutation can be either germinal and inherited by subsequent generations, or somatic and passed through cell lineage by cell division.
RT **chromosome, gene**
RT **clastogenesis, genotoxicity**

myasthenia Muscular weakness.

mycotoxin Toxin produced by a fungus.

mydriasis Extreme dilation of the pupil of the eye, either as a result of normal physiological response or in response to a chemical exposure.

myelosuppression Reduction of bone marrow activity leading to a lower concentration of platelets, red cells, and white cells in the blood.

narcotic
1. Nonspecific usage: An agent that produces insensibility or stupor.
2. Specific usage; An opioid, any natural or synthetic drug that has morphine-like actions.

natriuretic Substance increasing the rate of excretion of sodium ion in the urine.

natural occurrence The presence of a substance in nature, as distinct from the presence resulting from inputs from human activities. The contamination of the natural environment by some man-made compounds may be so widespread that it is practically impossible to get access to biota with a truly natural level; only ''normal'' levels can be measured—those which are usually prevalent in places where there is no obvious local contamination.

necropsy See SN **autopsy.**
RT **biopsy**

necrosis
1. Mass death of areas of tissue or bone surrounded by healthy areas.
2. Morphological changes that follow cell death, characterized most frequently by nuclear changes.

negligible risk
1. Probability of adverse effects occurring that can reasonably be described as trivial.
2. Probability of adverse effects occurring that is so low that it cannot be reduced appreciably by increased regulation or investment of resources.

RT **acceptable risk, accepted risk, risk** *de minimis*

nematocide Substance intended to kill nematodes.

neonat/e(n.), **-al**(adj.) Infant during the first 4 weeks of postnatal life; for statistical purposes some scientists have defined the period as the first 7 days.

neoplas/ia, -m New and abnormal formation of tissue as a tumor or growth by cell proliferation that is faster than normal and continues after the initial stimulus (*i*) that initiated the proliferation has ceased.
PS **tumor**
RT **hyperplasia, metaplasia**

nephritis Inflammation of the kidney, leading to kidney failure, usually accompanied by proteinuria, ematuria, edema, and hypertension.

nephrotoxic Chemically harmful to the cells of the kidney.

neural Pertaining to a nerve or to the nerves.

neuron(e) Nerve cell, the morphological and functional unit of the central and peripheral nervous systems.

neuropathy Any disease of the central or peripheral nervous system.

neurotoxic/(adj.), **-ity**(n.) Able to produce chemically an adverse effect on the nervous system: such effects may be subdivided into two types:
1. Central nervous system effects (including transient effects on mood or performance and presenile dementia such as Alzheimer's disease).
2. Peripheral nervous system effects (such as the inhibitory effects of organophosphorus compounds on synaptic transmission).

nitrification Sequential oxidation of ammonium salts to nitrite and nitrate by microorganisms.

no acceptable daily intake allocated This expression is applicable to a substance for which the available information is not sufficient to establish its safety, when the specifications for identity and purity are not adequate, or when the available data show that

the substance is hazardous and should not be used. The basis for the use of the expression should be determined before action is taken; in the previous first two cases, not being able to allocate an ADI does not mean that the substance is unsafe.
RT **acceptable daily intake**

***n*-octanol–water partition coefficient** See SN **octanol–water partition coefficient.**

nodule Small node or boss that is solid and can be detected by touch.

no effect level (NEL) Maximum dose (of a substance) that produces no detectable changes under defined conditions of exposure. Currently, this term tends to be substituted by no-observed-adverse-effect-level (NOAEL) or no-observed-effect-level (NOEL).
RT **adverse effect, no-observed-adverse-effect-level (NOAEL), no-observed-effect-level (NOEL)**

non-bioenvironmental transformation Change in the chemical or physical nature of a substance occurring as a result of physicochemical conditions and independent of any biological system.

noneffective dose Amount of a substance that has no effect on the organism. It is lower than the threshold of harmful effect and is estimated while establishing the threshold of harmful effect.
SN **subthreshold dose**
RT **threshold**

nonoccupational exposure Environmental exposure outside the workplace to substances that are otherwise associated with particular work environments and/or activities and processes that occur there.

nontarget organism Organism affected by a pesticide although not the intended object of its use.

no-observed-adverse-effect-level (NOAEL) Greatest concentration or amount of a substance, found by experiment or observation, which causes no detectable adverse alteration of morphology, functional capacity, growth, development, or life span of the target organism under defined conditions of exposure.
WHO (1979)
RT **adverse effect**

no-observed-effect-level (NOEL) Greatest concentration or amount of a substance, found by experiment or observation, that causes no alterations of morphology, functional capacity, growth, development, or life span of target organisms distinguishable from those observed in normal (control) organisms of the same species and strain under the same defined conditions of exposure.
RT **adverse effect**

no-response level Maximum dose of a substance at which no specified response is observed in a defined population and under defined conditions of exposure.
IRPTC (1982)

nosocomial Associated with a hospital or infirmary, especially used for diseases that may result from treatment in such an institution.
BT **iatrogenic**

noxious substance See SN **harmful substance.**

nuisance threshold Lowest concentration of an air pollutant that can be considered objectionable.
IRPTC (1982)
RT **odor threshold, pollutant**

nutritional table method Procedure for evaluating the dietary intake of a large number of people. The accuracy of the method depends on the accuracy with which records of the food consumption can be established and the accuracy of the nutritional tables specifying the concentration of various nutrients, vitamins, essential, and nonessential substances including pesticide residues. For each record of quantity of food consumed during a certain time period, the daily intake of the substance in question is calculated by multiplying the substance concentration in the food item (as obtained from the nutritional table) by the quantity of food consumed and dividing by the time of observation.
WHO (1979)

nystagmus Involuntary, rapid, rhythmic movement (horizontal, vertical, rotary, or mixed) of the eyeball, usually caused by a disorder of the labyrynth of the inner ear or a malfunction of the central nervous system.

objective environment Actual physical, chemical, and social environment as described by objective measurements, such as noise levels in decibels and concentrations of air pollutants.
WHO (1979)

occupational environment Surrounding conditions at a workplace.

occupational exposure Experience of substances, intensities of radiation, etc., or other conditions while at work.

occupational exposure limit (OEL) Regulatory level of exposure to substances, intensities of radiation etc., or other conditions, specified appropriately in relevant government legislation or related codes of practice.

occupational exposure standard (OES)
1. Level of exposure to substances, intensities of radiation etc., or other conditions considered to rep-

resent specified good practice and a realistic criterion for the control of exposure by appropriate plant design, engineering controls, and, if necessary, the addition and use of personal protective clothing.

2. In the United Kingdom, health-based exposure limit defined under COSHH regulations as the concentration of any airborne substance, averaged over a reference period, at which, according to current knowledge, there is no evidence that it is likely to be injurious to employees if they are exposed by inhalation, day after day, to that concentration. The limit is set on the advice of the HSE Advisory Committee on Toxic Substances.

occupational hygiene Identification, assessment, and control of physicochemical and biological factors in the workplace that may affect the health or well-being of those at work and in the surrounding community.

octanol–water partition coefficient (P_{OW}, K_{OW}) Measure of lipophilicity by determination of the equilibrium distribution between octanol and water, as used in pharmacological studies and in the assessment of environmental fate and transport of organic chemicals.
RT **lipophilicity, lg10 K_{OW}, lg10 P_{OW}**

ocular Pertaining to the eye.

odds Ratio of the probability of occurrence of an event to that of nonoccurrence, or the ratio of the probability that something is so to the probability that it is not so.
Last (1988)

odds ratio Quotient obtained by dividing one set of odds by another. The term ''odds'' or ''odds ratio'' is defined differently according to the situation under discussion. Consider the following notation for the distribution of a binary exposure and a disease in a population or a sample:

	Exposed	Nonexposed
Disease	a	b
No disease	c	d

The odds ratio (cross-product ratio) is $ad/(bc)$.

1. The exposure odds ratio for a set of case control data is the ratio of the odds in favor of exposure among the cases (a/b) to the odds in favor of exposure among noncases (c/d). This reduces to $ad/(bc)$. With incident cases, unbiased subject selection, and a ''rare'' disease (e.g., <2% cumulative incidence rate over the study period), $ad/(bc)$ is an approximate estimate of the risk ratio. With incident cases, unbiased subject selection, and density sampling of controls, $ad/(bc)$ is an estimate of the ratio of the person-time incidence rates (forces of morbidity) in the exposed and unexposed. No rarity assumption is required.
2. The disease odds (rate odds) ratio for a cohort or cross section is the ratio of the odds in favor of disease among the exposed population (a/c) to the odds in favor of disease among the unexposed (b/d). This reduces to $ad/(bc)$ and hence is equal to the exposure odds ratio for the cohort or cross section.
3. The prevalence odds refers to an odds ratio derived cross sectionally as, for example, an odds ratio derived from studies of prevalent (rather than incident) cases.
4. The risk odds ratio is the ratio of the odds in favor of getting disease, if exposed, to the odds in favor of getting disease if not exposed. The odds ratio derived from a cohort study is an estimate.

Last (1988)
SN **cross-product ratio, relative odds**

oedema The presence of abnormally large amounts of fluid in intercellular spaces of body tissues.

odor threshold In principle, the lowest concentration of an odorant that can be detected by a human being: In practice, a panel of ''sniffers'' is used, and the threshold is taken as the concentration at which 50% of the panel can detect the odorant (although some workers have also used 100% thresholds).

olfactometer Apparatus for testing the power of the sense of smell.

oliguria Excretion of a diminished amount of urine in relation to fluid intake.

oncogene Gene that can cause neoplastic transformation of a cell; oncogenes are slightly changed equivalents of normal genes known as protooncogenes.
RT **transformation**

oncogenesis Production or causation of tumors.

one-hit model Dose–response model of the form

$$P(d) = 1 - \exp)(-bd)$$

where $P(d)$ is the probability of cancer death from a continuous dose rate (d) and b is a constant. The one-hit model is based on the concept that a tumor can be induced after a single susceptible target or receptor has been exposed to a single effective dose unit of an agent.
IRIS (1986)

onycholysis Loosening or detachment of the nail from the nailbed following some destructive process.

oogenesis Process of formation of the ovum (plural ova), the female gamete.

operon Complete unit of gene expression and regulation, including structural genes, regulator gene(s), and control elements in DNA recognized by regulator gene product(s).

ophthalmic Pertaining to the eye.

organ dose Amount of a substance or physical agent (radiation) absorbed by an organ.

organelle Microstructure or separated compartment within a cell that has a specialized function, for example, ribosome, peroxisome, lysosome, Golgi apparatus, mitochondrion, nucleolus, and nucleus. After Nagel *et al.* (1991)

organic carbon partition coefficient (K_{oc}) Measure of the tendency for organic substances to be adsorbed by soil and sediment, expressed as

$$K_{oc} = \frac{(\text{mg substance adsorbed})/(\text{kg organic carbon})}{(\text{mg substance dissolved})/(\text{liter of solution})}$$

The K_{oc} is substance specific and is largely independent of soil properties.
USEPA (1986)

organoleptic Involving an organ, especially a sense organ such as taste, smell, or sight.

osteo- Prefix meaning pertaining to bone.

osteodystrophy Abnormal development of bone.

osteogenesis Formation or development of bone.

osteoporosis Significant decrease in bone mass with increased porosity and increased tendency to fracture.

ovicide Substance intended to kill eggs.

palpitation
1. Unduly rapid or throbbing heartbeat that is noted by a patient: It may be regular or irregular.
2. Undue awareness by a patient of a heartbeat that is otherwise normal.

paraesthesia Abnormal sensation, such as burning or prickling.

paralysis Loss or impairment of motor function.

paraoccupational exposure
1. Exposure of a worker's family to substances carried from the workplace to the home.
2. Exposure of visitors to substances in the workplace.

parasympatholytic Producing effects resembling those caused by interruption of the parasympathetic nerve; also called anticholinergic.

parasympathomimetic Producing effects resembling those caused by stimulation of the parasympathetic nervous system; also called cholinomimetic.

parenteral dosage Method of introducing substances into an organism avoiding the gastrointestinal tract (subcutaneously, intravenously, intramuscularly, etc.).

paresis Slight or incomplete paralysis.

partition coefficient Ratio of the distribution of a substance between two phases when the heterogeneous system (of two phases) is in equilibrium; the ratio of concentrations (or, strictly speaking, activities) of the same molecular species in the two phases is constant at constant temperature. The partition coefficients most frequently used in acute toxicology are lipid–water and octanol–water distributions.
RT lg P_{ow}

passive smoking Inhalation of sidestream smoke by people who do not themselves smoke.
See RT **sidestream smoke**

peak daily average concentration of an air pollutant See SN **maximum average daily concentration of an atmospheric pollutant.**

perceived environment or risk See SN **subjective environment.**
RT **risk perception**

percutaneous Through the skin following application on the skin.

perinatal Relating to the period shortly before and after birth; from the 20th to the 29th week of gestation to 1–4 weeks after birth.

peritoneal dialysis Method of artificial detoxication in which a toxic substance from the body is transferred into liquid that is instilled into the peritoneum. Thus the employment of the peritoneum surrounding the abdominal cavity as a dialyzing membrane for the purpose of removing waste products or toxins accumulated as a result of renal failure.

permissible exposure limit (PEL) Recommendation by U.S. OSHA for TWA concentration that must not be exceeded during any 8-hr work shift of a 40-hr working week.
RT **exposure limit maximum allowable concentration, threshold limit value, time weighted average concentration (TWAC)**

peroxisome Organelle, similar to a lysosome, characterized by its content of catalase (EC 1.11.1.6), peroxidase (EC 1.11.1.7), and other oxidative enzymes.

persistence Attribute of a substance that describes the length of time that the substance remains in a particular environment before it is physically removed or chemically or biologically transformed.
IRPTC (1982)
RT **recalcitrance**

personal monitoring Type of environmental monitoring in which an individual's exposure to a substance is measured and evaluated: This is normally carried out using a personal sampler.
BT **monitoring**
RT **personal sampler**

personal protective device (PPD) See SN **personal protective equipment (PPE).**
SN **individual protective device (IPD)**

personal protective equipment (PPE) Equipment (clothing, gloves, hard hat, respirator, and so on) worn by an individual to prevent exposure to a potentially toxic substance.
SN **individual protective device (IPD), personal protective device (PPD)**

personal sampler Compact, portable instrument for individual air sampling and/or measuring the content of a harmful substance in the respiration zone of a working person.
IRPTC (1982)
SN **individual monitor**

pest Organism that may harm public health, that attacks food and other materials essential to mankind, or otherwise affects human beings adversely.

pesticide Strictly a substance intended to kill pests; in common usage, any substance used for controlling, preventing, or destroying animal, microbiological, or plant pests.
NT **fungicide, herbicide, insecticide**

pesticide residue Pesticide residue is any substance or mixture of substances in food for man or animals resulting from the use of a pesticide and includes any specified derivatives, such as degradation and conversion products, metabolites, reaction products, and impurities considered to be of toxicological significance.

phagocytosis Engulfing and digestion of microorganisms, other cells, and foreign particles by cells such as phagocytes.
RT **macrophage**

pharmaceuticals Drugs, medical products, medicines, or medicaments.

pharmacodynamics Process of interaction of pharmacologically active substances with target sites and the biochemical and physiological consequences leading to therapeutic or adverse effects.
RT **adverse effect, target, toxicodynamics**

pharmacogenetics Study of the influence of hereditary factors on the effects of drugs on individual organisms.
PS **toxicogenetics**
RT **ecogenetics, polymorphism**

pharmacokinetics Process of the uptake of drugs by the body, the biotransformation they undergo, the distribution of the drugs and their metabolites in the tissues, and the elimination of the drugs and their metabolites from the body. Both the amounts and the concentrations of the drugs and their metabolites are studied. The term has essentially the same meaning as toxicokinetics, but the latter term should be restricted to the study of substances other than drugs.
BT **chemobiokinetics**
PS **toxicokinetics**
RT **biotransformation, pharmacokinetics**

pharynx Throat, the part of the digestive tract between the esophagus below and the mouth and nasal cavities above and in front.

phase 1 reaction (of biotransformation) Enzymic modification of a substance by oxidation, reduction, hydrolysis, hydration, dehydrochlorination, or other reactions catalyzed by enzymes of the cytosol, of the endoplasmic reticulum (microsomal enzymes), or of other cell organelles.
BT **biotransformation.**
RT **cytochrome P420, cytochrome P448, cytochrome P450, microsome, phase 2 reaction, phase 3 reaction**

phase 2 reaction (of biotransformation) Binding of a substance, or its metabolites from a phase 1 reaction, with endogenous molecules (conjugation), making more water-soluble derivatives that may be excreted in the urine or bile.
BT **biotransformation**
RT **conjugate, phase 1 reaction, phase 3 reaction**

phase 3 reaction (of biotransformation) Further metabolism of conjugated metabolites produced by phase 2 reactions: It may result in the production of toxic derivatives.
BT **biotransformation**
RT **conjugate, phase 1 reaction, phase 2 reaction**

phenotype The observable structural and functional characteristics of an organism determined by its genotype and modulated by its environment.
Nagel *et al.* (1991)
RT **genotype**

pheromone Substance used in olfactory communication between organisms of the same species eliciting a change in sexual or social behavior.
SN **ectohormone, fermone**

photoirritation Inflammation of the skin caused by exposure to light, especially that due to metabolites formed in the skin by photolysis.
RT **photosensitization, phototoxicity**

photooxidant Substance able to cause oxidation when exposed to light of the appropriate wavelength.

photophobia Abnormal visual intolerance of light.

photosensitization Allergic reaction due to a metabolite formed by the influence of light.

phototoxicity Adverse effects produced by exposure to light energy, especially those produced in the skin.

phytotoxic Poisonous to plants; inhibiting plant growth.

piscicide Substance intended to kill fish.

plasma
1. Fluid component of blood in which the blood cells and platelets are suspended.
   SN **blood plasma**
2. Fluid component of semen produced by the accessory glands, the seminal vesicles, the prostate, and the bulbourethral glands.
3. Cell substance outside the nucleus.
   SN **cytoplasm**

plasma half-life See SN **elimination half-life.**

plasmapheresis Removal of blood from the body and centrifuging it to obtain plasma and packed red blood cells: The blood cells are resuspended in a physiologically compatible solution (usually type-specific fresh frozen plasma or albumin) and returned to the donor or injected into a patient who requires blood cells rather than whole blood.

plasmid Autonomous self-replicating extrachromosomal circular DNA molecule.

pleura Lining of the lung.

ploidy Term indicating the number of sets of chromosomes present in an organism.
RT **diploid, haploid**

plumbism Chronic poisoning caused by absorption of lead or lead salts.
SN **saturnism**

pneumoconiosis Usually fibrosis of the lungs that develops owing to (prolonged) inhalation of inorganic or organic dusts. Cause-specific types of pneumoconiosis:
1. anthracosis: from coal dust
2. asbestosis: from asbestos dust
3. byssinosis: from cotton dust
4. siderosis: from iron dust
5. silicosis: from silica dust
6. stannosis: from tin dust

IRPTC (1982) and Parkes (1982)

pneumonitis Inflammation of the lung.

po *Per os*—Latin for by mouth.

point mutation Reaction that changes a single base pair in DNA.

point source Single emission source in a defined location.
RT **area source**

poison Substance that, taken into or formed within the organism, impairs the health of the organism and may kill it.
SN **toxic substance**

poison-bearing Containing a poison.

poisoning Morbid condition produced by a poison.
SN **intoxication**

pollutant Any undesirable solid, liquid, or gaseous matter in a solid, liquid, or gaseous environmental medium: ''Undesirability'' is often concentration dependent, with low concentrations of most substances being tolerable or even essential in many cases. For the meaning of ''undesirable'' in air pollution contexts, see ''pollution.'' A primary pollutant is one emitted into the atmosphere, water, sediments, or soil from an identifiable source. A secondary pollutant is a pollutant formed by chemical reaction in the atmosphere, water, sediments, or soil.
After WHO (1980)
PS **contaminant**
RT **pollution, secondary pollutant**

pollution Introduction of pollutants into a solid, liquid, or gaseous environmental medium; the presence of pollutants in a solid, liquid, or gaseous environmental medium; or any undesirable modification of the composition of a solid, liquid, or gaseous environmental medium. In the context of air pollution, an undesirable modification is one that has injurious or deleterious effects.
RT **contaminant, pollutant**
ISO (1979) and WHO (1989a)

polyclonal antibody Antibody produced by a number of different cell types.
BT **antibody**
RT **monoclonal antibody**

polydipsia Chronic excessive thirst.

polymorphism (polymorphia) in metabolism Interindividual variations in metabolism of endo- and exogenous compounds due to genetic influences, leading to enhanced side effects or toxicity of drugs (e.g., poor versus fast metabolizers) or to different clinical effects (metabolism of steroid hormones).
RT **ecogenetics, pharmacogenetics, toxicogenetics**

polyuria Excessive production and discharge of urine.

population In statistics, the totality of items under consideration. A clearly defined part of a population is called a subpopulation. In the case of a random variable, the probability distribution is considered as defining the population of that variable. The term ''population segment'' is sometimes used as a synonym for subpopulation.
WHO (1989a)

population at risk Number of persons who can and may develop an adverse health effect and who are potentially exposed to a risk factor under study: For example, all people in a population who have not developed immunity to an infectious disease are at risk of developing that disease if they are exposed to it. People already having chronic disease are excluded from the population at risk in studies of the incidence of the disease.
After WHO (1979)

population critical concentration (PCC) Concentration of a substance in the critical organ at which a specified percentage of the exposed population has reached the individual critical organ concentration. The percentage indicated by PCC-10 for 10%, PCC-50 for 50%, etc. (similar to the use of the term LD_{50}).
Kjellström *et al.* (1984)

population effect Absolute number or incidence rate of cases occurring in a group of people.

population risk See SN **societal risk.**

porphyria Disturbance of porphyrin metabolism characterized by increased formation, accumulation, and excretion of porphyrins and their precursors.

posology Study of dose in relation to the physiological factors that may influence response such as age of the exposed organisms.
Brown (1988)

potency Expression of chemical or medicinal activity of a substance compared to a given or implied standard or reference.

potentiation Dependent action in which a substance or physical agent at a concentration or dose that does not itself have an adverse effect enhances the harm done by another substance or physical agent.
RT **additive effect, antagonism, synergism**

practical certainty (of safety) Numerically specified low risk of exposure to a potentially toxic substance (e.g., 1 in 10^6) or socially acceptable low risk of adverse effects from such an exposure applied to decision making in regard to chemical safety.
After Duffus (1986)
RT **risk, safety**

precision Measure for the reproducibility of measurements within a set; that is, of the scatter or dispersion of a set about its central value.
Gold *et al.* (1987)

precordial Pertaining to the region over the heart and lower thorax.

precursor Substance from which another, usually more biologically active, substance is formed.

predictive validity Reliability of a measurement expressed in terms of its ability to predict the criterion; for example, an academic aptitude test that is validated against subsequent academic performance.
Last (1988)

predictive value Percentage of positive results that are true positives or of negative results that are true negatives.
Galen and Gambino (1975)
RT **sensitivity, specificity**

preneoplastic Before the formation of a tumor.

prevalence Number of instances of existing cases of a given disease or other condition in a given population at a designated time; sometimes used to mean prevalence rate. When used without qualification, the term usually refers to the situation at a specified point in time (point prevalence). Last (1988)
RT **incidence**

prevalence rate (ratio) Total number of individuals who have an attribute or disease at a particular time (or during a particular period) divided by the population at risk of having the attribute or disease at this point in time or midway through the period.
Last (1988)
RT **population at risk**

primary pollutant See BT **pollutant.**

primary protection standard Accepted maximum level of a pollutant (or its indicator) in the target organism, or some part thereof, or an accepted maximum intake of a pollutant or nuisance into the target in specified circumstances.
WHO (1989a)

probit Probability unit obtained by adding 5 to the normal deviates of a standardized normal distribution of results from a dose–response study: Addition of 5 removes the complication of handling negative values. A plot of probit against the logarithm of dose or concentration gives a linear plot if the distribution of response is a logarithmic normal one. Estimates of the LD_{50} and ED_{50} (or LC_{50} and EC_{50}) can be obtained from this plot.

procarcinogen Substance that has to be metabolized before it can induce malignant tumors.

prokaryote Unicellular organism characterized by the absence of a membrane-enclosed nucleus. Prokaryotes include bacteria, blue-green algae, and mycoplasmas.
After Nagel *et al.* (1991)
RT **eukaryote**

promoter (in oncology) Agent that induces cancer when administered to an animal or human being who has been exposed to a cancer initiator.
RT **initiator**

prophage Latent state of a phage genome in a lysogenic bacterium.
Nagel *et al.* (1991)

proportional mortality rate (ratio) (PMR) Number of deaths from a given cause in a specified time period, per 100 or per 1000 total deaths in the same time period: can give rise to misleading conclusions if used to compare mortality experience of populations with different causes of death.
Last (1988)

prospective cohort study See BT **cohort study.**

proteinuria Excretion of excessive amounts of protein (derived from blood plasma or kidney tubules) in the urine.

pseudoadaptation Apparent adaptation of an organism to changing conditions of the environment (especially chemical) associated with stresses in biochemical systems that exceed the limits of normal (homeostatic) mechanisms: Essentially, there is a temporary concealed pathology that later on can be manifested in the form of explicit pathological changes sometimes referred to as ''decompensation.''
RT **compensation**

psychosis Any major mental disorder characterized by derangement of the personality and loss of contact with reality.

psychotropic Exerting an effect upon the mind; capable of modifying mental activity.

public health impact assessment Applying risk assessment to a specific target population of known size, giving as the end product a quantitative statement about the number of people likely to be affected in a particular population.
BT **risk assessment**

pulmonary Pertaining to the lungs.

purgative See SN **cathartic, laxative.**

pyrexia Condition in which the temperature of a human being or mammal is above normal.

pyrogen Any substance that produces fever.

quality assurance All those planned and systematic actions necessary to provide adequate confidence that a product or service will satisfy given requirements for quality.
ISO (1986b)
RT **good laboratory practice, quality control**

quality control
1. Operational techniques and activities that are used to fulfill requirements for quality.
   ISO (1986b)
2. In toxicology, procedures incorporated in experimental protocols to reduce the possibility of error, especially human error: This is a requirement of good laboratory practice.
   RT **good laboratory practice, quality assurance**

quantal effect Condition that can be expressed only as ''occurring'' or ''not occurring,'' such as death or occurrence of a tumor.
AN **graded effect**
RT **stochastic effect**
SN **all-or-none effect**

quantitative structure–activity relationship (QSAR) Quantitative association between the physicochemical properties of a substance and/or the properties of its molecular substructures and its biological properties including its toxicity.
RT **surrogate**

râles See SN **crepitations.**

random sample Subset of a population that is arrived at by selecting units such that each possible unit has a fixed and determinate probability of selection.
After Last (1988)
AN **biased sample**
BT **sample**

rate Measure of the frequency of a phenomenon: an expression of the frequency with which an event occurs in a defined population during a specified time interval.
Last (1988)

rate difference (RD) Absolute difference between two rates, for example, the difference in incidence rate between a population group exposed to a causal factor and a population group not exposed to the factor. In comparisons of exposed and unexposed groups, the term ''excess rate'' may be used as a synonym for rate difference.
Last (1988)

rate ratio (RR) In epidemiology, the value obtained by dividing the rate in an exposed population by the rate in an unexposed population.
After Last (1988)

ratticide Substance intended to kill rats.
RT **rodenticide**

readily biodegradable Arbitrary classification of substances that have passed certain specified screening tests for ultimate biodegradability; these tests are so stringent that such compounds will be rapidly and completely biodegraded in a wide variety of aerobic environments.

reasonable maximum exposure (RME) Highest exposure that is reasonably expected to occur: Typically the 95% upper confidence limit of the toxicant distribution is used. If only a few data points (6–10) are available, the maximum detected concentration is used.
USEPA (1989)

recalcitrance Ability of a substance to remain in a particular environment in an unchanged form.
Nagel *et al.* (1991)
RT **persistence**

receptor High-affinity binding site for a particular toxicant.
BT **target, target organ**

recovery
1. Process leading to partial or complete restoration of a cell, tissue, organ, or organism following its damage from exposure to a harmful substance or agent.
2. Term used in analytical and preparative chemistry to denote the fraction of the total quantity of a substance recoverable following a chemical procedure.
RT **recovery factor**

recovery factor Fraction or percentage of the total quantity of a substance extracted under specified conditions.
Gold *et al.* (1987)

recycling (of waste) Process or method allowing for the recovery of some value from a waste, either as reusable material or as energy.

reference concentration Term used for an estimate of air exposure concentration to the human population (including sensitive subgroups) that is likely to be without appreciable risk of deleterious effects during a lifetime.
USEPA (1989)
RT **acceptable daily intake**
BT **dose**

reference distribution Statistical distribution of reference values.
Solberg (1987)

reference dose Term used for an estimate (with uncertainty spanning perhaps an order of magnitude) of a daily exposure to the human population (including sensitive subgroups) that is likely to be without appreciable risk of deleterious effects during a lifetime.
Barnes and Dourson (1988)
RT **acceptable daily intake**
BT **dose**

reference group See SN **reference sample group.**

reference individual Person selected with the use of defined criteria for comparative purposes in a clinical study.
Solberg (1987)

reference interval Area between and including two reference limits, for example, the percentiles 2.5 and 97.5.
Solberg (1987)

reference limit Boundary value defined so that a stated fraction of the reference values is less than or exceeds that boundary value with a stated probability.
Solberg (1987)

reference material Substance for which one or more properties are sufficiently well established to be used for the calibration of an apparatus, the assessment of a measurement method, or for assigning values to other substances.
Solberg (1987)
SN **calibration material, standard material**

reference population Group of all reference individuals used to establish criteria against which a population that is being studied can be compared.
Solberg (1987)

reference sample group Selected reference individuals, statistically adequate numerically to represent the reference population.
Solberg (1987)

reference value According to IFCC, measured value of a property in a reference individual or sample from a reference individual.
Solberg (1987)

regulatory dose Term used by the USEPA to describe the expected dose resulting from human exposure to a substance at the level at which it is regulated in the environment.
Barnes and Dourson (1988)

relative odds See SN **odds ratio.**

relative risk
1. Ratio of the risk of disease or death among the exposed to that among the unexposed.
SN **risk ratio**

2. Ratio of the cumulative incidence rate in the exposed to the cumulative incidence rate in the unexposed; the cumulative incidence ratio.

Last (1988)

renal Pertaining to the kidneys.

repellent Substance used mainly to repel blood-sucking insects in order to protect man and animals: also used to repel mammals, birds, rodents, mites, plant pests, etc.

replicate sampling Act of taking multiple samples concurrently under comparable conditions; may be accomplished by taking samples adjacent in time or space.

PAC (1990)

replication

1. Duplicated or repeated performance of an experiment under similar (controlled) conditions to reduce to a minimum the error and to estimate the variations and thus obtain a more precise result: Each determination, including the first, is called a replicate.
2. Process whereby the genetic material is duplicated.

reproducibility Closeness of agreement between test results obtained under reproducibility conditions.

ISO (1986a)

RT **reproducibility conditions**

reproducibility conditions Situation in which test results are obtained with the same method on identical test material in different laboratories with different operators using different equipment.

ISO (1986a)

reproductive toxicant Substance or preparation that produces nonheritable harmful effects on the progeny and/or an impairment of male and female reproductive function or capacity.

USEPA (1986)

RT **teratogen**

reproductive toxicology Study of the adverse effects of substances on the embryo, fetus, neonate, and prepubertal mammal and the adult reproductive and neuroendocrine systems.

RT **embryo, fetus, neonate**

reserve capacity Physiological or biochemical capacity that may be available to maintain homeostasis when the body or an organism is exposed to an environmental change.

resistance (in toxicology) Ability to withstand the effect of various factors including potentially toxic substances.

resorptive effect Action of a substance after its resorption from the gut into the blood.

IRPTC (1982)

response

1. Proportion of an exposed population with a defined effect or the proportion of a group of individuals that demonstrate a defined effect in a given time at a given dose rate.

   RT **dose–response relationship**
2. Reaction of an organism or part of an organism (such as a muscle) to a stimulus.

retention

1. Holding back within the body or within an organ, tissue, or cell of matter that is normally eliminated.

   AN **elimination**
2. Holding in memory of what has been learned for later use as recall, recognition, or relearning.
3. Amount of a substance that is left from the total absorbed after a certain time following exposure: If the retention follows a course in relation to time that is a first order process, it may be described in terms of biological half-life (half-time).

   RT **half-life**

retrospective study Research design used to test etiological hypotheses in which inferences about exposure to the putative causal factors(s) are derived from data relating to characteristics of the persons or organisms under study or to events or experiences in their past: The essential feature is that some of the persons under study have the disease or other outcome condition of interest, and their characteristics and past experiences are compared with those of other, unaffected persons. Persons who differ in the severity of the disease may also be compared.

RT **case control study**

Last (1988)

returned effect of poisons Enhancement of the dose–effect relationship for a poison following repeated exposure to decreasing doses.

reverse transcription Process by which an RNA molecule is used as a template to make a single-stranded DNA copy.

reversible alteration Change from normal structure or function, induced by a substance or other agent(s), that returns to normal status or within normal limits after cessation of exposure.

rhabdomyolysis Acute, fulminating, potentially lethal disease of skeletal muscle that causes disintegration of striated muscle fibers as evidenced by myoglobin in the blood and urine.

rhinitis Inflammation of the nasal mucosa.

rhonch/us (pl.-i) Harsh crepitation in the throat, often resembling snoring.
BT **crepitations**

ribonucleic acid Linear, usually single-stranded, polymer of ribonucleotides, each containing the sugar ribose in association with a phosphate group and one of four nitrogenous bases: adenine, guanine, cytosine, or uracil. It encodes the information for the sequence of amino acids in proteins synthesized using it as a template.
RT **deoxyribonucleic acid**

risk
1. Possibility that a harmful event (death, injury, or loss) arising from exposure to a chemical or physical agent may occur under specific conditions.
2. Expected frequency of occurrence of a harmful event (death, injury, or loss) arising from exposure to a chemical or physical agent under specific conditions.

NT **excess lifetime risk, extra risk**
RT **hazard**

risk acceptance Decision that the risk associated with a given chemical exposure or an event leading to such exposure is low enough to be tolerated in order to gain associated benefits.
RT **acceptable risk**

risk assessment Identification and quantification of the risk resulting from a specific use or occurrence of a chemical or physical agent, taking into account possible harmful effects on individual people or society of using the chemical or physical agent in the amount and manner proposed and all the possible routes of exposure. Quantification ideally requires the establishment of dose–effect and dose–response relationships in likely target individuals and populations.
RT **exposure assessment, hazard identification, risk characterization, risk estimation, risk evaluation, risk identification, risk management, risk perception**

risk assessment management process Global term for the whole process from hazard identification to risk management.
WHO (1988)
RT **hazard identification, risk management**

risk associated with a lifetime exposure Probability of the occurrence of a specified undesirable event following exposure of an individual person from a given population to a specified substance at a defined level for the expected lifetime of the average member of that population.

risk aversion Term used to describe the tendency of an individual person to avoid risk.

risk characterization Outcome of hazard identification and risk estimation applied to a specific use of a substance or occurrence of an environmental health hazard: The assessment requires quantitative data on the exposure of organisms or people at risk in the specific situation. The end product is a quantitative statement about the proportion of organisms or people affected in a target population.
After WHO (1979)
RT **hazard identification, risk estimation**

risk communication Interpretation and communication of risk assessments in terms that are comprehensible to the general public or to others without specialist knowledge.

risk *de minimis* Risk that is negligible and too small to be of societal concern (usually assumed to be a probability below 10^{-5} or 10^{-6}); can also mean ''virtually safe.'' In the United States, this is a legal term used to mean ''negligible risk to the individual.''
SN **negligible risk**

risk estimation Assessment, with or without mathematical modeling, of the probability and nature of effects of exposure to a substance based on quantification of dose–effect and dose–response relationships for that substance and the population(s) and environmental components likely to be exposed and on assessment of the levels of potential exposure of people, organisms, and environment at risk.
RT **risk evaluation**
RT **exposure assessment, hazard identification**

risk evaluation Establishment of a qualitative or quantitative relationship between risks and benefits, involving the complex process of determining the significance of the identified hazards and estimated risks to those organisms or people concerned with or affected by them.
RT **exposure evaluation, hazard identification, risk assessment, risk characterization, risk estimation, risk identification, risk perception**

risk identification Recognition of a potential hazard and definition of the factors required to assess the probability of exposure of organisms or people to that hazard and of harm resulting from such exposure.

risk indicator See SN **risk marker.**

risk management Decision-making process involving considerations of political, social, economic, and engineering factors with relevant risk assessments relating to a potential hazard so as to develop, analyze, and compare regulatory options and to select

the optimal regulatory response for safety from that hazard. Essentially, risk management is the combination of three steps: risk evaluation, emission and exposure control, and risk monitoring.
RT **emission and exposure control, risk evaluation, risk monitoring**

risk marker Attribute that is associated with an increased probability of occurrence of a disease or other specified outcome and that can be used as an indicator of this increased risk: not necessarily a causal or pathogenic factor.
Last (1988)
SN **risk indicator**

risk monitoring Process of following up the decisions and actions within risk management in order to check whether the aims of reduced exposure and risk are achieved.
WHO (1988)
BT **monitoring**
RT **risk management**

risk perception Subjective perception of the gravity or importance of the risk based on a person's knowledge of different risks and the moral, economic, and political judgment of their implications.
RT **risk evaluation**
WHO (1988)

risk phrases Word groups identifying potential health or environmental hazards required under CPL directives (European Community); may be incorporated into safety data sheets.
RT **material safety data sheet, safety data sheet**

risk ratio Value obtained by dividing the probability of occurrence of a specific effect in one group by the probability of occurrence of the same effect in another group, or the value obtained by dividing the probability of occurrence of one potentially hazardous event by the probability of occurrence of another. Calculation of such ratios is used in choosing between options in risk management.
RT **risk management**

risk-specific dose Amount of exposure corresponding to a specified level of risk.
USEPA (1989)

rodenticide Substance intended to kill rodents.

route of exposure Means by which a toxic agent gains access to an organism by administration through the gastrointestinal tract (ingestion), lungs (inhalation), skin (topical), or by other routes such as intravenous, subcutaneous, intramuscular, or intraperitoneal.

safety Reciprocal of risk: practical certainty that injury will not result from a hazard under defined conditions.
1. Safety of a drug or other substance in the context of human health: the extent to which a substance may be used in the amount necessary for the intended purpose with a minimum risk of adverse health effects.
2. Safety (toxicological): The high probability that injury will not result from exposure to a substance under defined conditions of quantity and manner of use, ideally controlled to minimize exposure.

RT **practical certainty, risk**

safety data sheet Single page giving toxicological and other safety advice, usually associated with a particular preparation, substance, or process.

safety factor See SN **uncertainty factor.**

saluretic See SN **natriuretic.**

sample
1. In statistics, a group of individuals often taken at random from a population for research purposes.
2. One or more items taken from a population or a process and intended to provide information on the population or process.
3. Portion of material selected from a larger quantity in some manner chosen so that the portion is representative of the whole.
PAC (1990)

RT **biased sample, random sample, stratified sample, systematic sample.**

sampling Procedure used to obtain or constitute a sample.
RT **sample**

sampling error Part of the total estimation error of a parameter (or value of a property, such as concentration) caused by the random nature of the sample.
ISO (1977)
RT **sample, sampling**

sarcoma Malignant tumor arising in a connective tissue and composed primarily of anaplastic cells resembling supportive tissue.

saturnism Intoxication caused by lead.
SN **plumbism**

scotoma Area of depressed vision within the visual field, surrounded by an area of less depressed or normal vision.

sclerosis Hardening of an organ or tissue, especially that due to excessive growth of fibrous tissue.

screening
1. Carrying out of a test or tests, examination(s), or procedure(s) in order to expose undetected abnormalities, unrecognized (incipient) diseases, or defects: Examples are mass X-rays and cervical smears.

2. Pharmacological or toxicological screening consists of a specified set of procedures to which a series of compounds is subjected to characterize pharmacological and toxicological properties and to establish dose–effect and dose–response relationships.

screening level Decision limit or cutoff point at which a screening test is regarded as positive.
Last (1988)

secondary metabolite Product of biochemical processes other than the normal metabolic pathways, mostly produced in microorganisms or plants after the phase of active growth and under conditions of nutrient deficiency.
After Nagel *et al.* (1991)

secondary pollutant See BT **pollutant.**

secondhand smoke See SN **sidestream smoke.**

secretion
1. Process by which a substance such as a hormone or enzyme produced in a cell is passed through a plasma membrane to the outside, for example, the intestinal lumen or the blood (internal secretion).
2. Solid, liquid, or gaseous material passed from the inside of a cell through a plasma membrane to the outside as a result of cell activity.

sedative Substance that exerts a soothing or tranquillizing effect.
RT **anesthetic, narcotic**

self-cleaning of water (in a reservoir) Water purification by natural biological and physicochemical processes.

self-purification of the atmosphere Purification of the atmosphere from contaminants by natural biological and physicochemical processes.
RT **contaminant**

semichronic See SN **subchronic.**

sensibilization See SN **sensitization.**

sensitivity (in analytical chemistry) Extent to which a small change in concentration of an analyte can cause a large change in the related measurement.
Gold *et al.* (1987)

sensitivity (of a screening test) Extent (usually expressed as a percentage) to which a method gives results that are free from false negatives; the fewer the false negatives, the greater the sensitivity. Quantitatively, sensitivity is the proportion of truly diseased persons in the screened population who are identified as diseased by the screening test.
Galen and Gambino (1975)
RT **specificity (of a screening test)**

sensitization Immune process whereby individuals become hypersensitive to substances, pollen, dandruff, or other agents that make them develop a potentially harmful allergy when they are subsequently exposed to the sensitizing material (allergen).
RT **allergy, hypersensitivity**

sensory effect level
1. Intensity, where the detection threshold level is defined as the lower limit of the perceived intensity range (by convention the lowest concentration that can be detected in 50% of the cases in which it is present).
2. Quality, where the recognition threshold level is defined as the lowest concentration at which the sensory effect can be recognized correctly in 50% of the cases.
3. Acceptability and annoyance, where the nuisance threshold level is defined as the concentration at which not more than a small proportion of the population (<5%) experiences annoyance for a small part of the time (<2%); since annoyance will be influenced by a number of factors, a nuisance threshold level cannot be set on the basis of concentration alone.
RT **nuisance threshold**
WHO (1987)

serum
1. Watery proteinaceous portion of the blood that remains after clotting.
SN **blood serum**
2. Clear watery fluid especially that moistens the surface of serous membranes or that is exuded through inflammation of any of these membranes.

short-term effect See SN **acute effect.**

short-term exposure limit (STEL) As used by U.S NIOSH, unless noted otherwise, the 15-min time-weighted average exposure that should not be exceeded at any time during a work day.

side effect Action of a drug other than that desired for beneficial pharmacological effect.

siderosis
1. Pneumoconiosis resulting from the inhalation of iron dust.
BT **pneumoconiosis**
2. Excess of iron in the urine, blood, or tissues characterized by hemosiderin granules in urine and iron deposits in tissues.

sidestream smoke Cloud of small particles and gases that is given off from the end of a burning tobacco product (cigarette, pipe, and cigar) between puffs and is not directly inhaled by the smoker; the smoke

that gives rise to passive inhalation on the part of bystanders.
SN **secondhand smoke**
RT **mainstream smoke**

sign Objective evidence of a disease, deformity, or an effect induced by an agent, perceptible to an examining physician.

silicosis Pneumoconiosis resulting from inhalation of silica dust.
BT **pneumoconiosis**

simulation test Procedure designed to predict the rate of biodegradation of a compound under relevant environmental conditions.

sink In environmental chemistry, an area or part of the environment in which, or a process by which, one or more pollutants is removed from the medium in which it is dispersed; for example, moist ground acts as a sink for sulfur dioxide in the air.

sister chromatid exchange (SCE) Reciprocal exchange of chromatin between two replicated chromosomes that remain attached to each other until anaphase of mitosis; used as a measure of mutagenicity of substances that produce this effect.
RT **mitosis**

skeletal fluorosis Osteosclerosis due to fluoride.

slimicide Substance intended to kill slime-producing organisms (used on paper stock, water cooling systems, paving stones, etc.).

slope factor Value, in inverse concentration or dose units, derived from the slope of a dose–response curve; in practice, limited to carcinogenic effects with the curve assumed to be linear at low concentrations or doses. The product of the slope factor and the exposure is taken to reflect the probability of producing the related effect.
RT **concentration–effect curve, concentration–response curve, dose, dose–effect curve, dose–response curve**

societal risk Total probability of harm to a human population including the probability of adverse health effects to descendants and the probability of disruption resulting from loss of services such as industrial plant or loss of material goods and electricity.

solvent abuse Deliberate inhalation (or drinking) of volatile solvents in order to become intoxicated.
SN **''solvent sniffing''**
NT **''glue sniffing''**

''solvent sniffing'' See SN **solvent abuse.**
NT **''glue sniffing''**

somatic
1. Pertaining to the body as opposed to the mind.
2. Pertaining to nonreproductive cells or tissues.
3. Pertaining to the framework of the body as opposed to the viscera.

soporific Substance producing sleep.
RT **anesthetic, narcotic, sedative**

sorption Noncommittal term used instead of adsorption or absorption when it is difficult to discriminate experimentally between these two processes.
Gold *et al.* (1987)

speciation Determination of the exact chemical form or compound in which an element occurs in a sample; for instance, determination of whether arsenic occurs in the form of trivalent or pentavalent ions or as part of an organic molecule, and the quantitative distribution of the different chemical forms that may coexist.

species
1. In biological systematics, a group of organisms of common ancestry that are able to reproduce only among themselves and that are usually geographically distinct.
2. See NT **chemical species.**

species differences in sensitivity Quantitative or qualitative differences of response to the action(s) of a potentially toxic substance on various species of living organisms.
RT **species-specific sensitivity**

species-specific sensitivity Quantitative and qualitative features of response to the action(s) of a potentially toxic substance that are characteristic for particular species of living organism.
RT **species differences in sensitivity**

specific death rate Death rate computed for a subpopulation of individual organisms or people having a specified characteristic or attribute and named accordingly (e.g., age-specific death rate, the number of deaths of persons of a specified age during a given period of time, divided by the total number of persons of that age in the population during that time).
IPCS (1987)

specific pathogen free (SPF) Describing an animal removed from its mother under sterile conditions just prior to term and subsequently reared and kept under sterile conditions.
RT **germ-free animal**

specificity (of a screening test) Proportion of truly nondiseased persons who are identified by the screening test.

specimen Specifically selected portion of any substance, material, organism (specifically tissue, blood, urine, or feces), or environmental medium assumed to be representative of the parent substance etc. at the time it is taken for the purpose of diagnosis, identification, study, or demonstration.
PAC (1990)

spreader Agent used in some pesticide formulations to extend the even disposition of the active ingredient.

stability half-life (half-time) Time required for the amount of a substance in a formulation to decrease, for any reason, by one-half (50%).
Brown (1988)

standard
1. That which is established as a measure or model to which others of a similar nature should conform.
2. Technical specification, usually in the form of a document available to the public, drawn up with the consensus or general approval of all interests affected by it; based on the consolidated results of science, technology, and experience; aimed at the promotion of optimum community benefits; and approved by a body recognized on the national, regional, or international level.
   SN **technical directive.**
3. Reference substance.
   SN **standard material**

standard material (in analytical chemistry)
1. Reference material (or calibration material) for which, for specified element concentrations, values are recommended by some official body.
   Gold *et al.* (1987)
2. Substance sufficiently well defined to be used for calibration and quality control of measurement techniques.
   PS **reference material**

standard(ized) mortality (morbidity) ratio (SMR) Ratio of the number of events observed in the study group or population to the number of deaths expected if the study population had the same specific rates as the standard population, multiplied by 100.
Last (1988)

standardization
1. Making any substance, drug, or other preparation conform to type or precisely defined characteristics.
2. Establishment of precisely defined characteristics, or precisely defined methods, for future reference.
3. Definition of precise procedures for administering, scoring, and evaluating the results of a new method that is under development.

stannosis Pneumoconiosis resulting from inhalation of tin dust.

stochastic Of, pertaining to, or arising from chance and hence involving probability and obeying the laws of probability.

stochastic effect Consequence for which the probability of occurrence depends on the absorbed dose: Hereditary effects and cancer induced by radiation are considered to be stochastic effects. The term ''stochastic'' indicates that the occurrence of effects so named would be random. This means that, even for an individual, there is no threshold of dose below which the effect will not appear, and the chance of experiencing the effect increases with increasing dose.
WHO (1989a)
RT **all-or-none effect, quantal effect**

stratification (in epidemiology) Process of or result of separating a sample into several subsamples according to specified criteria, such as age groups and socioeconomic status.
Last (1988)

stratified sample Subset of a population selected according to some important characteristic.
RT **stratification**

structure–activity relationship (SAR) Association between the physicochemical properties of a substance and/or the properties of its molecular substructures and its biological properties including its toxicity.
PS **quantitative structure–activity relation (QSAR)**

subacute Term used to describe a form of repeated exposure or administration usually occurring over about 21 days, not long enough to be called ''long-term'' or ''chronic.''
PS **subchronic**
RT **subacute effect, subchronic effect, subchronic toxicity, subchronic toxicity test**

subacute (sometimes called subchronic) effect Biological change resulting from multiple or continuous exposures usually occurring over about 21 days. Sometimes the term is used synonymously with subchronic effect and care should be taken to check the usage in any particular case.
PS **subchronic effect**
RT **subchronic toxicity, subchronic toxicity test**

subchronic Related to repeated dose exposure over a short period, usually about 10% of the life span; an imprecise term used to describe exposures of intermediate duration.
PS **subacute**

RT **subacute effect, subchronic effect, subchronic toxicity, subchronic toxicity test**
SN **semichronic**

subchronic (sometimes called subacute) effect Biological change resulting from an environmental alteration lasting about 10% of the lifetime of the test organism. In practice with experimental animals, such an effect is usually identified as resulting from multiple or continuous exposures occurring over 3 months (90 days). Sometimes a subchronic effect is distinguished from a subacute effect on the basis of its lasting for a much longer time.
PS **subacute effect**
RT **subchronic toxicity, subchronic toxicity test**

subchronic toxicity
1. Adverse effects resulting from repeated dosage or exposure to a substance over a short period, usually about 10% of the life span.
2. The capacity to produce adverse effects following subchronic exposure.

RT **subacute, subchronic, subchronic effect, subchronic toxicity test**

subchronic (sometimes called subacute) toxicity test Animal experiment serving to study the effects produced by the test material when administered in repeated doses (or continually in food, drinking water and air) over a period of up to about 90 days.
WHO (1979)
SN **semichronic toxicity test**

subclinical effect Biological change following exposure to an agent known to cause disease either before symptoms of the disease occur or when they are absent.

subjective environment Surrounding conditions as perceived by persons living in these conditions.
After WHO (1979)
SN **perceived environment**

subthreshold dose See SN **noneffective dose.**

sudorific Substance that causes sweating.

sufficient evidence According to the USEPA's Guidelines for Carcinogen Risk Assessment, sufficient evidence is a collection of facts and scientific references that is definite enough to establish that an adverse effect is caused by the agent in question.
RT **carcinogenicity, classification according to IARC, limited evidence**

suggested no-adverse-response level (SNARL) Maximum dose or concentration that on current understanding is likely to be tolerated by an exposed organism without producing any harm.

summary sheet Two- to four-page summary of a risk assessment.
IRIS (1986)

summation (in neurophysiology) Process of addition of separate postsynaptic responses caused by stimuli that are adjacent in time and space. Excitation of a synapse evokes a graded potential change in the postsynaptic membrane that may be below the threshold required to trigger an impulse. If two or more such potentials are caused nearly simultaneously, at different synapses on the same neurone (spatial summation), or in rapid succession at the same synapse (temporal summation), the summed response may be sufficient to trigger a postsynaptic impulse. Summation may occur between excitatory potentials, inhibitory potentials, or between an excitatory and an inhibitory potential.

Superfund Federal authority, established by the U.S. Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) in 1980, responding directly to releases or threatened releases (such as from dumps) of hazardous substances that may endanger health or welfare.
IRIS (1986)

superthreshold dose See PS **toxic dose.**

surface layer Region of space comprising and adjoining the phase boundary between a solid and liquid phase, between a solid and gas phase, or between a liquid and gas phase within which properties of matter are significantly different from the values in the adjoining bulk phases.
PS **interfacial layer**

surrogate Relatively well-studied toxicant whose properties are assumed to apply to an entire chemically and toxicologically related class; for example, benzo (*a*) pyrene data may be used as toxicologically equivalent to that for all carcinogenic polynuclear aromatic hydrocarbons.
RT **quantitative structure–activity relationship**

surveillance Ongoing scrutiny, generally using methods distinguished by their practicability and uniformity, and frequently by their rapidity, rather than by complete accuracy. Its main purpose is to detect changes in trend or distribution in order to initiate investigative or control measures.
Last (1988)

susceptibility Condition of lacking the power to resist a particular disease or infection; thus, in susceptible people ''normal expected'' results occur but with a lower exposure (or dose) than in the rest of the population.

sympatholytic
1. (adj.) Blocking transmission of impulses from the adrenergic (sympathetic) postganglionic fibers to effector organs or tissues.
2. (n.) Agent that blocks transmission of impulses from the adrenergic (sympathetic) postganglionic fibers to effector organs or tissues.

SN **antiadrenergic**

sympathomimetic
1. (adj.) Producing effects resembling those of impulses transmitted by the postganglionic fibers of the sympathetic nervous system.
2. (n.) Agent that produces effects resembling those of impulses transmitted by the postganglionic fibers of the sympathetic nervous system.

SN **adrenergic**

symptom Any subjective evidence of a disease or an effect induced by a substance as perceived by the affected subject.

symptomatology General description of all the signs and symptoms of exposure to a toxicant: Signs are the overt (observable) responses associated with exposure (such as convulsions and death), whereas symptoms are covert (subjective) responses (such as nausea and headache).
Brown (1988)

synapse Functional junction between two neurons, where a nerve impulse is transmitted from one neuron to another.

synaptic transmission See RT **synapse.**

syndrome Set of signs and symptoms occurring together and often characterizing a particular disease-like state.

synergism Pharmacological or toxicological interaction in which the combined biological effect of two or more substances is greater than expected on the basis of the simple summation of the toxicity of each of the individual substances.

synergistic effect Biological effect following exposure simultaneously to two or more substances that is greater than the simple sum of the effects that occur following exposure to the substances separately.
RT **additive effect, antagonism, potentiation**

systematic sample Subset selected according to some simple rule such as specified date or alphabetic classification.
RT **biased sample, stratified sample**

systemic Relating to the body as a whole.

systemic effect Consequence that is of either a generalized nature or that occurs at a site distant from the point of entry of a substance: A systemic effect requires absorption and distribution of the substance in the body.

tachy- Prefix meaning rapid, as in tachycardia and tachypnoea.

tachycardia Abnormally fast heartbeat.
AN **bradycardia**

tachypnoea Abnormally fast breathing.
AN **bradypnoea**

target (biological) Any organism, organ, tissue, cell, or cell constituent that is subject to the action of a pollutant or other chemical, physical, or biological agent.
WHO (1979)
RT **receptor**

target (of environmental pollution) Human being or any organism, organ tissue, cell, resource, or any constituent of the environment, living or not, that is subject to the activity of a pollutant or other chemical or physical activity or other agent.
WHO (1979)
RT **receptor**

target organ(s) Organ(s) in which the toxic injury manifests itself in terms of dysfunction or overt disease.
WHO (1979)
RT **receptor**

target population (epidemiology)
1. Collection of individuals, items, measurements, etc. about which we want to make inferences: The term is sometimes used to indicate the population from which a sample is drawn and sometimes to denote any reference population about which inferences are required.
2. Group of persons for whom an intervention is planned.

Last (1988)

T cell See **T lymphocyte.**

technical directive See RT **standard.**

temporary acceptable daily intake Value for the acceptable daily intake proposed for guidance when data are sufficient to conclude that use of the substance is safe over the relatively short period of time required to generate and evaluate further safety data but are insufficient to conclude that use of the substance is safe over a lifetime. A higher than normal safety factor is used when establishing a temporary ADI and an expiration date is established by which time appropriate data to resolve the safety issue should be available.
After de Koning (1987)
RT **acceptable daily intake**

temporary maximum residue limit Temporary maximum residue limit is established for a specified, limited period when
1. Only a temporary acceptable daily intake has been established for the pesticide concerned.
2. Although an acceptable daily intake has been established, the residue data are inadequate for firm maximum residue recommendations.

WHO (1976)

teniacide Substance intended to kill tapeworms.

teratogen Agent that, when administered prenatally (to the mother), induces permanent structural malformations or defects in the offspring.

teratogenicity Potential to cause or the production of structural malformations or defects in offspring.
After WHO (1987)
RT **developmental toxicity, embryotoxicity**

testing of chemicals
1. In toxicology, evaluation of the therapeutic and potentially toxic effects of substances by their application through relevant routes of exposure with appropriate organisms or biological systems so as to relate effects to dose following application.
2. In chemistry, qualitative or quantitative analysis by the application of one or more fixed methods and comparison of the results with established standards.

tetanic Pertaining to tetanus, characterized by tonic muscle spasm.

therapeutic index Ratio between toxic and therapeutic doses (the higher the ratio, the greater the safety of the therapeutic dose).

threshold Dose or exposure concentration below which an effect is not expected.

threshold limit value (TLV) Concentration in air of a substance to which it is believed that most workers can be exposed daily without adverse effect (the threshold between safe and dangerous concentrations). These values are established (and revised annually) by the American Conference of Governmental Industrial Hygienists) and are time-weighted concentrations for a 7- or 8-hr workday and a 40-hr workweek. For most substances the value may be exceeded, to a certain extent, provided there are compensatory periods of exposure below the value during the workday (or in some cases the week). For a few substances (mainly those that produce a rapid response) the limit is given as a ceiling concentration (maximum permissible concentration, designated by ''C'') that should never be exceeded.

thrombocytopenia Decrease in the number of blood platelets (thrombocytes).

tidal volume Quantity of air or test gas that is inhaled and exhaled during one respiratory cycle.

time-weighted average exposure (TWAE) or concentration (TWAC) Concentration in the exposure medium at each measured time interval multiplied by that time interval and divided by the total time of observation: For occupational exposure a working shift of 8 hr is commonly used as the averaging time.
WHO (1979)

tinnitus Continual noise in the ears, such as ringing, buzzing, roaring, or clicking.

tissue dose Amount of a substance or physical agent (radiation) absorbed by a tissue.

T lymphocyte Animal cell which possesses specific cell surface receptors through which it binds to foreign substances or organisms, or those which it identifies as foreign, and which initiates immune responses.
RT **B lymphocyte, immune response, lymphocyte**

tolerable daily intake (TDI) Regulatory value equivalent to the acceptable daily intake established by the European Commission Scientific Committee on Food. Unlike the ADI, the TDI is expressed in mg/person, assuming a body weight of 60 kg. TDI is normally used for food contaminants.
RT **acceptable daily intake**

tolerable risk Probability of suffering disease or injury that can, for the time being, be tolerated, taking into account the associated benefits and assuming that the risk is minimized by appropriate control procedures.
PS **acceptable risk**

tolerance
1. Adaptive state characterized by diminished effects of a particular dose of a substance: The process leading to tolerance is called ''adaptation.''
2. In food toxicology, dose that an individual can tolerate without showing an effect.
3. Ability to experience exposure to potentially harmful amounts of a substance without showing an adverse effect.
4. Ability of an organism to survive in the presence of a toxic substance: Increased tolerance may be acquired by adaptation to constant exposure.
5. In immunology, state of specific immunological unresponsiveness.

tonic
1. Characterized by tension, especially muscular tension.

2. Medical preparation that increases or restores normal muscular tension.

topical Pertaining to a particular area, as in a topical effect that involves only the area to which the causative substance has been applied.

total diet study
1. Study designed to establish the pattern of pesticide residue intake by a person consuming a defined diet.
   WHO (1976)
2. Study undertaken to show the range and amount of various foodstuffs in the typical diet or to estimate the total amount of a specific substance in a typical diet.
   After WHO (1989a)

toxic Able to cause injury to living organisms as a result of physicochemical interaction.

toxicant See SN **toxic substance.**

toxic chemical See SN **toxic substance.**

toxic dose Amount of a substance which produces intoxication without lethal outcome.
SN **superthreshold dose**

toxicity
1. Capacity to cause injury to a living organism defined with reference to the quantity of substance administered or absorbed, the way in which the substance is administered (inhalation, ingestion, topical application, or injection), and distributed in time (single or repeated doses), the type and severity of injury, the time needed to produce the injury, the nature of the organism(s) affected, and other relevant conditions.
2. Adverse effects of a substance on a living organism defined with reference to the quantity of substance administered or absorbed, the way in which the substance is administered (inhalation, ingestion, topical application, or injection) and distributed in time (single or repeated doses), the type and severity of injury, the time needed to produce the injury, the nature of the organism(s) affected, and other relevant conditions.
3. Measure of incompatibility of a substance with life: This quantity may be expressed as the reciprocal of the absolute value of median lethal dose (1/LD50) or concentration ($1/LC_{50}$).

RT **acute toxicity, chronic toxicity, subacute toxicity, subchronic toxicity**

toxicity equivalency factor (TEF) Factor used in risk assessment to estimate the toxicity of a complex mixture, most commonly a mixture of chlorinated dibenzo-*p*-dioxins, furans, and biphenyls: In this case, TEF is based on relative toxicity to 2,3,7,8-tetrachlorodibenzo-*p*-dioxin (TEF = 1).

toxicity equivalent (TEQ) Contribution of a specified component (or components) to the toxicity of a mixture of related substances. The amount of substance (or substance concentration) of total toxicity equivalent is the sum of that for the components B, C, ⋯ N:

$$\text{S } n(\text{TEQ}) = n(\text{TEQ})\text{B} + n(\text{TEQ})\text{C} + \cdots n\ (\text{TEQ})\text{N}$$

Toxicity equivalent is most commonly used in relation to the reference toxicant 2,3,7,8-tetrachlorodibenzo-*p*-dioxin, by means of the toxicity equivalency factor (TEF, *f*), which is 1 for the reference substance; hence;

$$\text{S } n(\text{TEQ}) = f\text{B}n\text{B} + f\text{C}n\text{C} + \cdots f\text{N}n\text{N}$$

toxicity test Experimental study of the adverse effects of exposure of a living organism to a substance for a defined duration under defined conditions.
RT **acute toxicity test, carcinogenicity test, chronic toxicity test, subchronic toxicity test**

toxic material See SN **toxic substance.**

toxicodynamics Process of interaction of potentially toxic substances with target sites, and the biochemical and physiological consequences leading to adverse effects.
RT **adverse effect, pharmacodynamics, target**

toxicogenetics Study of the influence of hereditary factors on the effects of potentially toxic substances on individual organisms.
RT **ecogenetics, pharmacogenetics, polymorphism**

toxicokinetics Process of the uptake of potentially toxic substances by the body, the biotransformation they undergo, the distribution of the substances and their metabolites in the tissues, and the elimination of the substances and their metabolites from the body. Both the amounts and the concentrations of the substances and their metabolites are studied. The term has essentially the same meaning as pharmacokinetics, but the latter term should be restricted to the study of pharmaceutical substances.
WHO (1979)
BT **chemobiokinetics**
RT **biotransformation, pharmacokinetics**

toxicological data sheet Document that gives in a uniform manner data relating to the toxicology of a substance, its production and application, and properties and methods of identification; the data sheet may also include recommendations on protective measures.
PS **toxicological profile, toxicological dossier**
IRPTC (1982)

toxicology Scientific discipline involving the study of the actual or potential danger presented by the harmful effects of substances (poisons) on living organisms and ecosystems, of the relationship of such harmful effects to exposure, and of the mechanisms of action, diagnosis, prevention, and treatment of intoxications.
NT **chemical toxicology**

toxicometry Term sometimes used to indicate a combination of investigative methods and techniques for making a quantitative assessment of toxicity and the hazards of potentially toxic substances.

toxicophobia Morbid dread of poisons.
RT **chemophobia**

toxicophoric (toxophoric) group Structural moiety that upon metabolic activation exerts toxic effects: The presence of a toxicophoric group indicates only potential and not necessarily actual toxicity of a drug or other substances.
SN **toxogenic group**

toxicovigilance Active process of identification, investigation, and evaluation of various toxic effects in the community with a view to taking measures to reduce or control exposure(s) involving the substance(s) which produces these effects.

toxic substance Material causing injury to living organisms as a result of physicochemical interactions.
SN **chemical etiologic agent, poison, toxicant, toxic chemical, toxic material**

toxification Metabolic conversion of a potentially toxic substance to a product that is more toxic.

toxin Poisonous substance produced by a biological organism such as a microbe, animal, or plant.
PS **venom**

toxinology Scientific discipline involving the study of the chemistry, biochemistry, pharmacology, and toxicology of toxins.
RT **toxicology, toxin**

toxogenic group See SN **toxicophoric group.**

tracer
1. Means by which something may be followed; for example, a radioactive isotope may replace a stable chemical element in a toxic compound enabling the toxicokinetics to be followed.
2. Labeled member of a population used to measure certain properties of that population.
Gold *et al.* (1987)

transcription Process by which the genetic information encoded in a linear sequence of nucleotides in one strand of DNA is copied into an exactly complementary sequence of RNA.
RT **reverse transcription**

transformation
1. Alteration of a cell by incorporation of foreign genetic material and its subsequent expression in a new phenotype.
RT **phenotype**
2. Conversion of cells growing normally to a state of rapid division in culture resembling that of a tumor.
3. Chemical modification of substances in the environment.

transgenic Adjective used to describe animals carrying a gene introduced by microinjecting DNA into the nucleus of the fertilized egg.

treatability In relation to wastewater, the amenability of substances to removal without adversely affecting the normal operation of biological treatment processes (such as a sewage treatment plant).

triage Assessment of sick, wounded, and injured persons following a disaster to determine priority needs for efficient use of available medical facilities.

trophic level Amount of energy in terms of food that an organism needs: Organisms not needing organic food, such as plants, are said to be on a low trophic level, whereas predator species needing food of high-energy content are said to be on a high trophic level. The trophic level indicates the level of the organism in the food chain.
WHO (1979)

tumor
1. Any abnormal swelling or growth of tissue, whether benign or malignant.
2. An abnormal growth, in rate and structure, that arises from normal tissue but serves no physiological function.
SN **neoplasm**

tumorigenic Able to cause tumors.

tumor progression Sequence of changes by which a benign tumor develops from the initial lesion to a malignant stage.

turnover time See SN **mean life.**

ulcer Defect, often associated with inflammation, occurring locally or at the surface of an organ or tissue owing to sloughing of necrotic tissue.

uncertainty factor
1. In assay methodology, confidence interval or fiducial limit used to assess the probable precision of an estimate.
2. In toxicology, value used in extrapolation from experimental animals to man (assuming that man may be more sensitive) or from selected individuals to the general population: for example, a value

applied to the no-observed-effect-level (NOEL) or no-observed-adverse-effect-level (NOAEL) to derive an acceptable daily intake or reference dose (RfD) (the NOEL or NOAEL is divided by the value to calculate the acceptable daily intake or RfD). The value depends on the nature of the toxic effect, the size and type of population to be protected, and the quality of the toxicological information available.
SN **safety factor**
RT **modifying factor, no-observed-effect-level, no-observed-adverse-effect-level, reference dose**

unit risk (as used by the USEPA) Incremental upper-boundary lifetime risk estimated to result from lifetime exposure to an agent if it is in air at a concentration of 1 mg/m^3 or in the water at a concentration of 1 mg/liter.
IRIS (1986)

upper boundary Estimate of the plausible upper limit to the true value of a quantity: This is usually not a statistical confidence limit.
IRIS (1986)

uptake Entry of a substance into the body, an organ, a tissue, a cell, or the body fluids by passage through a membrane or by other means.
PS **absorption**

urticaria Vascular reaction of the skin marked by the transient appearance of smooth, slightly elevated patches (wheals and hives) that are redder or paler than the surrounding skin and often attended by severe itching.

vacuole Membrane-bound cavity within a cell.

validity (of a measurement) Expression of the degree to which a measurement measures what it purports to measure.
NT **concurrent validity, construct validity, content validity, criterion validity, predictive validity**
Last (1988)

validity of a study Degree to which the inferences drawn from a study, especially generalizations extending beyond the study sample, are warranted when account is taken of the study methods, the representativeness of the study sample, and the nature of the population from which it is drawn.
Last (1988)
NT **external validity, internal validity**

vasoconstriction Decrease of the caliber of the blood vessels leading to a decreased blood flow.
AN **vasodilation**

vasodilation Increase in the caliber of the blood vessels, leading to an increased blood flow.
AN **vasoconstriction**

vehicle Substance(s) used to formulate active ingredients for administration or use (general term for solvents, suspending agents, etc.).
Brown (1988)
RT **excipient**

venom Animal toxin generally used for self-defense or predation and usually delivered by a bite or sting.
PS **toxin**

ventilation
1. Process of supplying a building or room with fresh air.
2. Process of exchange of air between the ambient atmosphere and the lungs.
3. In physiology, the amount of air inhaled per day.
4. Oxygenation of blood.

ventricular fibrillation Irregular heartbeat characterized by uncoordinated contractions of the ventricle.

vermicide Substance intended to kill worms.

vermifuge Substance that causes the expulsion of intestinal worms.

vertigo Dizziness; an illusion of movement as if the external world were revolving around an individual or as if the individual were revolving in space.

vesicant
1. (adj.) Producing blisters on the skin.
2. (n.) Substance that causes blisters on the skin.

vesicle
1. Small sac or bladder containing fluid.
2. Blister-like elevation on the skin containing serous fluid.

volume of distribution Apparent (hypothetical) volume of fluid required to contain the total amount of a substance in the body at the same concentration as that present in the plasma assuming equilibrium has been attained.
RT **plasma**

waste Anything that is deliberately or otherwise disposed of on the assumption that it is of no further use to the primary user.

wasting syndrome Disease marked by weight loss and atrophy of muscular and other connective tissues that is not directly related to a decrease in food and water consumption.

Weibull model Dose–response model of the form

$$P(d) = 1 - \exp(-bd^m)$$

where $P(d)$ is the probability of cancer death due to a continuous dose rate, d, and b, and m are constants.
IRIS (1986)

weight-of-evidence for toxicity Extent to which the available biomedical data support the hypothesis

that a substance causes a defined toxic effect such as cancer in humans.
IRIS (1986)

withdrawal effect Adverse event following withdrawal from a person or animal of a drug to which they have been chronically exposed or on which they have become dependent.

working zone Space measuring up to 2 m over the level of the floor or platform that contains a worker's permanent or temporary station.
IRPTC (1982)

x-disease Hyperkeratotic disease in cattle following exposure to chlorinated dibenzo-*p*-dioxins, naphthalenes, and related compounds.

xenobiotic

1. Strictly, any substance interacting with an organism that is not a natural component of that organism.
   SN **exogenous substance, foreign substance or compound**
2. Man-made compounds with chemical structures foreign to a given organism.
   Nagel *et al.* (1991)

SN **anthropogenic substance**

zoocide Substance intended to kill animals.

zygote

1. Cell such as a fertilized egg resulting from the fusion of two gametes.
2. Cell obtained as a result of complete or partial fusion of cells produced by meiosis.
   Nagel *et al.* (1991)

References

American Conference of Governmental Industrial Hygienists (ACGIH) (1985). *International Symposium on Occupational Exposure Limits,* Ann. ACGIH, Vol. 12, ACGIH, Cincinnati, OH.

Barnes, D. G., and Dourson, M. L. (1988). *Regul. Toxicol. Pharmacol.* **8,** 471–486.

Berlin, A., Yodaiken, R. E., and Henman, B. A. (1984). *Assessment of Toxic Agents at the Workplace: Roles of Ambient and Biological Monitoring,* Nijhoff, Boston.

Brown, V. K. (Ed.) (1988). *Acute and Sub-Acute Toxicology.* Edward Arnold, London.

Butterworths (1978). *Butterworths Medical Dictionary,* 2nd ed. Butterworths, London.

Churchill (1989). *Churchill's Medical Dictionary,* Churchill Livingstone, New York.

Codex Alimentarius Commission (1986a). *Codex Alimentarius, Volume XIII, Codex Maximum Limits for Pesticide Residues,* 2nd ed. FAO/WHO, Rome.

Codex Alimentarius Commission (1986b). *Codex Alimentarius, Volume XIV, Food Additives.* FAO/WHO, Rome.

Codex Alimentarius Commission (1989). *Report of the 21rst Session of the Codex Committee on Pesticide Residues, The Hague, 10–17 April, 1989.* FAO/WHO, Rome.

De Koning, H. W. (Ed.) (1987). *Setting Environmental Standards, Guidelines for Decision Making.* World Health Organization, Geneva.

Dorland (1988). *Dorland's Illustrated Medical Dictionary,* 27th ed. Saunders, Philadelphia.

Duffus, J. H. (Ed.) (1986). *Environmental Toxicology and Ecotoxicology,* Environmental Health Series No. 10. World Health Organization, Regional Office for Europe, Copenhagen.

Galen, R. S., and Gambino, S. R. (1975). *Beyond Normality: The Predictive Value and Efficiency of Medical Diagnoses.* Wiley, New York.

Gold, V., Loening, K. L., McNaught, A. D., and Sehmi, P. (Eds.) (1987). *International Union of Pure and Applied Chemistry, Compendium of Chemical Terminology. IUPAC Recommendations,* Blackwell, Oxford.

Guengerich, F. P. (1988). *Cancer Res.* **48,** 2946–2954.

Integrated Risk Information System (IRIS) (1986). *Integrated Risk Information System of the United States,* EPA/600/6-86/032a. U.S. Environmental Protection Agency, Washington, DC.

International Agency for Research on Cancer (IARC) (1987). *IARC Monographs on the Evaluation of Carcinogenic Risk to Humans, Supplement 7.* World Health Organization/IARC, Lyon.

International Atomic Energy Agency (IAEA) (1978). Particle size analysis in estimating the significance of airborne contamination, Technical Report Series No. 179. IAEA, Vienna.

International Commission on Radiological Protection (1965). *Principles of Environmental Monitoring Related to the Handling of Radioactive Materials,* Report of Committee IV of the International Commission on Radiological Protection. Pergamon Press, Oxford.

International Organization for Standardization (ISO) (1972). *Nuclear Energy Glossary,* ISO 921. ISO, Geneva.

International Organization for Standardization (ISO) (1975). *Vibration and Shock—Vocabulary,* ISO 2041. ISO, Geneva.

International Organization for Standardization (ISO) (1977). *Statistics—Vocabulary and Symbols,* ISO 3534. ISO, Geneva.

International Organization for Standardization (ISO) (1979). *Cleaning Equipment for Air or Other Gases—Vocabulary,* ISO 3649. ISO, Geneva.

International Organization for Standardization (ISO) (1980). *Air Quality: General Aspects—Vocabulary,* ISO 3649. ISO, Geneva.

International Organization for Standardization (ISO) (1986a). *Precision of Test Methods—Determination of Repeatability and Reproducibility for a Standard Test Method by Interlaboratory Tests,* ISO 5725. ISO, Geneva.

International Organization for Standardization (ISO) (1986b) *Quality—Vocabulary,* ISO 8402. ISO, Geneva.

International Programme on Chemical Safety (IPCS) (1978). *Principles and Methods for Evaluating the Toxicity of Chemicals. Part 1.* World Health Organization, Geneva.

International Programme on Chemical Safety (IPCS) (1989). "*International Programme on Chemical Safety Glossary of Terms for Use in IPCS Publications.*" World Health Organization, Geneva.

International Register of Potentially Toxic Substances (IRPTC) (1982). *International Register of Potentially Toxic Substances, English–Russian Glossary of Selective Terms in Preventive Toxicology,* interim document. United Nations Environment Programme, Moscow.

Kjellström, T., Elinder, C. G., and Friberg, L. (1984). *Environ. Res.* **33,** 284–295.

Last, J. M. (Ed.) (1988). *A Dictionary of Epidemiology,* 2nd ed. Oxford Medical Publications, Oxford Univ. Press, New York.

Nagel, B., Dellweg, H., and Gierasch, L. M. (Eds.) (1991). *Pure Appl. Chem.* **64,** 143–168.

Oxford English Dictionary (1991). *The Oxford English Dictionary,* 2nd ed. (prepared by J. A. Simpson and E.S.C. Weiner). Clarendon, Oxford.

PAC (1972). *Pure Appl. Chem.* **31,** 577–628.

PAC (1990). *Pure Appl. Chem.* **62,** 1193–1208.

Palmer, G., and Reedijk, J. (1991). *Eur. J. Biochem.* **200,** 599–611.

Parkes, W. R. (1982). *Occupational Lung Disorders,* 2nd ed. Butterworths, London.

Roitt, I., Brostoff, J., and Male, D. (1989). *Immunology.* Churchill Livingstone, Edinburgh, UK.

Royal College of Physicians (RCP) (1984). *Food Intolerance and Food Aversion; A Joint Report of the Royal College of Physicians and British Nutrition Foundation* RCP, London.

Solberg, H. E. (1987). *Acta Bioqim. Clin. Latinoam.* **22,** 297–303 (in Spanish): *Ann. Biol. Clin.* **45,** 237–241: *Clin. Chim. Acta* **165,** 111–118: *J. Clin. Chem. Clin. Biochem.* **25,** 337–342: *Labmedica* **4,** 27–33.

Stedman (1990). *Stedman's Medical Dictionary,* 25th ed. Williams & Wilkins, Baltimore.

U.S. Environmental Protection Agency (USEPA) (1986). *United States Environmental Protection Agency, Superfund Public Health Evaluation Manual,* EPA/5401/1-86/060. USEPA, Washington, DC.

U.S. Environmental Protection Agency (USEPA) (1989). *Glossary of Terms Related to Health, Exposure, and Risk Assessment,* EPA/450/3-88/016. USEPA, Washington DC.

Vettorazzi, G. (Ed.) (1980). *Handbook of International Food Regulatory Toxicology—Vol. 1: Evaluation.* Spectrum, New York.

Weatherall, D.J., Ledingham, J.G.G., and Warrell, D. A. (Eds.) (1987). *Oxford Textbook of Medicine,* 2nd ed. Oxford Univ. Press, Oxford.

World Health Organization (WHO) (1976), WHO Tecnical Report Series, No. 592 (Report of the 1975 Joint Meeting of the FAO Working Party of Experts on Pesticide Residues and the WHO Expert Committee on Pesticide Residues). WHO, Geneva.

World Health Organization (WHO) (1978a). *Principles and Methods for Evaluating the Toxicity of Chemicals, Part 1,* Environmental Health Criteria 6. WHO, Geneva.

World Health Organization (WHO) (1978b). *Primary Health Care,* Report of the International WHO/UNICEF Conference on Health Care, Alma Ata, USSR, September 6–12, 1978. WHO, Geneva.

World Health Organization (WHO) (1979). Agreed terms on health effects evaluation and risk and hazard assessment of environmental agents', internal report of a working group (EHE/EHC/79.19). WHO, Geneva.

World Health Organization (WHO) (1980). *Glossary on Air Pollution,* WHO Regional Publications, European Series No. 9. WHO Regional Office for Europe, Copenhagen.

World Health Organization (WHO) (1987). *Air Quality Guidelines for Europe,* WHO Regional Publications, European Series, No. 23. WHO Regional Office for Europe, Copenhagen.

World Health Organization (WHO) (1988). *Basic Terminology for Risk and Health Impact Assessment and Management,* internal report of working group, April 12, 1988 (Annex 3). WHO, Geneva.

World Health Organization (WHO) (1989a). *Glossary of Terms on Chemical Safety for Use in IPCS Publications.* WHO, Geneva.

World Health Organization (WHO) (1989b). *Guidelines for Predicting Dietary Intake of Pesticide Residues.* WHO, Geneva.

World Health Organization (WHO) (1991). *Evaluation of Certain Veterinary Drug Residues in Food (38th Meeting of JECFA)* WHO Technical Report Series. WHO, Geneva.

Zielhuis, R. L., and Henderson, P. TH. (1986). *Int. Arch. Occup. Environ. Health* **57,** 249–257.

APPENDIX

2

Career Opportunities in Toxicology

SOCIETY OF TOXICOLOGY
1767 Business Center Drive, Suite 302
Reston, Virginia 20190-5332
Phone: 703-438-3115
Fax: 703-438-3113

INTRODUCTION

The Society of Toxicology

The Society of Toxicology (SOT) is a professional and scholarly organization of scientists from academic institutions, government, and industry representing the great variety of scientists who practice toxicology in the U.S. and abroad. The organization is dedicated to supporting the creation of sound scientific information to reduce uncertainties in assessing risks and making improved decisions regarding the health of humans, other animals, and the environment.

The Society of Toxicology was founded in 1961 as a not-for-profit scientific society. It is governed by an 11 person elected Council and managed by an administrative office in the Washington, DC area. There are approximately 5,000 members from 44 countries, and there are nearly 60 Corporate Associate members. SOT's activities are highly diverse and assisted by the efforts of nearly 20 elected and appointed committees and task forces. The Society has established 18 Specialty Sections and 18 Regional Chapters that foster scientific exchange throughout the year.

SOT communicates research to diverse audiences throughout the world. SOT members publish their findings in the leading research journals, present their research at meetings and conferences, testify before government panels, serve in advisory capacities on an international basis, and conduct lectures and training programs for professionals, students, and the general public. The SOT Annual Meeting each March is the largest of its kind in the world with about 5,000 participants, and features groundbreaking toxicology research and exhibitions of the latest in instrumentation and services.

SOT has a strong commitment to public and professional education, offering a variety of programs including continuing education courses, workshops, symposia, student travel awards, and student summer internships. Significant efforts are also aimed at recruiting students from under represented populations to careers in toxicology, and to helping the public achieve a better understanding of toxicology. SOT coordinates several community outreach programs, including a public forum on local issues, special training programs for K–12 teachers, and media training for toxicologists.

Students with an interest in toxicology who are enrolled full-time in a graduate degree program are eligible for student membership in the Society. The nominal dues include the SOT newsletter and other membership mailings. Students may subscribe to the Society journals at the reduced member rates. Other Society activities of interest to students are the SOT Placement Service, the Student Luncheon at the annual meeting, and the Graduate Student Fellowship Awards. In addition, the SOT presents travel awards to a number of student members presenting a paper or poster at the annual meeting.

The Society of Toxicology endeavors to provide equal opportunity to all individuals interested in career opportunities in toxicology, and SOT-sponsored activities are open to all individuals, regardless of race, creed, color, gender, religion, age, disability or national origin.

Facts You Should Know about Toxicology

• Toxicology is the science that studies the harmful effects of excessive exposure to drugs, environmental contaminants, and naturally occurring substances found in food, water, air, and soil.

• Toxicology research is important for improving the health of humans, animals, and their environments.

• Toxicology studies are required to ensure the safety of medicines, household and gardening chemicals, and industrial and natural compounds to which humans and animals are frequently exposed.

• Toxicology research is intended to identify harmful effects of potential new products, prevent very unsafe products from reaching the marketplace, and to determine safe levels for approved products.

• Toxicology research also provides understanding of the mechanisms by which chemical substances cause injury. Such studies provide information that can be used in the treatment of poisonings.

FINANCIAL SUPPORT FOR GRADUATE STUDIES IN TOXICOLOGY

Most students in toxicology graduate programs have financial support, which can come from a variety of sources.

The Government

Federal Programs Offering Financial Support

1. Research Manpower Development Programs

The National Institute of Environmental Health Sciences (NIEHS) supports research training in four areas related to toxicology: (1) environmental toxicology, emphasizing training in the principles that determine the effects of exposure to environmental agents; (2) environmental pathology, emphasizing training in chemical, as opposed to infectious disease, pathology; (3) environmental mutagenesis, emphasizing training in the application of the principles of genetics and biochemistry to assess the potential genetic hazards to man of environmental chemicals; and (4) environmental epidemiology and biostatistics, emphasizing training in the use of statistical and mathematical tools to assist in the identification of environmental diseases in human populations and in experimental design and interpretation of data.

2. NIH Individual Investigator Research Awards

Many toxicologists in academic institutions who receive grant support from the NIH have Research Assistantships (RAs), available for graduate student support. These RA positions are often used to support graduate students in their final years of dissertation research. The level of support for a RA may vary from institution to institution, but are generally similar or slightly in excess of training grant stipends.

3. Miscellaneous Federal Programs

In addition to the specific programs noted above, federal support for graduate training may be available through other training programs or research grants and contracts sometimes available from other Federal agencies such as the National Science Foundation, the Armed Forces, the Environmental Protection Agency or the Department of Energy.

The Private Sector

The Society of Toxicology selects several predoctoral students each year to receive graduate fellowship awards. These awards are currently sponsored by the Covance Company, Novartis, and Proctor & Gamble. Any student member with at least two years of graduate study towards the Ph.D. degree in an area of toxicology and whose major professor is a member of the Society of Toxicology may apply. The Education Committee evaluates candidates on scholastic achievement, letters of recommendation and the dissertation research. Applications and further information are available from the SOT Web site.

Individual academic programs may also receive graduate student training support from sponsoring industries or foundations.

The Colgate-Palmolive Company offers a postdoctoral fellowship directed specifically toward innovations in toxicology methodology involving alternatives to whole animal use in testing. This award is administered through the Society to Toxicology, and further information can be found on the SOT Web site.

Academic Institutions

Many universities have funds to support graduate students during their training. These awards are generally offered as either Teaching Assistantships (TAs,) or as Research Assistantships (RAs). As TAs, students are generally required to assist in the preparation and teaching of undergraduate or graduate courses, and obtain valuable experience in teaching that will help them in their future careers as toxicologists. RAs generally assist faculty in research on specific topics, or provide general assistance to multiple faculty in the program. Check with the specific academic program directors for more information on the availability of student support for graduate training at your school of choice.

CAREER OPPORTUNITIES IN TOXICOLOGY

What Is Toxicology?

Hardly a week goes by without hearing about a chemical that may potentially threaten our health—

pesticides in the food we eat, pollutants in the air we breathe, chemicals in the water we drink, toxic dump sites near our homes. Are these chemicals really dangerous? How much does it take to cause harm? What are the effects of chemicals—cancer? nervous system damage? birth defects?

Finding scientifically sound answers to these very important questions is what toxicologists do, using the most modern chemical and biological techniques available. Toxicology combines the elements of biology and chemistry with many other disciplines to help us understand the harmful effects of chemicals on living organisms.

An additional important aspect of toxicology is the determination of the likelihood that such harmful effects will occur under a specific set of exposure circumstances, sometimes called ''risk assessment.'' If the risks are real, then we must be able to deal with them effectively. If the risks are trival, then we must ensure that valuable public resources are not spent ineffectively. Such important decisions must be made with the best scientific evidence possible. Thus, it is the responsibility of the toxicologist to (1) develop new and better ways to determine the potential harmful effects of chemical and physical agents and the amount (dosage) that will cause such effects. An essential part of this is to increase the understanding of the basic molecular, biochemical and cellular processes responsible for diseases caused by exposure to chemical or physical substances; (2) design and carry out carefully controlled studies of specific chemicals of social and economic importance to determine the conditions under which they can be used safely, i.e., have little or no impact on human health or the environment; (3) assess the probability, or likelihood, that particular chemicals, processes or situations present a significant risk to human health and/or the environment, and assist in the establishment of rules and regulations aimed at protecting and preserving human health and the environment.

Toxicology has been defined as the study of the adverse effects of chemical and physical agents on biological organisms, and the assessment of the probability of their occurrence. Such studies span the spectrum from molecular biology to human toxicology. The basic science of toxicology studies the cellular, biochemical and molecular mechanism(s) by which a chemical produces toxic effects, but also uses chemicals as tools to study basic biological processes important to the health and well-being of humans and the environment. The applied science of toxicology evaluates the effects of potentially toxic chemical and physical substances in whole animals and attempts to use the universe of knowledge about the chemical or physical agent to extrapolate to humans or other organisms of concern in the environment.

Why Consider a Career in Toxicology?

Challenges

Chemicals are an essential component of the high standard of living we enjoy. The challenge to toxicologists is to ensure that we are not endangering our health or the environment with the products and by-products of modern and comfortable living. As a career, toxicology provides the excitement of science and research while also contributing to the well-being of current and future generations. Few other careers offer such exciting and socially important challenges as protecting public health and the environment.

Opportunities

With the increase in our ''health consciousness,'' as well as concern for our environment, a wide and growing variety of career opportunities exist in toxicology.

Toxicologists

- participate in basic research using the most advanced techniques in molecular biology, chemistry, and biomedical sciences;
- work with chemical, pharmaceutical, and many other industries to test and ensure that their products and workplace are safe and to evaluate the implications of new research data;
- work for local and federal governments to develop and enforce laws to ensure that chemicals are produced, used and disposed of safely;
- work in academic institutions to teach others about the safe use of chemicals, and to train future toxicologists.

Attractive Salaries and Professional Advancement

The demand for well-trained toxicologists continues to increase. Highly competitive salaries are available in a variety of employment sectors. Increasing specialization in the science of toxicology now provides the toxicologist with a competitive advantage over chemists, engineers, biologists or other scientists without specialized training in toxicology. Opportunities for career advancement to executive levels exists for those with organizational and administrative skills and a superb record of scientific achievement.

What Do Toxicologists Do?

Research

Many toxicologists are principally involved in the acquisition of new knowledge concerning the mechanisms by which toxic substances produce their effects.

There are many sub-specialty areas in toxicology research: chemical carcinogenesis, reproductive and developmental toxicology, neurotoxicology, immunotoxicology, inhalation toxicology, risk assessment, and many others. Researchers utilize both laboratory animals and *in vitro* systems to examine the cellular, biochemical and molecular processes underlying toxic responses. Research opportunities are available for individuals employed in industry, academia and government. There are many commerical and non-profit laboratories that also provide interesting and challenging research opportunities.

Research may be considered to be ''basic,'' where no immediate commercial or public health application is expected, but the knowledge will add to our understanding of basic life processes, and is eventually of great value in solving important problems. Examples of this would be: studies of how a particular enzyme involved in the detoxification of a chemical is regulated at the gene level, or how a chemical affects the rate of cell division in cell culture.

Other research may be considered ''applied,'' where the results are expected to yield direct social or commercial benefit. Examples of this would be studies to identify new chemicals that selectively kill certain pests, or studies to determine if a particular industrial process is responsible for a specific disease identified in a population of workers. Development of antidotes for radiation injury or chemical poisoning are examples of applied research of public health importance.

Protect Safety Evaluation

Many industries employ toxicologists to assist in the evaluation of the safety of their products. For therapeutic drugs, food additives, cosmetics, agricultural chemicals, and other classes of chemicals, federal laws often require that the manufacturer provide adequate testing of the product before it is released into commerce. Tests to determine if a chemical has the potential to cause cancer, birth defects, reproductive effects, neurological toxicity or other adverse effects are commonly conducted by the manufacturer. Toxicologists involved in product safety evaluation have the responsibility to ensure that such tests are designed, conducted and interpreted in a scientifically sound manner. Information from such studies is in turn reviewed by toxicologists in various regulatory agencies, such as the Food and Drug Administration (FDA), or the Environmental Protection Agency (EPA), and by international bodies, to ensure that the products will not present an unreasonable risk to human health or the environment.

When the information is available, toxicologists also utilize studies of human populations (the science of epidemiology) to assist in the evaluation of the safety and potential risks of chemical products and by-products of modern society.

Teaching

Toxicologists employed in colleges and universities are frequently involved in teaching toxicology to others. Because of the growing interest on impacts of chemicals on our society, most colleges and universities are developing new courses at both the undergraduate and graduate level to provide students with a background in the science of toxicology. There are already many graduate programs in toxicology (see Chapter 15 for a description of individual programs). Many other academic institutions that do not have specific graduate programs in toxicology will employ toxicologists to participate in curriculum development and teaching in more basic programs such as chemistry and biology. Thus, opportunities exist to teach toxicology in small colleges as well as major universities. One of the most important efforts of toxicologists in academic institutions is the training of future generations of toxicologists in basic and applied research, data interpretation and evaluation, and risk assessment and regulatory affairs.

Public Service and Regulatory Affairs

The tremendous growth in public awareness of chemical hazards over the last two decades has resulted in the passage of many laws governing the production, use and disposal of chemicals. Many local, state and federal regulatory agencies employ toxicologists to assist in the development and enforcement of these laws. An increasingly important area of toxicology is in public communication of chemical risks. Toxicologists employed by regulatory agencies may often be called upon to explain the scientific basis for regulatory actions, or to assist in communicating to the public why regulatory actions are or are not taken in particular situations. There are many private consulting firms with expanding expertise in toxicology that can now provide such services to local and state health departments, public utilities, private industries, etc. Thus, many employment opportunities in the private sector are available to the toxicologist interested in assisting public agencies and private industries in resolving many important public health and environmental problems.

Where Do Toxicologists Work?

Chemical, Pharmaceutical, and Support Industries: number 1 employer of toxicologists (47%). Product development, product safety evaluation, and regulatory

compliance generate a large job market for toxicologists. Pharmaceutical industries employ 17% of toxicologists, and chemical industries employ 7%. These industries often employ toxicologists trained at all three levels of education: bachelor's, master's and doctoral. Many industries have their own research and product safety evaluation programs, whereas others may contract their work to specific research organizations which are managed independently from the industry.

Academic Institutions: number 2 employer of toxicologists (21%). The rapid growth in toxicology programs has generated a large and growing market for toxicologists with doctoral level training. Although most of these opportunities are in schools of medicine and/or public health in major universities, smaller colleges are beginning to employ toxicologists to teach toxicology in basic biology, chemistry and engineering programs.

Government: number 3 employer of toxicologists (14%). Although most government jobs are with federal regulatory agencies, many states are now beginning to employ toxicologists with master's or doctoral degrees.

Other (12%): *Professional Services Industry:* A growing employer of toxicologists. Many graduates of baccalaureate and master's programs in toxicology are finding employment with consulting firms. Individuals with doctoral training and several years of experience in applied toxicology may also find opportunities to direct projects and serve as team leaders or administrators in the consulting field. Providing professional guidance and advice to local public agencies, industries, and attorneys involved in problems with toxic chemicals is a rapidly growing activity for the experienced toxicologist. *Research Foundations:* Opportunities for research in toxicology supported by non-for-profit organizations (4%). Numerous public and private research foundations employ toxicologists to conduct research on specific problems of industrial or public concern. Toxicologists at all levels of education may find employment with these research foundations.

Regional Distribution of Toxicology Jobs

Although the majority of government and industry jobs are located in the mid-Atlantic states, employment opportunities at all levels are available throughout the United States.

How Much Do Toxicologists Earn?

As with any profession, the level of education and length of experience are key determinants of salary. Although summary statistics on current job salaries of toxicologists are not readily available, entry level positions for those the doctoral degrees often in the range of $35,000–$60,000, with rapid advancement possible. In general, positions in industry pay slightly better than government or academia. Mid-range professionals with a Ph.D. degree and 10 years of experience can expect to earn $70,000 to $100,000 annually. Most executive positions in toxicology exceed $100,000 per year, and some corporate executive toxicologists earn $200,000 or more. Of course, salaries for those with Master's and/or Bachelor's degrees in toxicology will generally be less than those for individuals with doctoral degrees, but they are still highly competitive with all other science-based professions.

How Do I Prepare for a Career in Toxicology?

If you are in the midst of your college education, careful planning of undergraduate courses will enhance your graduate education opportunities. If you've already received an advanced degree, such as a Ph.D., M.D., or D.V.M., in a biomedical science other than Toxicology, you can focus your career toward toxicology through postdoctoral training. Indications are that this is a good time to pursue toxicology, as the number of toxicologists emerging from degree programs is expected to peak in 1999. The following tips will help you in gaining the most from your graduate and post-graduate training:

1. Undergraduate and Graduate Training

Plan Your Education

Depending upon your career aspirations, a bachelor's degree may not be enough for you to achieve your goals. Although there are some employment opportunities in toxicology for those with bachelor's degrees, the breadth of career choices and opportunity for advancement are much greater for those with post-baccalaureate degrees. To ensure your acceptance into the best graduate programs in toxicology, you need a strong academic record and evidence of research and/or leadership abilities.

Most graduate toxicology programs have specific prerequisites for admission. In addition to a baccalaureate degree in a relevant field of study, these often include advanced coursework in chemistry, especially organic chemistry, at least one year of general biology, a year of college math, usually including calculus, and general physics. Additional upper division courses in biochemistry and physiology will often increase your competitive advantage for admission. As the ability to be an effective communicator is an important skill for

toxicologists, coursework in specific writing and public speaking is also useful.

Performance on the Graduate Record Examination is also important. You should take the exam at least 9 months prior to the time you plan to begin your graduate study, and you should prepare in advance for the exam. Consult the following directory of programs to determine the specific admission requirements for programs of interest to you. In addition to a strong academic record, demonstration of basic laboratory and research skills will enhance your chances of admission. Taking laboratory courses in chemistry and biology as an important part of your undergraduate education, and will begin to develop your research skills.

Working during the summer in a research laboratory is one good way to enhance these skills. The Society of Toxicology serves as a clearinghouse for Summer Internships in Toxicology to help provide interested undergraduate science majors with a stimulating summer research experience in toxicology. These internships are available in academic and industrial research laboratories across the country. Contact the Society of Toxicology headquarters office for more information.

Involvement in extracurricular activities is a valuable way to develop and demonstrate your leadership and communication skills. If possible, plan to visit the programs you wish to consider in advance of your application process. Notify the director of the program of your interests, and arrange to speak with the director and other faculty in the porgram.

Select a Toxicology Program That's Right for You

Identifying a graduate training program that is best for you requires some advanced planning. First, you should establish a potential career plan. Consider the various sub-specialties in toxicology, such as neurotoxicology, chemical carcinogenesis, teratology, etc., to determine if there is a specific field of research that is of particular interest to you. Although such a choice early in your education certainly does not commit you to this direction, it will help you in deciding which programs are most likely to meet your needs. It is also useful to talk with toxicologists in local universities, industries and governmental agencies to help you in your selection of a training program and future career direction. Make sure that you are able to satisfy all of the admission requirements prior to the time you intend to begin the program, as these requirements may vary between programs and from the general requirements described above. Geographical considerations are also important to some individuals, which may limit the number of choices substantially. The list of Academic Programs on Toxicology contained in this guide should help you in selecting the right program for you.

2. Postdoctoral Training In Toxicology

If you've already completed a doctoral degree in a biomedical science, you can enter the field of toxicology by spending two to three years as a postdoctoral fellow in a toxicology laboratory. Postdoctoral education of a Toxicologist takes many forms depending on the goal of the scientist. Post-doctoral experience is necessary for most academic and research positions, but is not a requirement for many other positions in government or industry.

Postdoctoral Opportunities through Government-Sponsored Programs

Numerous government agencies, such as the Environmental Protection Agency (in its regional laboratories), the Food and Drug Administration at its Beltsville and National Center for Toxicology Research facilities, Occupational Safety and Health Administration, National Institute for Occupational Safety and Health and the many National Institutes of Health laboratories, especially National Institute of Environmental Health Sciences, provide intramural (in-house) postdoctoral training programs in toxicology. Although many of these positions are filled with graduates of toxicology programs, opportunities are frequently available for individuals with doctoral degrees in areas other than toxicology.

A time-honored postdoctoral training route has been through investigator-initiated research grants, which focus the postdoctoral fellow in the area of the mentor. Most researchers at academic institutions who receive federal research grants have funds to support postdoctoral fellows. One means of exploring postdoctoral opportunities is to contact directly individual faculty listed in this resource guide. The index to this resource guide should help you in identifying individual programs and faculties that have research programs of interest to you.

In addition to individual research grants, many academic programs receive federal training grants which have funds specifically dedicated to postdoctoral training. For example, the NIEHS provides 136 postdoctoral fellowships to over 30 different academic institutions for postdoctoral training in Environmental Toxicology and/or Environmental Pathology. You can write to the Program Administrator, Scientific Programs Branch, MD 3/03, NIEHS, Division of Extramural Research and Training, PO Box 12233, Research Triangle Park, NC 27709, to obtain a list of academic programs that

receive NIEHS-sponsored postdoctoral training grants in toxicology.

Postdoctoral Opportunities through Industry-Sponsored Programs

Many companies that employ toxicologists (e.g., pharmaceutical, chemical, food, and automotive companies) provide postdoctoral training opportunities in toxicology for individuals with doctoral degrees in toxicology or related disciplines; some of these are included in Chapter 16.

Another often-overlooked source of postdoctoral training opportunities is the contract laboratory. The contract laboratory exposes the young scientist to the broadest issues in general toxicology, especially testing and preparing documents for submission to regulatory agencies. In many respects, this type of experience represents the practice or art of toxicology, while the university experience represents the science of toxicology.

The Society of Toxicology Placement Service maintains an active list of postdoctoral opportunities available in toxicology. You may obtain more information on the Placement Service by visiting the SOT Web page, or by contacting the Society of Toxicology.

GUIDE TO ACADEMIC AND POSTDOCTORAL PROGRAMS IN TOXICOLOGY

The SOT list of academic and postdoctoral programs in toxicology in Chapter 16 provides contact information, including program web site address, the degrees offered (e.g., B.S., M.S., Ph.D.), and areas of program strengths. The *Resource Guide to Careers in Toxicology, 4th Edition*, will be available at the SOT Web site, http://www.toxicology.org, with direct links to the listed program Web sites. For each program of interest, you should contact the program directly to obtain additional information and necessary application procedures and forms. The programs are listed alphabetically.

Although every attempt was made to provide descriptions from all the academic programs in toxicology, and all descriptions received by the Society were included, there may be additional degree-granting programs in toxicology that are not included in Chapter 16. The presence of a program does not constitute endorsement by the Society of Toxicology, nor does the omission of a program constitute lack of endorsement.

This Page Intentionally Left Blank

Index

B

C

G

H

L

M

O

P

Q

S

T

U

X

Y

Z

This Page Intentionally Left Blank

There's amnesia in a hang knot
And comfort in the ax,
But the simple way of poison will make your nerves relax.

There's surcease in a gunshot,
And sleep that comes from racks,
But a handy draft of poison avoids the harshest tax.

You find rest upon the hot squat,
Or gas can give you pax,
But the closest corner chemist has peace in packaged stacks.

There's refuge in the church lot
When you tire of facing facts,
and the smoothest route is poison prescribed by kindly quacks.

(Robert A. Heinlein, *Stranger in a Strange Land*)

There was a king reigned in the East:
There, when kings will sit to feast,
They get their fill before they think
With poisoned meat and poisoned drink.
He gathered all that springs to birth
From the many-venomed earth;
First a little, thence to more,
He sampled all her killing store;
And easy, smiling, seasoned sound,
Sate the king when healths went round.
They put arsenic in his meat
And stared aghast to watch him eat;
They poured strychnine in his cup
And shook to see him drink it up:
They shook, they stared as white's their shirt:
Them it was their poison hurt.
—I tell the tale that I heard told.
Mithridates, he died old.

(A. E. Housman, *Terence, This Is Stupid Stuff*)

This Page Intentionally Left Blank