Stellman, Jeanne Mager (ed.)

/Encyclopaedia/ /Occupational health/ /Occupational safety/. 13.04.2
ISBN 92-2-109203-8 (set)
92-2-109814-1 (V. 1) 92-2-109815-X (V. 2) 92-2-109816-8 (V. 3) 92-2-109817-6 (V. 4)


ILO Cataloguing in Publication Data

The designations employed in ILO publications, which are in conformity with United Nations practice, and the presentation of material therein do not imply the expression of any opinion whatsoever on the part of the International Labour Office concerning the legal status of any country, area or territory or of its authorities, or concerning the delimitation of its frontiers.

The responsibility for opinions expressed in signed articles, studies and other contributions rests solely with their authors, and publication does not constitute an endorsement by the International Labour Office of the opinions expressed in them. The reader accepts that the parties make this documentation available without warranty of any kind. The parties do not accept responsibility for the validity or completeness of any data including inaccuracies, errors or omissions or for any consequences arising from the use of such data. Neither the authors, nor the ILO or collaborating institutions shall be liable for damages or other claims and demands arising out of the use of the data.

Reference to names of firms and commercial products and processes does not imply their endorsement by the International Labour Office or any collaborating institution, and any failure to mention a particular firm, commercial product or process is not a sign of disapproval.

ILO publications can be obtained through major bookellers or ILO local offices in many countries, or direct from ILO Publications, International Labour Office, CH-1211 Geneva 22, Switzerland. Catalogues or lists of new publications are available free of charge from the above address.
P.K. Abeytunga, PhD, MSc  
*Vice-President, Director General*  
Canadian Centre for Occupational Health and Safety  
Hamilton, Ontario  
Canada

Sheila H. Akabas, PhD, MBA  
*Professor, Director*  
Workplace Center  
School of Social Work  
Columbia University  
New York, New York  
United States

Munehira Akita, PhD, MA  
*Professor of Psychology*  
Faculty of Social and Information Sciences  
Nihon Fukushi University  
Kyoto  
Japan

Lorenzo Alessio, MD  
*Professor, Director*  
Institute of Occupational Medicine  
University of Brescia  
Brescia  
Italy

Peter Arlien-Seborg, MD  
*Assistant Professor, Head*  
Department of Neurology  
Hvidovre Hospital, University of Copenhagen  
Copenhagen  
Denmark

Bruce K. Armstrong, MB, D Phil  
*Director*  
Cancer Control Information Centre  
New South Wales Cancer Council  
Sydney  
Australia

Pat Armstrong, PhD, MA  
*Professor, Director*  
School of Canadian Studies  
Carleton University  
Ottawa, Ontario  
Canada

Thomas J. Armstrong, PhD, MPH  
*Professor*  
Occupational Health and Industrial and Operations Engineering  
University of Michigan  
Ann Arbor, Michigan  
United States

Ian M.F. Arnold, MD, MSc  
*Director*  
Occupational Health and Safety  
Alcan Aluminium Ltd.  
Montreal, Quebec  
Canada

Gordon Atherley, MB, ChB, MD  
*President*  
Oberon Composer Software  
Oakville, Ontario  
Canada

Michael D. Attfield, PhD  
Division of Respiratory Disease Studies  
National Institute for Occupational Safety and Health  
Morgantown, West Virginia  
United States

Rahmat Awang, Dr  
Associate Professor, Head  
Drug and Poison Information Unit  
National Poison Centre  
Universiti Sains Malaysia  
Penang  
Malaysia

Olav Axelson, MD  
*Professor*  
Division of Occupational and Environmental Medicine  
Department of Health and Environment  
Linköping University  
Linköping  
Sweden

Dean B. Baker, MD, MPH  
*Professor, Director*  
Center for Occupational and Environmental Health  
University of California-Irvine  
Irvine, California  
United States

Robin Baker, MPH  
*Director*  
Labor Occupational Health Program  
University of California-Berkeley  
Berkeley, California  
United States

Isabelle Balty, MS  
*Technical Consultant*  
Directorate of Applications for Prevention  
National Institute of Safety Research and Occupational Risk Prevention  
Paris  
France

Randal D. Beaton, PhD  
*Clinical Psychologist, Research Associate Professor*  
School of Nursing  
University of Washington  
Seattle, Washington  
United States

Margaret R. Becklake, MD  
*Professor*  
Departments of Medicine, Epidemiology and Biostatistics and Occupational Health  
McGill University  
Montreal, Quebec  
Canada

Raymond Begin, MD  
*Professor of Medicine*  
University Hospital  
University of Sherbrooke  
Sherbrooke, Quebec  
Canada

Vladimír Bencko, MD, PhD  
*Professor, Head*  
Institute of Hygiene and Epidemiology  
Charles University  
Prague  
Czech Republic

Irene K. Berezovsky, BA  
*Instructor*  
Department of Pathology  
School of Medicine  
University of Maryland  
Baltimore, Maryland  
United States

Elliott H. Berger, MS  
*Senior Scientist*  
Auditory Research Department  
E-A-R/Aearo Company  
Indianapolis, Indiana  
United States

Joan Bertin, JD  
*School of Public Health*  
Columbia University  
New York, New York  
United States

Marco Biagi  
*Professor of Labour Law*  
Department of Business Administration  
University of Modena  
Bologna  
Italy

Elyce Anne Biddle  
National Institute for Occupational Safety and Health  
Morgantown, West Virginia  
United States

Annibale Biggeri, MD  
*Professor of Medical Statistics*  
School of Medicine  
University of Florence  
Florence  
Italy
Donald Birmingham, MD  
Professor Emeritus  
Department of Dermatology  
Wayne State University  
Detroit, Michigan  
United States

Helmut Blome, Dr rer nat  
Deputy Director  
Berufsgenossenschaftliches Institute für Arbeitssicherheit  
Hauptverband der gewerblichen Berufsgenossenschaften  
Sankt Augustin  
Germany

Sheila B. Blume, MD, CAC  
Medical Director  
Alcoholism, Chemical Dependency and Compulsive Gambling Programs  
South Oaks Hospital  
Amityville, New York  
United States

Frank Bochmann, Dr  
Head of Section  
Berufsgenossenschaftliches Institute für Arbeitssicherheit  
Hauptverband der gewerblichen Berufsgenossenschaften  
Sankt Augustin  
Germany

Paolo Boffetta, MD, MPH  
Chief  
Unit of Environmental Cancer Epidemiology  
International Agency for Research on Cancer  
Lyon  
France

Marcel-André Boillat, MD, MS  
Associate Professor  
Institute of Occupational Health Sciences  
University of Lausanne  
Lausanne  
Switzerland

Carole Brabant, PhD  
Associate Editor  
Encyclopaedia of Occupational Health and Safety  
International Labour Office  
Geneva  
Switzerland

Mario Braga, MD  
Deputy Director  
Evaluation Epidemiology unit  
Agency for Regional Health Services  
Rome  
Italy

Paul Brandt-Rauf, MD, ScD, Dr PH  
Professor, Director  
Occupational and Environmental Medicine  
School of Public Health  
Columbia University  
New York, New York  
United States

Sherry I. Brandt-Rauf, JD, M Phil  
Assistant Professor of Social Medicine  
Columbia University  
New York, New York  
United States

Mark Braverman, PhD, M Ed  
Principal  
Crisis Management Group Inc.  
Newton Upper Falls, Massachusetts  
United States

William B. Bunn, MD, JD, MPH  
Director of Health  
Workers' Compensation and Safety  
Navistar Corporation  
Chicago, Illinois  
United States

Wayne N. Burton, MD  
First Vice President, Corporate Medical Director  
First Chicago NBD  
Chicago, Illinois  
United States

Martin Butz, PhD  
Head of Section  
Hauptverband der gewerblichen Berufsgenossenschaften  
Sankt Augustin  
Germany

LaMont Byrd, MSc  
Director of Safety and Health  
International Brotherhood of Teamsters  
Washington, DC  
United States

C. D. Calnan*  
Institute of Dermatology  
St. John's Hospital for Diseases of the Skin  
London  
United Kingdom

Barry L. Castleman, ScD, MSE  
Environmental Consultant  
Baltimore, Maryland  
United States

Chaiyuth Chavalinitikul, PhD, MPH  
Director  
National Institute for the Improvement of Working Conditions and Environment  
Bangkok  
Thailand

Haim Chayon, MJ  
Former Director  
Invalidity Department  
National Insurance Institute  
Jerusalem  
Israel

Kee-Seng Chia, MD, MBBS, MSc  
Associate Professor  
Department of Community, Occupational and Family Medicine  
National University of Singapore  
Singapore

Gerolamo Chiappino, MD  
Professor, Director  
Clinic of Occupational Medicine  
Institute of Occupational Medicine  
Milan  
Italy

K.S. Cho, MD*  
Director  
Institute of Industrial Medicine  
Catholic Medical College  
Seoul  
Republic of Korea

Emmert Clevestine, PhD, MS  
International Occupational Safety and Health Information Centre  
International Labour Office  
Geneva  
Switzerland

W. Coenen, Dipl Ing  
Director of Prevention  
Hauptverband der gewerblichen Berufsgenossenschaften  
Sankt Augustin  
Germany

Edward Cohen-Rosenthal, Ed M  
Director  
Work and Environment Initiative  
School of Industrial and Labor Relations  
Cornell University  
Ithaca, New York  
United States

Paula Coleman, BS  
Curriculum Specialist  
Carpenters Health and Safety Fund  
Washington, DC  
United States

* Contributor to the 3rd edition of this Encyclopaedia. This biographical information has not been updated.
Georges H. Coppée, MD  
Chief of Medical Section  
Occupational Safety and Health Branch  
International Labour Office  
Geneva, Switzerland

D. Wayne Cornell, ScD  
Director  
Operations Eastern Region  
Health Canada  
Ottawa, Ontario  
Canada

James Corry, PhD, MS  
Director  
Corporate Wellness and Fitness Services  
Metropolitan Life Insurance Company  
New York, New York  
United States

Maureen P. Corry, MPH  
General Director  
Maternity Center Association  
New York, New York  
United States

John W. F. Cowell, MD, MSc  
President, Chief Executive Officer  
Workers’ Compensation Board of Alberta  
Edmonton, Alberta  
Canada

Breen Creighton, LLB, PhD  
Special Counsel  
Corrs Chambers Westgarth  
Melbourne  
Australia

Marie L. Cros-Courtial, Dr d’Etat en droit  
Maitre de Conference en Droit  
Department A.E.S.  
Paul Valéry University  
Montpellier  
France

Mark R. Cullen, MD  
Professor of Medicine and Public Health  
Yale University School of Medicine  
New Haven, Connecticut  
United States

Ellen Cutler, MPA  
National Director  
Program Services  
March of Dimes Birth Defects Foundation  
White Plains, New York  
United States

Monica Dahlgvist, PhD  
Assistant Professor  
Department of Environmental Technology and Work Science  
Royal Institute of Technology  
Stockholm  
Sweden

Antonio J. Dajer, MD  
Neuilly-sur-Seine  
France

Louis Dampousse, MD, MSc  
Medical Consultant  
Maclaren Inc.  
Masson, Quebec  
Canada

Frank Darby, MSc  
Consultant in Ergonomics  
Wellington  
New Zealand

Alois David, MD, PhD  
Associate Professor  
Department of Occupational Medicine  
Postgraduate Medical School  
Prague  
Czech Republic

Véronique De Keyser, PhD  
Professor of Work Psychology, Dean of Faculty  
University of Liège  
Liège  
Belgium

David M. DeMarini, PhD  
Environmental Carcinogenesis Division  
US Environmental Protection Agency  
Research Triangle Park, North Carolina  
United States

Dušan Djurić, DSc, ChE  
Institute of Occupational and Radiological Health  
Belgrade  
Yugoslovakia

Mel Doyle, MPhil  
Deputy General Secretary  
Workers’ Educational Association  
London  
United Kingdom

Louis-Philippe Durocher, MD, FRCP  
Professor of Dermatology  
Notre Dame Hospital  
Montreal, Quebec  
Canada

Robert W. Dykes, PhD  
Director  
Center for Research  
Rehabilitation Institute of Montreal  
Montreal, Quebec  
Canada

Lawrence D. Eicher, PhD  
Secretary-General  
International Organization for Standardization  
Geneva  
Switzerland

G. Enderlein, Dr rer nat  
Head of Group  
Department of Risk Assessment and Epidemiological Study Design  
Federal Institute for Occupational Safety and Health  
Berlin  
Germany

John W. Farquhar, MD  
Professor of Medicine, Director  
Stanford Center for Research in Disease Prevention  
Stanford University School of Medicine  
Palo Alto, California  
United States

Igor A. Fedotov, MD, MSc  
Occupational Health Specialist  
International Labour Office  
Geneva  
Switzerland

Ilise Levy Feithmans, Esq JD, ScM  
Trustee  
Society of Medical Jurisprudence  
Global Alliance for Women’s Health  
Riverdale, New York  
United States

Robert G. Feldman, MD  
Professor, Chair  
Department of Neurology  
School of Medicine  
Professor  
School of Public Health  
Boston, University  
Boston, Massachusetts  
United States

Adalberto Ferioli, MD, PhD  
Senior Scientist  
Department of Occupational Toxicology  
International Centre for Pesticide Safety  
Busto Garolfo  
Italy
Jonathan E. Fielding, MD, MBA, MPH  
Professor of Health Sciences and Pediatrics  
University of California–Los Angeles  
Los Angeles, California  
United States

John Finklea, MD, Dr PH  
Medical Officer  
Center to Protect Workers' Rights  
Former Director  
National Institute for Occupational Safety and Health  
Washington, DC  
United States

Vito Foà, MD  
Professor of Industrial Hygiene  
Institute of Occupational Medicine  
University of Milan  
Milan  
Italy

G. Frada, Dr Proj*  
Director  
Institute of Occupational Medicine  
University of Palermo  
Palermo  
Italy

John R. Franks, PhD  
Chief  
Bioacoustics and Occupational Vibration Section  
National Institute for Occupational Safety and Health  
Cincinnati, Ohio  
United States

T.M. Fraser, MD, Msc, P Eng  
Professor Emeritus  
Systems Design Engineering  
University of Waterloo  
Waterloo, Ontario  
Canada

Herbert J. Freudenberg, PhD  
Psychologist, Psychoanalyst  
New York, New York  
United States

George Friedman-Jiménez, MD  
Director  
Bellevue Occupational and Environmental Medicine Clinic  
Bellevue Hospital Center  
New York, New York  
United States

Howard Frumkin, MD, Dr PH, MPH  
Associate Professor, Chair  
Department of Environmental and Occupational Health  
Rollins School of Public Health  
Emory University  
Atlanta, Georgia  
United States

Lawrence Garfinkel, MA  
Former Vice-President for Epidemiology and Statistics  
American Cancer Society  
New York, New York  
United States

Otto Gieeker, Dr kfm  
Former Deputy Director General  
Department for Internal Rehabilitation Allgemeine Unfall Versicherungsanstalt  
Vienna  
Austria

Issachar Gilad, PhD  
Professor of Industrial Engineering and Ergonomics  
Technion-Israel Institute of Technology  
Haifa  
Israel

William I. Glass, MB ChB, DIH, DPH  
Occupational Medicine Specialist  
Christchurch  
New Zealand

F. Gobbato*  
Institute of Occupational Medicine  
University of Trieste  
Trieste  
Italy

Berenice I. Ferrari Goelzer, CIH, MPH  
Occupational Hygienist  
Office of Occupational Health and Safety  
World Health Organization  
Geneva  
Switzerland

Kristan D. Goldfin, Ed D  
Manager of Corporate Wellness  
Merrill Lynch Inc.  
Adjunct Assistant Professor  
Teacher's College  
Columbia University  
New York, New York  
United States

Bernard D. Goldstein, MD  
Director  
Environmental and Occupational Health Sciences Institute  
Chair  
Department of Environmental and Community Medicine  
UMDNJ-Robert Wood Johnson Medical School  
Piscataway, New Jersey  
United States

David Gompertz, MD, PhD  
Senior Lecturer (Honorary)  
Institute of Occupational Health  
University of Birmingham  
Birmingham  
United Kingdom

Joke H. Grady-van den Nieuwoober, MSc  
Roessingh Rehabilitation Centre  
Haksbergen  
The Netherlands

E. Grandjean, Dr med (deceased)*  
Former Director  
Institute of Hygiene and Work Physiology  
Zurich  
Switzerland

Philippe Grandjean, MD, DMSc  
Professor  
Environmental Medicine  
Odense University  
Odense  
Denmark

Peter Greenwald, MD, Dr PH  
Director  
Division of Cancer Prevention and Control  
National Cancer Institute  
Bethesda, Maryland  
United States

Dieter Greiner, Dr jur  
Deputy Director General  
Hauptverband der gewerblichen Berufsgenossenschaften  
Sankt Augustin  
Germany

Gudela Grote, PhD  
Professor  
Work and Organizational Psychology  
Swiss Federal Institute of Technology  
Zurich  
Switzerland

Saul G. Gruner, MS  
SG Gruner Associates Inc.  
Westport, Connecticut  
United States

* Contributor to the 3rd edition of this Encyclopaedia. This biographical information has not been updated.
Per Gustavsson, MD, PhD
Associate Professor
Department of Occupational Health
Karolinska Hospital
Stockholm
Sweden

Winfried Hacker, Dr rer nat habil
Professor, Chair
General Psychology
University of Technology
Dresden
Germany

Mats Hagberg, MD, PhD
Professor
Division of Work and Environmental Physiology
National Institute for Working Life
Solna
Sweden

David Hamerman, MD
University Professor of Medicine
Albert Einstein College of Medicine
New York, New York
United States

Takashi Haratani, PhD
Senior Researcher
National Institute of Industrial Health
Kawasaki
Japan

Jillian Haschurh, MB, ChB
Medical Advisor
Marks and Spencer PLC
London
United Kingdom

Fengsheng He, MD
Professor of Occupational Medicine and Neurotoxicology, Honorary Director
Institute of Occupational Medicine
Chinese Academy of Preventive Medicine
Beijing
China

Catherine A. Heaney, PhD, MPH
Associate Professor
School of Public Health
Ohio State University
Columbus, Ohio
United States

Steven Hecker, MSPH
Associate Professor
Labor Education and Research Center
University of Oregon
Eugene, Oregon
United States

Dick Heederik, PhD, MSc
Associate Professor of Occupational Epidemiology
University of Wageningen
Wageningen
The Netherlands

Lothar A.J. Heinemann, MD, DSc
Director
Centre for Epidemiology and Health Research
Zepernick
Germany
Adjunct Professor for Epidemiology and Biostatistics
McGill University
Montreal, Quebec
Canada

Rolf Helbig, Dr-Ing
Head of Engineers
Institut für Arbeitwissenschaft
Technische Hochschule Darmstadt
Darmstadt
Germany

George P. Henshaw III, MD, PhD
Professor of Ophthalmology
College of Medicine
University of Oklahoma
Oklahoma City, Oklahoma
United States

Sven Hernberg, MD
Professor Emeritus, Former Director
Department of Epidemiology and Biostatistics
Finnish Institute of Occupational Health
Helsinki
Finland

Robert F. Herrick, ScD
Lecturer in Industrial Hygiene
Department of Environmental Health
Harvard School of Public Health
Boston, Massachusetts
United States

Raymond Héut, PhD (deceased)
Former Director
Acoustical Group
Medical Faculty
University of Montreal
Montreal, Quebec
Canada

Gerd E. Heuchert, MD, Dr med sci
Professor, Head
Department of Epidemiology
Federal Institute for Occupational Safety and Health
Berlin
Germany

Herbert Heuer, Dr rer nat
Professor, Head
Department of Occupational and Experimental Psychology
Institut für Arbeitsphysiologie
Dortmund
Germany

Penny D. Higgins, RN, BS
President
OH Associates, Ltd.
Des Plaines, Illinois
United States

Michael J. Hodgson, MD, MPH
Associate Professor of Medicine
University of Connecticut Health Center
Farmington, Connecticut
United States

Perrine Hoeft, MD, MIH, MSc
Research Associate
Industrial Toxicology and Occupational Medicine Unit
Faculty of Medicine
Catholic University of Louvain
Brussels
Belgium

Burkhard Hoffmann, DPhil
Head of Section
Documentation and Statistics
Gewerkschaftliche Berufsgenossenschaften
Sankt Augustin
Germany

Johan Högberg, MD, PhD
Professor of Toxicology
National Institute for Working Life
Solna
Sweden

Judith C. Holder, PhD
Assistant Director of Occupational Mental Health Programs
Duke University Medical Center
Durham, North Carolina
United States

Bo Holmberg, PhD
Professor Emeritus
Department of Toxicology
National Institute for Working Life
Solna
Sweden

Irene L.D. Houtman, PhD
Senior Researcher
NIA TNO
Amsterdam
The Netherlands
Ann F. Hubbs, DVM, PhD, MS  
Health Effects Laboratory Division  
National Institute for Occupational Safety and Health  
Morgantown, West Virginia  
United States

James Huff, PhD, MS  
Environmental Carcinogenesis Program  
National Institute of Environmental Health Sciences  
Research Triangle Park, North Carolina  
United States

Vilma Hunt, BDS, AM  
Adjunct Professor  
Department of Work Environment  
University of Massachusetts-Lowell  
Lowell, Massachusetts  
United States

Joseph J. Hurrell, Jr., PhD  
Senior Research Epidemiologist  
Hazard Evaluation and Technical Assistance Branch  
National Institute for Occupational Safety and Health  
Cincinnati, Ohio  
United States

Robert Husbands  
Vocational Rehabilitation Branch  
International Labour Office  
Geneva  
Switzerland

Masayuki Ikeda, MD, PhD  
Professor Emeritus of Public Health  
Kyoto University  
Kyoto  
Japan

Terence G. Ison, LLB  
Professor Emeritus  
Osgoode Hall Law School  
York University  
North York, Ontario  
Canada

Masaaki Iuchi, BL  
Deputy Director  
Policy Planning Division  
Employment Measures for the Aged and Disabled Department  
Ministry of Labour  
Tokyo  
Japan

Nikolai Izmerov, PhD  
Professor of Medicine, Director  
RAMS Institute of Occupational Health  
Moscow  
Russian Federation

Regina Jäckel, MD  
Department of Health Effects of Hazardous Substances  
Federal Institute for Occupational Safety and Health  
Berlin  
Germany

Peter Jacobsen, MD  
Medical Superintendent  
Clinic of Occupational Medicine  
Rigshospitalet  
Copenhagen  
Denmark

Marek Jakubowski, PhD, MSc  
Professor, Head  
Occupational and Environmental Health Division  
Nofer Institute of Occupational Medicine  
Lodz  
Poland

Jerry Jeyaramam, PhD, MSc  
Head  
Division of Occupational Medicine  
National University of Singapore  
Singapore

Gunnar Johanson, Dr med sci  
Senior Researcher  
Department of Toxicology  
National Institute for Working Life  
Solna  
Sweden

Barry L. Johnson, PhD  
Assistant Surgeon General, Assistant Administrator  
Agency for Toxic Substances and Disease Registry  
Atlanta, Georgia  
United States

T. K. Joshi, MS, MSc  
International Labour Office (Bhutan and India)  
New Delhi  
India

Roland Kadeff, PhD  
Professor  
Department of Injury Prevention  
Chalmers University of Technology  
Göteborg  
Sweden

Jeffrey P. Kahn, MD  
President  
Center for Work Stress Reduction  
Farmington, Connecticut  
WorkPsych Associates Inc.  
Scarsdale, New York  
United States

Craig Karpillow, MD  
President  
International Professional Associates, Ltd.  
Seattle, Washington  
United States

Timo Kauppinen, PhD  
Head of Register Unit  
Finnish Institute of Occupational Health  
Helsinki  
Finland

George Kazantzis, FRCP, FFCM, FFFOM  
London School of Hygiene and Tropical Medicine  
TUC Centenary Institute of Occupational Health  
London  
United Kingdom

Homayoun Kazemi, MD  
Professor of Medicine  
Harvard Medical School  
Chief  
Pulmonary and Critical Care Unit  
Massachusetts General Hospital  
Boston, Massachusetts  
United States

Åsa Kilborn, MD  
Professor, Director  
Department of Ergonomics  
National Institute for Working Life  
Solna  
Sweden

Kikuzo Kimura, Dr med sci  
Institute for Science of Labour  
Kawasaki  
Japan

Howard M. Kipen, MD, MPH  
Associate Professor, Director  
Division of Occupational Health  
Environmental and Occupational Health Science Institute  
UMDNJ-Robert Wood Johnson Medical School  
Piscataway, New Jersey  
United States

* Contributor to the 3rd edition of this Encyclopaedia. This biographical information has not been updated.
Georg R. Kliesch  
Former Director  
Working Conditions and Environment  
International Labour Office  
Geneva  
Switzerland

Manolis Kogevinas, **MD**, **PhD**, **MSc**  
Associate Professor  
Unit of Respiratory and Environmental Health Research  
Institut Municipal d’Investigacio Medica  
Barcelona  
Spain

Kazutaka Kogi, **MD**, **Dr med sci**  
Director  
Institute for Science of Labour  
Kawasaki  
Japan

David Koh, **MBBS**, **PhD**, **MSc**  
Associate Professor  
Department of Community, Occupational and Family Medicine  
National University  
Singapore

Michiel A. J. Kompier, **PhD**  
Professor  
Department of Work and Organizational Psychology  
University of Nijmegen  
Nijmegen  
The Netherlands

Lawrence D. Kornreich, **PhD**, **M SPH**  
President  
EnviroHealth and Safety Management  
Mt Arlington, New Jersey  
United States

Andreas Kranig, **Dr jur**  
Head of Section  
German Accident Insurance Law  
Hauptverband der gewerblichen Berufsge nossenschaften  
Sankt Augustin  
Germany

Richard S. Kraus, **PE**, **CSP**  
Principal  
Petroleum Safety Consultants  
Annandale, Virginia  
United States

Leon Kreitman, **DSc**, **MSc**  
Director  
Maturity Marketing Ltd.  
London  
United Kingdom

Penny M. Kris-Etherton, **PhD**, **RD**  
Professor  
Department of Nutrition  
Pennsylvania State University  
University Park, Pennsylvania  
United States

Karl H.E. Kroemer, **Dr-Ing**  
Professor, Director  
Industrial Ergonomics Laboratory  
Human Factors Engineering Center  
ISE Department  
Virginia Tech  
Blacksburg, Virginia  
United States

Ilkka Kuorinka, **MD**, **PhD**  
Director  
Safety and Ergonomics Division  
Institute for Occupational Health and Safety Research  
Montreal, Quebec  
Canada

Joseph LaDou, **MD**, **MS**  
Director  
International Center for Occupational Medicine  
University of California-San Francisco  
San Francisco, California  
United States

Jay Lasser, **MD**  
President  
Center for Work Stress Reduction  
Farmington, Connecticut  
United States

Patricia A. Last, **FRCS**, **FRCOG**  
Consultant, Women’s Health  
Hertfordshire  
United Kingdom

Aishah A. Latiff, **PhD**  
Director  
Doping Control Centre  
Universiti Sains of Malaysia  
Penang  
Malaysia

Wolfgang Laurig, **Dr-Ing**  
Professor, Director  
Department of Ergonomics  
Institut für Arbeitsphysiologie  
University of Dortmund  
Dortmund  
Germany

Robert R. Lauwerys, **MD**, **DSc**, **MIH**, **MSc**  
Professor  
Industrial Toxicology and Occupational Medicine Unit  
Faculty of Medicine  
Catholic University of Louvain  
Brussels  
Belgium

Antoine Laville  
Professor, Director  
Laboratoire d’Ergonomie Physiologique-Cognitive  
École Pratique des Hautes Études  
Paris  
France

Marjatta Leirisalo-Repo, **MD**  
Consultant in Rheumatology  
Department of Medicine  
Helsinki University Central Hospital  
Helsinki  
Finland

Grace Kawas Lemasters, **PhD**, **MSN**  
Professor  
Department of Epidemiology and Environmental Health  
University of Cincinnati  
Cincinnati, Ohio  
United States

Richard A. Lemen, **PhD**, **MS**  
Former Assistant Surgeon General, Deputy Director  
National Institute for Occupational Safety and Health  
Atlanta, Georgia  
United States

Michel Lesage, **MD**, **CSPQ**  
Occupational Health Specialist  
International Labour Office  
Geneva  
Switzerland

Lennart Levi, **MD**, **PhD**  
Professor Emeritus, Former Director  
Department of Stress Research  
Karolinska Institute  
Stockholm  
Sweden

Linnéa Liljenberg, **PhD**  
Senior Occupational Hygienist  
Department of Occupational Medicine  
Sahlgrenske University Hospital  
Göteborg  
Sweden

Morton Lippmann, **PhD**  
Professor of Environmental Medicine  
Nelson Institute of Environmental Medicine  
New York University Medical Center  
Tuxedo, New York  
United States
James E. Lockey, MD, MS
Professor, Director
Department of Occupational and Environmental Medicine
University of Cincinnati
Cincinnati, Ohio
United States

Veikko Louhevaara, PhD
Professor of Ergonomics, Senior Researcher
Unit of Ergonomics
Department of Physiology
University of Kuopio
Kuopio Institute of Occupational Health
Kuopio
Finland

Michelle Madelien
Paulson and Cooper Inc.
Chicago, Illinois
United States

Mohd Isa Abd Majid, PhD
Head
Toxicology Laboratory Unit
National Poison Centre
Universiti Sains Malaysia
Penang
Malaysia

Nicole Mamelle, PhD
Director of Research
National Institute of Health and Medical Research
Lyon
France

Norman M. Mann, MD
Chemosensory Clinical Research Center
Department of Medicine
University of Connecticut
Farmington, Connecticut
United States

S. Zack Mansdorf, PhD
Managing Director
Liberty International Risk Services
Boston, Massachusetts
United States

Alfred C. Marcus, PhD
Director
Division of Behavioral Science Research
AMC Cancer Research Center
Denver, Colorado
United States

Kazimierz J. Marek, MD, PhD
Professor, Head
Clinical Department
Institute of Occupational Medicine and Environmental Health
Soznowiec
Poland

Anthony A. Martin, MD, MPH
Division of Respiratory Disease Studies
National Institute for Occupational Safety and Health
Morgantown, West Virginia
United States

Steven B. Markowitz, MD
Associate Professor, Deputy Director
Division of Environmental and Occupational Medicine
Mount Sinai School of Medicine
New York, New York
United States

Marco Maroni, MD
Director
International Centre for Pesticide Safety
Institute of Occupational Medicine
Milan
Italy

M. Masali*
Institute of Anthropology and Ethnology
University of Turin
Turin
Italy

Donald R. Mattison, MD, MS
Professor, Dean
Graduate School of Public Health
University of Pittsburgh
Pittsburgh, Pennsylvania
United States

A. Mayer, Eng
Head
Department of Machinery and Protective Devices
Research Centre
National Institute of Safety Research
Vandoeuvre
France

Alan Maynard, BA, B Phil
Department of Economics
University of York
Heslington, York
United Kingdom

Daniel McBain, MA
Hamilton, Ontario
Canada

Michael McCann, PhD, CIH
Senior Associate Editor
Encyclopedia of Occupational Health and Safety
International Labour Office
New York, New York
United States

Robert J. McCunney, MD, MPH
Director
Environmental Medical Service
Massachusetts Institute of Technology
Cambridge, Massachusetts
United States

Ross A. McKinnon, PhD
Lecturer in Pharmaceutical Biotechnology
School of Pharmacy and Medical Sciences
University of South Australia
Adelaide
Australia

Thomas H. McQuiston, MS
University of North Carolina
Chapel Hill, North Carolina
United States

Dick J. Meertens, Eng saf
Programme Manager
Accident Prevention and Insurance
Studies and Operations Branch
International Social Security Association
Geneva
Switzerland

Heather Menzies, BA
School of Canadian Studies
Carleton University
Ottawa, Ontario
Canada

Donna Mergler, PhD
Professor
Centre for the Study of Biological Interactions in Health and Environment
University of Quebec-Montreal
Montreal, Quebec
Canada

Franco Merletti, MD, MSc
Professor of Medical Statistics
Department of Medical Sciences
University of Turin
Turin
Italy

Jacqueline Messite, MD
Clinical Professor
Department of Environmental Medicine
New York University College of Medicine
New York, New York
United States

Jean-Jacques Meyer, PhD
Professor of Ergonomics, Head of Laboratory
Vision Ergonomics Laboratory
Institute of Occupational Health Sciences
Lausanne
Switzerland

* Contributor to the 3rd edition of this Encyclopedia. This biographical information has not been updated.
Jarle-Erik Michelsson, MD, PhD
Lovisa
Finland

H. Mierzecki
Former Chief
Institute of Dermatology
Academy of Medicine
Wroclaw
Poland

R. Rita Misra, PhD
Laboratory of Comparative Carcinogenesis
National Cancer Institute
Frederick, Maryland
United States

Toyohiko Miura, MD
Institute for Science of Labour
Kawasaki
Japan

Willi Momm, MA
Chief
Vocational Rehabilitation Branch
International Labour Office
Geneva
Switzerland

John S. Morawetz, ScM
Director
ICWU Center for Worker Health and Safety Education
Cincinnati, Ohio
United States

Vivian K. Morgan, BS
Acting Chief
Information Resources Branch
National Institute for Occupational Safety and Health
Cincinnati, Ohio
United States

Sharon L. Morris, BA
Assistant Chair for Community Outreach
Department of Environmental Health
University of Washington
Seattle, Washington
United States

April E. Mott, MD
Medical Director
Chemosensory Clinical Research Center
University of Connecticut Health Center
Farmington, Connecticut
United States

Sonia Muchnick-Baku, MA, ScM
Director
Washington Business Group on Health
Washington, DC
United States

Vladimir M. Munipov, MS
Chair, Professor of Ergonomics
Moscow Institute of Radio Engineering, Electronics and Automation
Moscow
Russian Federation

Lawrence R. Murphy, PhD
Research Psychologist
Applied Psychology and Ergonomics Branch
National Institute for Occupational Safety and Health
Cincinnati, Ohio
United States

Karl J. Musgrave, DVM, MPH
Wyoming State Health Department
Cheyenne, Wyoming
United States

Melvin L. Myers, BS, MPA
Deputy Director
Office of Extramural Coordination and Special Projects
National Institute for Occupational Safety and Health
Atlanta, Georgia
United States

Friedhelm Nachreiner, Dr rer nat
Professor of Applied Psychology
Work and Organizational Psychology Unit
Carl von Ossietzky University
Oldenburg
Germany

Pranab Kumar Nag, PhD, DSc, MSc
Deputy Director
Indian Council of Medical Research
National Institute of Occupational Health
Ahmedabad
India

Daniel W. Nebert, MD, MS
Professor, Director
Center for Environmental Genetics
University of Cincinnati Medical Center
Cincinnati, Ohio
United States

Carolyn Needelman, PhD
Professor, Director
Occupational/Environmental Health Program
Graduate School of Social Work and Social Research
Bryn Mawr College
Bryn Mawr, Pennsylvania
United States

Thomas J. Nelson, BS, CIH
NIHIS Inc.
Ardentown, Delaware
United States

Toshihito Okubo, MD, Dr Med Sci
Professor, Director
Department of Environmental Epidemiology
University of Occupational and Environmental Health
Kitakyushu City
Japan

Shauna Olney, LLB, BCL
Senior Legal Officer
Freedom of Association Branch
International Labour Office
Geneva
Switzerland

Peter Orris, MD, MPH
Associate Professor of Medicine
Cook County Hospital
University of Illinois
Chicago, Illinois
United States

Dave W. Ostlieb, BS
Director
Safety and Health Department
United Paperworkers International Union
Nashville, Tennessee
United States

M. Gerald Ott, PhD, MS
Director of Epidemiology
BASF Corporation
Mount Olive, New Jersey
United States

Heinz Otten, Dr rer nat
Head of Section
Hauptverband der gewerblichen Berufsgenossenschaften
Sankt Augustin
Germany

Muneto Ozaki
Labour Law and Labour Relations Branch
International Labour Office
Geneva
Switzerland

Freda L. Paltiel, CSW, MPH, CM
Former Senior Advisor, Status of Women Consultant in Health and Social Policy
Health Canada
Ottawa, Ontario
Canada
Sheila Pantry, OBE, BA, FdA, FInf Sci
Sheila Pantry Associates-Information Services Consultancy
Sheffield
United Kingdom

Edward L. Petsonk, MD, CM
Chief, Clinical Section
Division of Respiratory Disease Studies
National Institute for Occupational Safety and Health
Morgantown, West Virginia
United States

Wai-On Phoon, MB, DIH
Department of Occupational Health
University of Sydney
Sydney
Australia

Simon Pickvance, BA
Occupational Health Advisor
Sheffield Occupational Health Project
Sheffield
United Kingdom

Robert Ransom, MA
Senior Specialist
Vocational Rehabilitation Branch
International Labour Office
Geneva
Switzerland

Jorma Rantanen, MD, PhD
Director General
Finnish Institute of Occupational Health
Helsinki
Finland

Carl Raskin, BA, Dip Ed
Coordinator
Global Applied Disability Research and Information Network on Employment and Training
Canadian Labour Force Development Board
Nepean, Ontario
Canada

Dzulkifli Abdul Razak, MSc
Professor, Director
National Poison Centre
Universiti Sains Malaysia
Penang
Malaysia

Paule Rey, MD, MPH
Professor Emeritus
Faculty of Medicine
University of Geneva
Geneva
Switzerland

Annie Rice, BSc
Director
Health Safety Environment Consultants
Petit Bornand
France

Peter Richter, Dr rer nat
Professor
Institut für Arbeitsschutz und Sozialpsychologie
Technical University of Dresden
Dresden
Germany

Wolfgang von Richthofen
Senior Labour Inspection Specialist
Labour Administration Branch
International Labour Office
Geneva
Switzerland

Hilkka Riihimäki, MD, Dr med sci
Director
Department of Epidemiology and Biostatistics
Finnish Institute of Occupational Health
Helsinki
Finland

Sally Roberts, PhD
Clinical Epidemiologist
Centre for Spinal Studies
Robert Jones and Agnes Hunt Orthopaedic and District Hospital
Oswestry, Shropshire
United Kingdom

Dilys Robertson, BA
Consultant
Ottawa, Canada

Walter Rohnert, Prof Dr-ing
Professor Emeritus
Institut für Arbeitswissenschaft
Technische Hochschule Darmstadt
Darmstadt
Germany

William N. Rom, MD, MPH
Professor of Medicine
Division of Pulmonary and Critical Care Medicine
New York University
New York, New York
United States

Linda Rosenstock, MD, MPH
Director
National Institute for Occupational Safety and Health
Washington, DC
United States
Clara Sue Ross, MD, JD
President
Environmental and Occupational Health Consultants Inc.
Cincinnati, Ohio
United States

John Rudge, MBA
Senior Lecturer and OHS Programmes Coordinator
School of Management
University of South Australia
Adelaide
Australia

Jon Rudnick, MD, MPH, MSc
Corporate Medical Director
Dow Corning Corporation
Midland, Michigan
United States

John W. Ruser, PhD, MA
Chief
Compensation Research Group
United States Bureau of Labor Statistics
Washington, DC
United States

Ragnar Rylander, MD, PhD
Professor
Department of Environmental Medicine
University of Göteborg
Göteborg
Sweden

David L.S. Ryon, MD
Division of Pulmonary and Critical Care Medicine
New York University
New York, New York
United States

Sheldon W. Samuels, AB
Former Director of Health, Safety and Environment
Industrial Union Department
American Federation of Labor and Congress of Industrial Organizations
Washington, DC
United States

Andries F. Sanders, PhD
Professor of Cognitive Psychology
Department of Psychometrics
Free University
Amsterdam
The Netherlands

Rodolfo Saracci, MD
Director of Research
National Research Council
Pisa
Italy

Annie J. Sasco, MD, Dr PH
Head
Programme of Epidemiology for Cancer Prevention
International Agency for Research on Cancer
Lyon
France

Denis Sasseville, MD, FRCPC
Associate Professor of Medicine (Dermatology)
McGill University
Montreal, Quebec
Canada

Steven L. Sauter, PhD
Chief
Applied Psychology and Ergonomics Branch
National Institute for Occupational Safety and Health
Cincinnati, Ohio
United States

Marianne Saux, MD
Head
Department of Occupational Medicine
Director of Medical Inspection Service
Ministry of Work
Paris
France

Heikki Savolainen, Dr med sci
Professor of Occupational Medicine
Institute of Occupational Health Sciences
Lausanne
Switzerland

Richard Schilling, MD, DSc
Occupational Health Consultant
London
United Kingdom

William J. Schneider, MD, MPH
Director of Health Services
J.P. Morgan and Co. Inc.
New York, New York
United States

Wolfram D. Schneider, Prof Dr med
Head
Department of Health Effects of Hazardous Substances
Federal Institute for Occupational Safety and Health
Berlin
Germany

Steven M. Schrader, PhD
Chief
Functional Toxicology Section
National Institute for Occupational Safety and Health
Cincinnati, Ohio
United States

Horst Schulz, Dipl Volkswirt
Head
Computer and Documentation Department
Hauptverband der gewerblichen Berufsgenossenschaften
Sankt Augustin
Germany

Susan Scott-Parker, BA
Chief Executive
Employers’ Forum on Disability
London
United Kingdom

Patrick Sébastien, PhD
Scientific Director
Institute of Occupational Health and Safety Research
Montreal, Quebec
Canada

Marie-Claire Séguret
Conditions of Work and Welfare Facilities Branch
International Labour Office
Geneva
Switzerland

Anna Maria Seppäläinen, MD, PhD
Chief
Division of Clinical Neurophysiology
University of Helsinki
Helsinki
Finland

Lowell E. Sever, PhD
Program Director for Public Health Sciences
 Battelle Seattle Research Center
Seattle, Washington
United States

Erwin Seyfried, PhD
Professor of Social Psychology, Director
Research Unit for Vocational Training
Labour Market and Evaluation
Berlin
Germany

Behrouz Shahandeh, MA
Senior Advisor on Drugs and Alcohol
Vocational Rehabilitation Branch
International Labour Organization
Geneva
Switzerland

Housshang Shahnazav, PhD, MSc
Professor of Industrial Ergonomics
Director
Center for Ergonomics of Developing Countries
Luleå University of Technology
Luleå
Sweden
AUTHORS AND EDITORS

Steven Short, DO
Medical Officer
Division of Respiratory Disease Studies
National Institute for Occupational Safety and Health
Morgantown, West Virginia
United States

Donald E. Shrey, PhD
Associate Professor
Department of Physical Medicine and Rehabilitation
University of Cincinnati Medical Center
Cincinnati, Ohio
United States

Joel Shufro, PhD
Executive Director
NYCOSH
New York, New York
United States

Ellen Silbergeld, PhD
Professor of Epidemiology and Pathology
University of Maryland at Baltimore
Baltimore, Maryland
United States

Leif Simonsen, PhD
Department of Toxicology and Biology
National Institute of Occupational Health
Copenhagen
Denmark

William T. Singleton, DSc, MA
Professor Emeritus of Applied Psychology
Aston University
Birmingham
Northumberland
United Kingdom

Susan Sink, MFA
Artist
Chicago, Illinois
United States

Gisela Sjøgaard, PhD, Dr med sci
Director
Department of Physiology
National Institute of Occupational Health
Copenhagen
Denmark

Juhani Smolander, PhD
Senior Researcher
Finnish Institute of Occupational Health
Vaasa
Finland

David Snowball, PhD
Deputy Director General's Office
Health and Safety Executive
London
United Kingdom

Marja Sorsa, PhD
Director
Ministry of Education
Helsinki
Finland

Colin L. Soskolne, PhD
Professor, Director of Graduate Training
Department of Public Health Services
University of Alberta
Edmonton, Alberta
Canada

Jerry Spiegel, MA, MSc
Director
Pollution Prevention
Manitoba Environment
Winnipeg, Manitoba
Canada

Heide Stark, Dr med
Department of Epidemiology
Federal Institute for Occupational Safety and Health
Berlin
Germany

Jeanne M. Stellman, PhD
Editor-in-Chief
Encyclopedia of Occupational Health and Safety
International Labour Office
Geneva
Switzerland

Steven D. Stellman, PhD, MPH
Chief
Division of Epidemiology
American Health Foundation
New York, New York
United States

Craig R. Stenberg, PhD
Director
Occupational/Mental Health Programs
Departments of Psychiatry and Community and Family Medicine
Duke University Medical School
Durham, North Carolina
United States

James H. Stewart, PhD, CIH
School of Public Health
Harvard University
Boston, Massachusetts
United States

B.J. Stiles, BD, BA
President, Chief Executive Officer
National AIDS Fund
Washington, DC
United States

Phillip W. Strine, BA
Special Assistant to the Assistant Surgeon General and Deputy Director, Public Health Advisor
National Institute for Occupational Safety and Health
Atlanta, Georgia
United States

Zhi Su, MD, MPH
Director
Department Health Inspection and Supervision
Ministry of Health
Beijing
China

Haruko Suzuki
Research Information Division
Institute for Science of Labour
Kawasaki
Japan

Ken Takahashi, MD, D MSc, MPH
Associate Professor
Department of Environmental Epidemiology
University of Occupational and Environmental Health
Kitakyushu City
Japan

Jukka Takala, Dr Tech, MSc
Chief
Occupational Safety and Health Branch
International Labour Office
Geneva
Switzerland

Krishna Talluri, MB
Department of Psychiatry
Duke University Medical Center
Durham, North Carolina
United States

Rachael F. Taylor, LLB
Consultant
International Labour Office
Geneva
Switzerland

Spomenka Telišman, DSc, MSc
Senior Scientific Consultant
Institute for Medical Research and Occupational Health
Zagreb
Croatia
Benedetto Terracini, MD  
Former Head  
Unic of Cancer Epidemiology  
University Hospital and University of Turin  
Turin  
Italy

Ulrike Tittelbach, Dr med  
Department of Health Effects of Hazardous Substances  
Federal Institute for Occupational Safety and Health  
Berlin  
Germany

Lori Todd, PhD, MS  
Associate Professor  
Department of Environmental Science and Engineering  
University of North Carolina  
Chapel Hill, North Carolina  
United States

Angela K. Traiforos, M Ed  
Executive Director  
Center for Administration, Rehabilitation and Employment Services  
International Association of Machinists  
Upper Marlboro, Maryland  
United States

Anne Trebilcock, JD  
Principal Legal Officer  
Office of the Legal Adviser  
International Labour Office  
Geneva  
Switzerland

Benjamin F. Trump, MD  
Professor, Chair  
Department of Pathology  
School of Medicine  
University of Maryland  
Baltimore, Maryland  
United States

Ulf Ulfvarson, PhD  
Professor of Industrial Ergonomics  
Department of Environmental Technology and Work Science  
Royal Institute of Technology  
Stockholm  
Sweden

Eberhard Ulich, Prof Dr, Dr hc  
Professor  
Department of Work and Organizational Psychology  
Swiss Federal Institute of Technology Zurich  
Switzerland

Jill P. G. Urban, PhD  
Senior Research Fellow  
Laboratory of Physiology  
University of Oxford  
Oxford  
United Kingdom

Antero Vihapassi, MSc  
Chief Technical Adviser  
Labour Administration Branch  
International Labour Office  
Geneva  
Switzerland

Harri Vainio, MD, PhD  
Chief  
Unit of Chemoprevention  
International Agency for Research on Cancer  
Lyon  
France

José A. Valciukas, PhD  
Associate Professor, Director  
Psychology Internship Training Program  
Lincoln Medical and Mental Health Center  
New York, New York  
United States

Kees A. van der Heijden, Dr  
Director  
Bilthoven Division  
World Health Organization European Centre for Environment and Health  
Bilthoven  
The Netherlands

Henk van Loveren, PhD  
Head  
Immunobiology and Haematology Section  
Laboratory for Pathology and Immunobiology  
National Institute of Public Health and the Environment  
Bilthoven  
The Netherlands

Joachim Vedder, Dipl-Ing, MS  
Department of Ergonomics  
Institut für Arbeitsphysiologie  
University of Dortmund  
Dortmund  
Germany

Maria Luz Vega Ruiz, Lab Law  
Specialist in Labour Law and Labour Relations  
International Labour Office  
Geneva  
Switzerland

Marc Vericel, Dr d’Etat en droit  
Master of Conference  
Law Faculty  
University of Saint-Etienne  
Saint-Etienne  
France

Eira Viikari-Juntura, MD, Dr med sci  
Musculoskeletal Research Unit  
Department of Physiology  
Finnish Institute of Occupational Health  
Helsinki  
Finland

Paolo Vineis, MD  
Deputy Director  
Unit of Cancer Epidemiology  
Main Hospital and University  
Turin  
Italy

Eva Vingard, MD, PhD  
Senior Physician, Researcher  
National Institute for Working Life  
Solna  
Sweden

Serge Volkoff  
Director  
Centre for Research and Study on Age and the Working Population  
Paris  
France

Joseph G. Vos, DVM, PhD  
Head  
Laboratory for Pathology and Immunobiology  
National Institute of Public Health and the Environment  
Bilthoven  
The Netherlands

Michael P. Waalkes, PhD  
Chief  
Inorganic Carcinogenesis Section  
National Cancer Institute  
Frederick, Maryland  
United States

Gregory R. Wagner, MD  
Director  
Division of Respiratory Disease Studies  
National Institute for Occupational Safety and Health  
 Morgantown, West Virginia  
United States

Nina B. Wallerstein, Dr PH, MPH  
Associate Professor  
Department of Family and Community Medicine  
University of New Mexico  
Albuquerque, New Mexico  
United States
PRODUCTION TEAM

Sarah Alvarez
Maria Arteta
May Ballerio-Hofman
Lillian Benjamin
Michel Berka
Walter Benjamin
Christian Bolufer
Claude Chaperon
Kyle Creame
Denis Cullinan
Johanna de Vries
Robert Deers
Margaret Fennessy
Raymond Figuières
Betty Goldman
Susan Guthridge
Kathleen Susan Hurst
Claudia Hommel
Rachael Horner
Sanna Immonen
Lisa Kellner
Diana Signe Kline
Nana-Ekua Leigh
Robert Leuze
Elizabeth Mahiga
Christiane Melin
Jacky Merteau

John McKenna
Julie Nayler
Catherine H. Perring
Peter Perring
Bodhani Pieris
Giles Reed
Kirsten Reed
John G. Rodwan, Jr.
Nancy J. Rodwan
David Rosenweig
David Rowley
Oriole Rovaletti
Daniel Ruffieux
Jacques P. Tremblay
Steven Sacks
Barbara Sandi
Gabor Sandi
Anneliese Shulte
Jonathan Stempf
Fred Stanton
Prabha Sundaram
Juan Tenorio
Jennifer Valdes
Tracy Weber
Berit Widing-Pry
Sydney G. Williams
Su Zen
Stellman, Jeanne Mager (ed.)
/Encyclopaedia/, /Occupational health/, /Occupational safety/. 13.04.2
ISBN 92-2-109293-8 (set)
92-2-109814-1 (V. 1) 92-2-109815-X (V. 2) 92-2-109816-8 (V. 3) 92-2-109817-6 (V. 4)


ILO Cataloguing in Publication Data

The designations employed in ILO publications, which are in conformity with United Nations practice, and the presentation of material therein do not imply the expression of any opinion whatsoever on the part of the International Labour Office concerning the legal status of any country, area or territory or of its authorities, or concerning the delimitation of its frontiers. The responsibility for opinions expressed in signed articles, studies and other contributions rests solely with their authors, and publication does not constitute an endorsement by the International Labour Office of the opinions expressed in them. The reader accepts that the parties make this documentation available without warranty of any kind. The parties do not accept responsibility for the validity or completeness of any data including inaccuracies, errors or omissions or for any consequences arising from the use of such data. Neither the authors, nor the ILO or collaborating institutions shall be liable for damages or other claims and demands arising out of the use of the data. Reference to names of firms and commercial products and processes does not imply their endorsement by the International Labour Office or any collaborating institution, and any failure to mention a particular firm, commercial product or process is not a sign of disapproval.
ILO publications can be obtained through major booksellers or ILO local offices in many countries, or direct from ILO Publications, International Labour Office, CH-1211 Geneva 22, Switzerland. Catalogues or lists of new publications are available free of charge from the above address.
Ursula Ackermann-Liebrich, MD, MSc
Professor
Department of Social and Preventive Medicine
University of Basel
Basel
Switzerland

Elena Adán Liébana, Chem Eng
Occupational Health and Safety Technician
National Centre of Working Conditions
National Institute for Occupational Safety and Hygiene
Barcelona
Spain

Alfred A. Amendola, PhD
Research Associate Professor, Associate Director
Safety Engineering Program
Texas A&M University
College Station, Texas
United States

Yngve Anderberg, MD, PhD
Fire Safety Design AB
Lund
Sweden

Ragnar Andersson, PhD, MEng
Injury Program Director
Department of Public Health Sciences
Karolinska Institute
Sundbyberg
Sweden

Diego Andreoni, Dr Ing
Former Director-General
Ente Nazionale Prevenzione Infortuni
Rome
Italy

Jean Arteau, Ing, PhD, MSc
Researcher
Institute for Occupational Safety and Health Research
Montreal, Quebec
Canada

Tomas Backström, PhD
Researcher
National Institute for Working Life
Solna
Sweden

Gabriele Bammer, PhD
National Centre for Epidemiology and Population Health
Australian National University
Canberra
Australia

Tamas Banky, Dr
Head of Fire Protection Scientific Department
Institute for Quality Control and Innovation in Building
Budapest
Hungary

Julian Barling, PhD
Professor of Organizational Behavior
School of Business
Queen's University
Kingston, Ontario
Canada

Rosalind C. Barnett, PhD
Senior Scholar in Residence
Murray Research Center
Women's Studies Program
Brandeis University
Waltham, Massachusetts
United States

Peter J. Baxter, MD, MSc
Institute of Public Health
University of Cambridge
Cambridge
United Kingdom

François Bélèm, PhD
Professor
Groupe de Recherche Interdisciplinaire en Santé
University of Montreal
Montreal, Quebec
Canada

Ron Bell, BSc
Head
Electrical and Control Systems Unit
Health and Safety Executive
Bootle, Merseyside
United Kingdom

David Bennett, PhD, MA
National Director
Workplace Health, Safety and Environment
Canadian Labour Congress
Ottawa, Ontario
Canada

Alan J. Benson, MSc, MB, ChB, FRACS
Consultant
Royal Air Force School of Aviation Medicine
Farnborough, Hants
United Kingdom

María José Berenguer, MChem
Head
Mass Spectrometry Laboratory
National Centre for Working Conditions
National Institute for Occupational Safety and Hygiene
Barcelona
Spain

Mats Berg, MD
Department of Dermatology
Karolinska Hospital
Stockholm
Sweden

Kenneth I. Berger, MD
Instructor of Medicine
Division of Pulmonary and Critical Care Medicine
New York University
New York, New York
United States

Ulf Bergqvist, Dr med sci, MSc
Technologist
Research Scientist
Department of Occupational Medicine
National Institute for Working Life
Solna
Sweden

Pier Alberto Bertazzi, MD, MPH
Associate Professor
Institute of Occupational Medicine
University of Milan
Milan
Italy

Diane Berthelette, PhD
Associate Professor
Department of Administrative Sciences
University of Quebec-Montreal
Montreal, Quebec
Canada

Ronald Bisset, MA, MSc
Scott Wilson Resource Consultants
Edinburgh, Scotland
United Kingdom

Jacques H.M. Bittel, MD, DERBH
Chief
Human Factors Department
Army Health Service Research Centre-Émile Pardé
La Tronche
France

Massimo Bovenzi, MD
Senior Physician, Contract Professor of Industrial Hygiene
Institute of Occupational Medicine
University of Trieste
Trieste
Italy
Carole Brabant, PhD
Associate Editor
Encyclopedia of Occupational Health and Safety
International Labour Office
Geneva
Switzerland

John Brazendale, BSc, MSc
Principal Specialist Inspector
Health and Safety Executive
Boole, Merseyside
United Kingdom

Cecilia Brighi
International Policy Department
CISL National Trade Union
Confederation
Rome
Italy

Robert Bringer, PhD
Staff Vice-President (Retired)
Environmental Technology and Services
3M
St. Paul, Minnesota
United States

Peter Bruckmann, PhD
Head of Division
Environmental Monitoring
Landesumweltamt, Nordrhein-Westfalen
Essen
Germany

Francoise Burhenne-Guilmin, Dr Law
Head
Environmental Law Centre
International Union for the Conservation of Nature
Bruxelles
Belgium

Ronald J. Burke, PhD
Professor
Faculty of Administrative Studies
York University
North York, Ontario
Canada

Ahmet Çakır, Dr-Ing, F Erg S
Scientific President
Ergonomic Institute for Social and Occupational Sciences
Berlin
Germany

Donald M. Campbell, FFPHM
Consultant in Public Health Medicine
Scottish Centre for Infection and Environmental Health
Glasgow
United Kingdom

Robert D. Caplan, PhD
Professor of Psychology, Psychiatry and Behavioral Science
Department of Psychology
George Washington University
Washington, DC
United States

Pascale Carayon, PhD
Visiting Professor
Ecole des Mines de Nancy
Nancy
France

Sue Cartwright, PhD
Senior Research Fellow
Manchester School of Management
University of Manchester
Manchester
United Kingdom

Emilio Castejón Vilella, Ing Ind
Director
National Centre of Working Conditions
National Institute for Occupational Safety and Hygiene
Barcelona
Spain

Weiping Chen, MD, MSc
Health Risk Assessment Specialist
Health Strategies and Research Division
Alberta Health
Edmonton, Alberta
Canada

V. I. Chernyuk, MD, ScD
Professor, Scientific Director
Institute for Occupational Health
Kiev
Ukraine

Robert N. Cherry Jr., PhD, MS
Colonel and Director of Army Radiation Safety
HQDA (DACS-SF)
U.S. Army
Washington, DC
United States

Eric Chivian, MD
Director
Center for Health and the Global Environment
Harvard Medical School
Boston, Massachusetts
United States

Renzo Comini
Responsible
DSG Unità Centrale Sicurezza Ed Igiene del Lavoro
ENEL SpA
Rome
Italy

Cary L. Cooper, PhD, MBA, MSc
Professor of Organizational Psychology
Institute of Science and Technology
University of Manchester
Manchester
United Kingdom

Georges H. Coppée, MD
Chief of Medical Section
Occupational Safety and Health Branch
International Labour Office
Geneva
Switzerland

D. Wayne Corneil, ScD
Director
Operations Eastern Region
Health Canada
Ottawa, Ontario
Canada

Robert Coyle
Principal Environmental Specialist
European Bank for Reconstruction and Development
London
United Kingdom

Derrick Crump, PhD
Section Head, Indoor Air Quality
Materials Group
Building Research Establishment
Watford
United Kingdom

Göran Dahlström, MD
Commanding Medical Officer, Director
Cold Center
Kiruna
Sweden

J.C. Davies, PhD, MSc
Principal Programmer/Analyst
Computing Services Department
University of Liverpool
Liverpool
United Kingdom

Nicole Dedobbeleer, ScD
Associate Professor of Research
Department of Social and Preventive Medicine
University of Montreal
Montreal
Canada
Edouard I. Denisov, Cand tech sci  
Senior Researcher  
RAMS Institute of Occupational Health  
Moscow  
Russian Federation

S.K. Dheri  
Chief Fire Officer  
Headquarters Delhi Fire Service  
New Delhi  
India

Leonard A. Dobrovolsky, MD, PhD, D Sci  
Head  
Department of Scientific and Medical Information  
Institute of Occupational Health  
Kiev  
Ukraine

Alexander E. Donagi, D Sc, MPH  
Professor  
School of Medicine  
Tel Aviv University  
Director  
Information Centre  
Institute of Occupational Safety and Hygiene  
Tel Aviv  
Israel

Marianne Döös, BSc  
Senior Researcher  
National Institute for Working Life  
Solna  
Sweden

Dennis P. Driscoll, PE, MSc  
President  
Associates in Acoustics Inc.  
Evergreen, Colorado  
United States

Dougal Drysdale, BSc, PhD  
Reader in Fire and Safety Engineering  
Department of Civil and Environmental Engineering  
University of Edinburgh  
Edinburgh, Scotland  
United Kingdom

Walter Dümmer, MPh  
Technical Advisor  
Chilean Safety Association  
Santiago  
Chile

William W. Eaton, PhD, MS  
Professor  
Department of Mental Hygiene  
School of Hygiene and Public Health  
Johns Hopkins University  
Baltimore, Maryland  
United States

John Elias, MPH  
Senior Occupational Hygienist  
Occupational and Environmental Medicine  
Health Sciences Center  
Winnipeg, Manitoba  
Canada

Zuheir Ibrahim Fakhri, MBBS, DHI, MSc OM, MD  
Occupational Health Consultant  
Ministry of Health  
Riyadh  
Saudi Arabia

Anne-Marie Feyer, PhD  
Director  
New Zealand Occupational and Environmental Health Research Centre  
Dunedin  
New Zealand

John Finklea, MD, Dr PH  
Medical Officer  
Center to Protect Workers’ Rights  
Former Director  
National Institute for Occupational Safety and Health  
Washington, DC  
United States

Brian Flannigan, PhD  
Department of Biological Sciences  
Heriot-Watt University  
Edinburgh, Scotland  
United Kingdom

Dominique Folliot, MD  
Deputy Head of Department  
Service Général de Médecine du Travail  
Paris  
France

Richard Forster  
Lighting Consultant  
Crowthorne, Berkshire  
United Kingdom

Bernard H. Fox, PhD  
Professor of Psychiatry  
School of Medicine  
Boston University  
Boston, Massachusetts  
United States

T.J.R. Francis, MSc, PhD, MFOM  
Naval Medical Research Laboratory  
Naval Submarine Base  
Groton, Connecticut  
United States

Marianne Frankenhaeuser, PhD, MA  
Professor Emeritus of Psychology  
University of Stockholm  
Stockholm  
Sweden

David Freestone, LLB, LLM  
Legal Advisor, Environment  
Environmental and International Law Unit  
Legal Department  
World Bank  
Washington, DC  
United States

Jean G. French, Dr PH  
Adjunct Professor  
Department of Epidemiology  
School of Public Health  
University of North Carolina  
Chapel Hill, North Carolina  
United States

Daniel Ganster, PhD  
Professor, Chair  
Department of Management  
University of Arkansas  
Fayetteville, Arkansas  
United States

Kenneth Gerecke  
Assistant Regional Administrator  
Occupational Safety and Health Administration  
US Department of Labor  
Philadelphia, Pennsylvania  
United States

Adrian Gheorghe, PhD, MSc  
Professor of Industrial Management  
University Politehnica  
Bucharest, Romania  
Director of Research  
Swiss Federal Institute of Technology  
Zurich  
Switzerland

Berenice I. Ferrari Goelzer, CIH, MPH  
Occupational Hygienist  
Office of Occupational Health  
World Health Organization  
Geneva  
Switzerland

Des Gorman, MD, PhD  
Head of Occupational Medicine  
School of Medicine  
University of Auckland  
Auckland  
New Zealand
Marilyn K. Gowing, PhD
Director
Personnel Resources and Development Center
United States Office of Personnel Management
Washington, DC
United States

Per-Ola Granberg, MD, PhD
Former Professor of Endocrine Surgery
Karolinska Hospital
Stockholm
Sweden

Martino Grandolfo, PhD
Director
Department of Physics
Instituto Superiore di Sanità
Rome
Italy

Casey C. Grant, PE
Assistant Vice-President
Codes and Standards Administration
National Fire Protection Association
International
Quincy, Massachusetts
United States

Michael J. Griffin, PhD
Professor of Human Factors
Institute of Sound and Vibration Research
University of Southampton
Southampton
United Kingdom

Jop Groeneveld, PhD
Senior Researcher
Centre for Safety Research
Leiden University
Leiden
The Netherlands

Carsten Gronberg, MSc
Research Engineer
RISO National Laboratory
Roskilde
Denmark

Xavier Guardino Solá, PhD
Chief of Department
National Centre for Working Conditions
National Institute for Occupational Safety and Hygiene
Barcelona
Spain

Johan Guasch Farrés
Head of Working Conditions Area
National Centre for Working Conditions
National Institute for Occupational Safety and Hygiene
Barcelona
Spain

Tee L. Guidotti, MD, MPH
Professor, Director
Occupational Health Program
Faculty of Medicine
University of Alberta
Edmonton, Alberta
Canada

K.C. Gupta, BE
Director-General
National Safety Council
Bombay
India

Niels Jorn Hahn, MSc
Managing Director
Working Group on Recycling and Waste Minimization
ISWA
Copenhagen
Denmark

Kari K. Häkkinen, PhD
Development Manager
Workers’ Compensation Department
Industrial Insurance Ltd.
Helsinki
Finland

Andrew R. Hale, PhD
Professor of Safety Science
Safety Science Group
Delft University of Technology
Delft
The Netherlands

L.D. Hamilton, MD, PhD
Professor
Biomedical and Environmental Assessment Group
Brookhaven National Laboratory
Upton, New York
United States

Kjell Hansson Mild, PhD
Researcher
National Institute for Working Life
Umeå
Sweden

Richard Helmer, PhD, MA
Chief
Urban Environmental Health
World Health Organization
Geneva
Switzerland

Ana Hernández Calleja
Occupational Health and Safety Technician
National Centre of Working Conditions
National Institute for Occupational Safety and Hygiene
Barcelona
Spain

Ivanildo Hespernol
Community Water Supply and Sanitation
World Health Organization
Geneva
Switzerland

Raymond Héut, PhD (deceased)
Former Director
Acoustic Group
Medical Faculty
University of Montreal
Montreal, Quebec
Canada

Manh Trung Ho, Ing civ
Former Assistant Director
Applications Prevention
National Institute of Safety and Research
Paris
France

Dietrich Hoffmann, PhD, MS
Associate Director
Naylor Dana Institute for Disease Prevention
American Health Foundation
Valhalla, New York
United States

Ingvar Holmér, PhD
Professor
Department of Ergonomics
National Institute for Working Life
Solna
Sweden

Vilma Hunt, BDS, AM
Adjunct Professor
Department of Work Environment
University of Massachusetts-Lowell
Lowell, Massachusetts
United States

Joseph J. Hurrell, Jr., PhD
Senior Research Epidemiologist
Hazard Evaluation and Technical Assistance Branch
National Institute for Occupational Safety and Health
Cincinnati, Ohio
United States
Claire Infante-Rivard, MD, PhD, MPH
Professor
Department of Occupational Health
Faculty of Medicine
McGill University
Montreal, Quebec
Canada

John M. Ivancevich, DBA
Hugh Ray and Lillie Granz Cullen Chair, Professor of Organizational Behavior and Management
College of Business Administration
University of Houston
Houston, Texas
United States

C. David Jenkins, PhD, MA
Adjunct Professor of Psychiatry and Preventive Medicine and Community Health
University of North Carolina
Chapel Hill, North Carolina
United States

Steve M. Jex, PhD
Associate Professor
Department of Psychology
University of Wisconsin-Oshkosh
Oshkosh, Wisconsin
United States

Jeffrey V. Johnson, PhD
Associate Professor of Social Science, Medicine and Occupational Health
Johns Hopkins School of Hygiene and Public Health
Baltimore, Maryland
United States

Peter F. Johnson, MSc, Dipl Ed
Manager
Arup Fire Engineering
Melbourne, Victoria
Australia

B. Juminer, PhD
Faculty of Medicine
Meshed
Islamic Republic of Iran

Kirsten Jorgensen, PhD, MSc
Head of Department
Analysis and Documentation Office
Danish Work Environment Service
Copenhagen
Denmark

Friedrich Karl Käferstein, Dr med vet
Director
Programme of Food Safety and Food Aid
World Health Organization
Geneva
Switzerland

Robert Karasek, PhD
Professor of Work Environment
University of Massachusetts-Lowell
Lowell, Massachusetts
United States

Waldemar Karwowski, PhD
Director, Professor of Industrial Engineering
Center for Industrial Ergonomics
University of Louisville
Louisville, Kentucky
United States

Gwendolyn Puryear Keita, PhD
Associate Executive Director
Public Interest Directorate
Director of Women’s Programs
American Psychological Association
Washington, DC
United States

W. Larry Kenney, PhD
Professor of Physiology and Kinesiology
Laboratory of Human Performance Research
Pennsylvania State University
University Park, Pennsylvania
United States

Eric P. Kindwall, MD
Associate Professor, Director of Hyperbaric Medicine
Medical College of Wisconsin
Milwaukee, Wisconsin
United States

Urban Kjellén, PhD
Professor of Safety Management
Department of Industrial Economics and Technology Management
Norwegian University of Science and Technology
Trondheim
Norway

Tord Kjellström, MD
Director
Office of Global and Integrated Environmental Health
World Health Organization
Geneva
Switzerland

Peter Knauth, Dr-Ing
Professor, Head
Department of Ergonomics
Institute of Industrial Production
University of Karlsruhe
Karlsruhe
Germany

Bengt Knave, MD, PhD
Head of International Secretariat and Committee
National Institute for Working Life
Solna
Sweden

Larry R. Kohler, PhD
Focal Point for Environment and Sustainable Development
Department of Working Conditions and Environment
International Labour Office
Geneva
Switzerland

Richard S. Kraus, PE, CSP
Principal
Petroleum Safety Consultants
Annandale, Virginia
United States

Yuri Kudziev, MD, Dr med sci
Director
Institute for Occupational Health
Kiev
Ukraine

Poul Lauridsen, MSc
Technical Advisor
Working Group on Recycling and Waste Minimization
ISWA
Copenhagen
Denmark

Wolfgang Laurig, Dr-Ing
Professor, Director
Department of Ergonomics
Institut für Arbeitsphysiologie
University of Dortmund
Germany

Tom B. Leamon, PhD, MSc
Vice-President
Liberty Mutual Insurance Group
Director
Liberty Mutual Research Center for Safety and Health
Hopkinton, Massachusetts
United States

* Contributor to the 3rd edition of this Encyclopaedia. This biographical information has not been updated.
Mark R. Lehto, PhD
Associate Professor
School of Industrial Engineering
Purdue University
West Lafayette, Indiana
United States

Lennart Levi, MD, PhD
Professor Emeritus, Former Director
Department of Stress Research
Karolinska Institute
Stockholm
Sweden

Sture Lidén, MD, PhD
Professor
Department of Dermatology
Karolinska Institute
Karolinska Hospital
Stockholm
Sweden

Soo-Yee Lim, PhD
National Research Council Associate
Applied Psychology and Ergonomics Branch
National Institute for Occupational Safety and Health
Cincinnati, Ohio
United States

Kari Lindström, PhD
Research Professor
Department of Psychology
Finnish Institute of Occupational Health
Helsinki
Finland

Anthony Linehan, BA, FIOSH
Former Director of Field Operations
H.M. Chief Inspector of Factories
Health and Safety Executive
Dorset
United Kingdom

Herbert I. Linn, MS
Chief of Information Management and Dissemination Activity
Division of Safety Research
National Institute for Occupational Safety and Health
Morgantown, West Virginia
United States

Gordon M. Lodde, BS
Health Physics Consultant
Mount Joy, Pennsylvania
United States

Wouter A. Lotens, PhD
Head
Department of Work Environment
TNO Human Factors Research Institute
Soesterberg
The Netherlands

Jacques B. Malchaire, PhD, MSc
Professor of Occupational Health
Unit of Hygiene and Work Physiology
Catholic University of Louvain
Brussels
Belgium

Albert Marty, HTI, Mech Eng
Senior Safety Engineer for Product Certification
Swiss National Accident Insurance Organization
Luzern
Switzerland

Christina Maslach, PhD
Professor
Department of Psychology
University of California-Berkeley
Berkeley, California
United States

R. Matthes, Dip-Ing
Head, NIR Dosimetry, Scientific Secretary
Institut für Strahlenhygiene
Oberschleissheim
Germany

Lucien Y. Maystre, MSc, Dip-Ing
Director
Institut de Génie de l’Environnement
École Polytechnique Fédérale de Lausanne
Lausanne
Switzerland

Michael McCann, PhD
Senior Associate Editor
Encyclopedia of Occupational Health and Safety
International Labour Office
New York, New York
United States

Neil McManus, MSc, M Eng
Consulting Industrial Hygienist
Northwest Occupational Health and Safety
North Vancouver, British Columbia
Canada

Karlheinz Meffert, Dr-Ing
Director
Berufsgenossenschaftliches Institut für Arbeits sicherheit
Hauptverband der gewerblichen Berufsgenossenschaften
Sankt Augustin
Germany

Claude Menguy, Dip Ing
Department Manager
Materials and Environmental Stress
Central Laboratory of Electronic Industries
Fontenay aux Roses
France

Jacqueline Messite, MD
Clinical Professor
Department of Environmental Medicine
New York University College of Medicine
New York, New York
United States

Jean-Jacques Meyer, PhD
Professor of Ergonomics, Head of Laboratory
Vision Ergonomics Laboratory
Institute of Occupational Health Sciences
Lausanne
Switzerland

James M. Miller, PE, PhD
Professor
Industrial and Operations Engineering
University of Michigan
Ann Arbor, Michigan
United States

Timothy H. Monk, PhD
Professor of Psychiatry
Western Psychiatric Institute and Clinic
University of Pittsburgh
Pittsburgh, Pennsylvania
United States

Michel Monteuau
Head of Accidents Department
National Institute of Research and Safety
Vandoeuvre
France

Carles Muntaner, MD, PhD
Assistant Professor
Institute of Occupational and Environmental Health/Prevention Research Center
West Virginia University
Morgantown, West Virginia
United States

Lawrence R. Murphy, PhD
Research Psychologist
Applied Psychology and Ergonomics Branch
National Institute for Occupational Safety and Health
Cincinnati, Ohio
United States

Melvin L. Myers, BS, MPA
Deputy Director
Office of Extramural Coordination and Special Projects
National Institute for Occupational Safety and Health
Atlanta, Georgia
United States
Debra L. Nelson, PhD
Professor
CBA Associates
Oklahoma State University
Stillwater, Oklahoma
United States

Bodil Nielsen, Dr Phil
Associate Professor
August Krogh Institute
Copenhagen University
Copenhagen
Denmark

Sarah A. Nunneley, MS, MD
Research Physician
Air Force Research Laboratory
Brooks Air Force Base
San Antonio, Texas
United States

Tokuo Ogawa, MD, PhD
Professor Emeritus
Aichi Medical University
Nagakute
Japan

Kristina Orth-Gomér, MD, PhD
Professor of Psychology
Department of Public Health Sciences
Karolinska Institute
Stockholm
Sweden

Suzanne C. Ouellette, PhD
Professor of Environmental Ergonomics
Department of Environmental Health Sciences
Loughborough University
Leicester
United Kingdom

Jonathan A. Patz, MD, MPH
Assistant Scientist, Director
Department of Environmental Health Sciences
Program on Health Effects of Global Environmental Change
Johns Hopkins School of Hygiene and Public Health
Baltimore, Maryland
United States

Dan Petersen, Ed D
Professor
Arizona State University
President
DPA Consulting Inc.
Tempe, Arizona
United States

Hans-Ulrich Pfeffer, Dr
Head of Department
Environmental Monitoring
Landesumweltamt Nordrhein-Westfalen
Essen
Germany

Chaya S. Piotrkowski, PhD
Professor
Graduate School of Social Service
Fordham University
New York, New York
United States

Thomas W. Planeck, PhD, CSP
Director
Research and Statistical Services
National Safety Council
Itasca, Illinois
United States

Gustav Pointingl, Dipl-Ing
Leiter des Verkehrs-Arbeitsinspectates
Bundesministerium für öffentliche Wirtschaft und Verkehr
Vienna
Austria

Tessa M. Pollard, D Phil
Lecturer in Biological Anthropology
Department of Anthropology
University of Durham
Durham
United Kingdom

Charles T. Pope
Area Director
Norfolk Area Office
Occupational Safety and Health Administration
US Department of Labor
Norfolk, Virginia
United States

Sydney W. Porter Jr., BS
Adjunct Professor
Graduate Institute of Environmental Studies
Drexel University
Ardmore, Pennsylvania
United States

Herbert C. Preul, PhD
Professor Emeritus
Department of Civil and Environmental Engineering
University of Cincinnati
Cincinnati, Ohio
United States

James Campbell Quick, PhD
Professor of Organizational Behavior
University of Texas
Arlington, Texas
United States

Fernando Ramos Pérez, Ind Eng
Management Engineer, Risk Prevention Specialist
Labour Accident Prevention Service
Valencia
Spain

A. Raouf, PhD
Rector
GIK Institute
Topi, Swabi
Pakistan

John T. Reeves, MD
Professor Emeritus
Department of Medicine and Pediatrics
University of Colorado Health Sciences Center
Denver, Colorado
United States

Dietmar A. Reinert, Dr rer nat
Head of Section
Berufsgenossenschaftliches Institut für Arbeitssicherheit
Hauptverband der gewerblichen Berufsgenossenschaften
Sankt Augustin
Germany

Michael H. Repacholi, PhD, MSc
Responsible Officer
Radiation Protection and Global Hazards Assessment
World Health Organization
Geneva
Switzerland

Toni Retsch, Dipl-Ing, ETH
Bereichsleiter-ALM2
Swiss National Accident Insurance Organization
Luzern
Switzerland

Paule Rey, MD, MPH
Professor Emeritus
Faculty of Medicine
University of Geneva
Geneva
Switzerland

J. Rieux, PhD*
Chaire de parasitologie
Faculté de médecine de Montpellier
Montpellier
France

* Contributor to the 3rd edition of this Encyclopedia. This biographical information has not been updated.
David H. Sliney, PhD
Commander
Laser Hazards Branch
USA-CHPPM
Aberdeen Proving Ground, Maryland
United States

Gordon S. Smith, MB, MPH
Associate Professor
Johns Hopkins University School of Public Health
Baltimore, Maryland
United States

Ian R. Smith, MSc
LAMP Coordinator
Program Development
Ontario Ministry of Environment and Energy
Toronto, Ontario
Canada

Michael J. Smith, PhD
Professor
Department of Industrial Engineering
University of Wisconsin
Madison, Wisconsin
United States

Mike Smith, PhD
Manchester School of Management
Institute of Science and Technology
University of Manchester
Manchester
United Kingdom

N. A. Smith, PhD
Lighting Consultant
Doncaster
United Kingdom

Colin L. Soskolne, PhD
Professor, Director of Graduate Training
Department of Public Health Services
University of Alberta
Edmonton, Alberta
Canada

Jerry Spiegel, MA, MSc
Director
Pollution Prevention
Manitoba Environment
Winnipeg, Manitoba
Canada

Bengt Springfeldt, PhD
Department for Social Medicine and International Health
Karolinska Institute
Stockholm
Sweden

Jeanne M. Stellman, PhD
Editor-in-Chief
Encyclopaedia of Occupational Health and Safety
International Labour Office
Geneva
Switzerland

Terje Sten, Cand
Senior Researcher
Division of Safety and Reliability
Foundation for Scientific and Industrial Research
Trondheim
Norway

Andrew Steptoe, DPhil, DSc
Professor of Psychology
St. George’s Hospital Medical School
University of London
London
United Kingdom

Tom F.M. Stewart, BSc
Managing Director
System Concepts Ltd.
London
United Kingdom

Daniel Stokols, PhD
Professor, Dean
School of Social Ecology
University of California-Irvine
Irvine, California
United States

Jerry Suls, PhD
Professor
Department of Psychology
University of Iowa
Iowa City, Iowa
United States

Alice H. Suter, PhD
Principal Consultant
Industrial Audiology and Community Noise
Alice Suter and Associates
Ashland, Oregon
United States

German A. Suvorov, Dr
Professor of Medicine, Deputy Director
RAMS Institute of Occupational Health
Moscow
Russian Federation

Naomi G. Swanson, PhD
Chief
Motivation and Stress Research Section
National Institute for Occupational Safety and Health
Cincinnati, Ohio
United States

Gary M. Taylor
Taylor-Wagner Inc.
Willowdale, Ontario
Canada

Benedetto Terracini, MD
Former Head
Unit of Cancer Epidemiology
University Hospital and University of Turin
Turin
Italy

Lois E. Tetrick, PhD
Professor
Department of Psychology
University of Houston
Houston, Texas
United States

Töres Theorell, MD, PhD
Professor, Director
National Institute for Psychosocial Factors and Health
Stockholm
Sweden

Dennis Tolsma, MPh
Director, Prevention and Practice Analysis
Kaiser Permanente Medical Care Program
Atlanta, Georgia
United States

Rüdiger M. Trimpop, PhD
Professor
Department of Industrial and Organizational Psychology
University of Yena
Yena
Germany

René Troxler, Dipl-Ing, HTL/STV
Senior Safety Engineer
Swiss National Accident Insurance Organization
Luzern
Switzerland

Tom Tseng, PhD
Manager
Toxics Prevention Division
Environmental Protection Branch
Environment Canada-Ontario Region
Downsview, Ontario
Canada
Arthur C. Upton, MD  
Clinical Professor  
Environmental and Community Medicine  
UMDNJ-Robert Wood Johnson Medical School  
Piscataway, New Jersey  
United States

Holger Ursin, MD  
Professor  
Department of Biological and Medical Psychology  
University of Bergen  
Bergen  
Norway

Johan Van de Kerckhove, Dr. scie  
Director  
HIVA-VORMING  
Professor  
Katholieke Universiteit Leuven  
Pellenberg  
Belgium

Mark A. Veazie, Dr. PH  
National Institute for Occupational Safety and Health  
Morgantown, West Virginia  
United States

Pierre Verger, MD, MSc, MPH  
Project Manager  
Laboratory of Epidemiology and Health Risk Analysis  
Institute of Nuclear Protection and Safety  
Fontenay-aux-Roses  
France

Amiran D. Vinokur, PhD  
Research Scientist  
Institute for Social Research  
University of Michigan  
Ann Arbor, Michigan  
United States

Jean-Jacques Vogt, MD  
Former Deputy Director General  
Institut National de Recherche et de Sécurité  
Paris  
France

Georg Vondracek, Dipl-Ing  
Department of Industrial Machines and Control Systems  
Swiss National Accident Insurance Organization  
Luzern  
Switzerland

Peter Warr, PhD  
Research Professor  
Institute of Work Psychology  
University of Sheffield  
Sheffield  
United Kingdom

David A. Warrell, DM, DSc  
Professor, Director  
Centre for Tropical Medicine  
University of Oxford  
Oxford  
United Kingdom

Leon J. Warshaw, MD  
Clinical Professor  
Department of Environmental Medicine  
New York University  
New York, New York  
United States

John V. Weil, MD  
Director  
Cardiovascular-Pulmonary Research Laboratory  
University of Colorado Health Sciences Center  
Denver, Colorado  
United States

Edmundo Werna, PhD  
Research Fellow  
South Bank University  
University of Sao Paolo  
Sao Paolo  
Brazil

John B. West, MD, PhD, DSc  
Professor of Medicine and Physiology  
Department of Medicine  
University of California-San Diego  
San Diego, California  
United States

Gunnla Westlander, PhD  
Professor Emeritus  
Department of Psychology  
University of Stockholm  
Stockholm  
Sweden

Marion Wichmann-Fiebig, MSc  
Dezernentin Schutz der Atmosphäre  
Landesumweltamt des Landes Nordrhein-Westfalen  
Essen  
Germany

Gerald J.S. Wilde, PhD  
Professor of Psychology  
Queen's University  
Kingston, Ontario  
Canada

Ann M. Williamson, PhD  
School of Psychology  
University of New South Wales  
Sydney  
Australia

Denis Winter  
Deputy Head  
Accident Studies Division  
Institute for Nuclear Safety and Protection  
Fontenay-aux-Roses  
France

Ernst L. Wynder, MD  
President  
American Health Foundation  
New York, New York  
United States

Annelise Yassi, MD, MSc  
Director  
Occupational and Environmental Medicine  
Health Sciences Centre and Unit  
University of Manitoba  
Winnipeg, Manitoba  
Canada

D. Zannini, PhD  
Institute of Occupational Medicine  
Ospedale San Martino  
Genoa  
Italy

José Luis Zaballos, MD, MPH  
Pan American Health Organization  
Washington, DC  
United States

Bernhard M. Zimolong, PhD  
Professor  
Work and Organizational Psychology  
Ruhr University  
Bochum  
Germany

Thomas Zosel, BS  
Manager  
Environmental Initiatives  
3M Inc.  
St. Paul, Minnesota  
United States

Jozef Zurada, PhD  
Assistant Professor  
Computer Information Systems  
University of Louisville  
Louisville, Kentucky  
United States

---

* Contributor to the 3rd edition of this Encyclopaedia. This biographical information has not been updated.
ENCYCLOPAEDIA OF OCCUPATIONAL HEALTH AND SAFETY
4TH EDITION

Editor-in-Chief
Jeanne Mager Stellman, PhD

Senior Associate Editor
Michael McCann, PhD, CIH

Associate Editors
Leon Warshaw, MD  Carole Brabant, PhD

Senior Editors
John Finklea, MD, Dr PH  Jacqueline Messite, MD
Georges H. Coppée, MD  Steven L. Sauter, PhD
Vilma R. Hunt, BDS, AM  Jerry Spiegel, MA, MSc
Richard S. Kraus, PE, CSP  Colin L. Soskolne, PhD
Wolfgang Laurig, Dr-Ing  Benedetto Terracini, MD
Melvin L. Myers, BS, MPA

Managing Editor
Chantal Dufresne, BA

INTERNATIONAL LABOUR OFFICE
GENEVA
Stellman, Jeanne Mager (ed.)
Geneva, International Labour Office, 1996. 4 V.


ILO Cataloguing in Publication Data

The designations employed in ILO publications, which are in conformity with United Nations practice, and the presentation of material therein do not imply the expression of any opinion whatsoever on the part of the International Labour Office concerning the legal status of any country, area or territory or of its authorities, or concerning the delimitation of its frontiers. The responsibility for opinions expressed in signed articles, studies and other contributions rests solely with their authors, and publication does not constitute an endorsement by the International Labour Office of the opinions expressed in them.

The reader accepts that the parties make this documentation available without warranty of any kind. The parties do not accept responsibility for the validity or completeness of any data including inaccuracies, errors or omissions or for any consequences arising from the use of such data. Neither the authors, nor the ILO or collaborating institutions shall be liable for damages or other claims and demands arising out of the use of the data.

Reference to names of firms and commercial products and processes does not imply their endorsement by the International Labour Office or any collaborating institution, and any failure to mention a particular firm, commercial product or process is not a sign of disapproval.

ILO publications can be obtained through major booksellers or ILO local offices in many countries, or direct from ILO Publications, International Labour Office, CH-1211 Geneva 22, Switzerland. Catalogues or lists of new publications are available free of charge from the above address.
Michael Adess, PhD
Chief
Human Factors Division Commandant
(G-WKS-3)
United States Coast Guard Headquarters
Washington, DC
United States

M. Agamennone, Dr Ing*
Istituto Guido Domeneg
Centro Ricerche Novara
Novara
Italy

Leen Akkers
Managing Director
Stichting Arbouw
Amsterdam
The Netherlands

R.G. Aldi, MASc, BSc, P Eng
Director
Quality and Environmental Affairs
Hiram Walker and Sons, Ltd.
Windsor, Ontario
Canada

Priscilla Alexander, BA
Coordinator
North American Task Force on Prostitution
New York, New York
United States

Sydney Allison, PhD
Communications Division
Mintek
Randburg
South Africa

Judith Anderson, MSc
Research Associate
Department of Environmental-Occupational Health
George Washington University
Washington, DC
United States

W. Stanley Anthony, MSc
Supervisory Agricultural Engineer
United States Cotton Ginning Laboratory
Agricultural Research Service
United States Department of Agriculture
Stoneville, Mississippi
United States

Elias Apud, PhD, MSc
Professor
Department of Physiopathology
University of Concepción
Concepción
Chile

M.P. Arias, PhD, MSc
Head
Environmental Safety and Health Department
Hospital Clinic Universitari
Barcelona
Spain

James R. Armstrong, CIH
Technical Services Coordinator
Ontario Natural Resources Safety Association
North Bay, Ontario
Canada

Ragnar Arnason, PhD
Professor
Department of Economics
University of Iceland
Reykjavik
Iceland

Tony Ashdown, CPS, MS, CSP
Loss Prevention Manager
Alpharma USPD, Inc.
Baltimore, Maryland
United States

George Astrakianakis, B Eng, M Eng
Research Scientist
Cancer Control Research
British Columbia Cancer Agency
Vancouver, British Columbia
Canada

Jörg Augusta, Dr med
Arbeitsgruppenleiter
Arbeitsgruppe Ergonomie und Waldarbeit
Landesanstalt für Wald und Forstwirtschaft
Gotha
Germany

William Avery, AS
President
Systems Safety Management USA, Inc.
Orlando, Florida
United States

Page Ayres, MS
Senior Environmental Engineer
Newport News Shipbuilding
Newport News, Virginia
United States

Angela Babine, MS
Associate Director
Center for Safety in the Arts
New York, New York
United States

G. Bachofen*
Chief of Branch
Division Information
Swiss National Accident Insurance Organization
Luzern
Switzerland

Dean B. Baker, MD, MPH
Professor, Director
Center for Occupational and Environmental Health
University of California-Irvine
Irvine, California
United States

David E. Baker, CSP
Assistant Program Director
Agriculture, Food and Natural Resources
University of Missouri-Columbia
Columbia, Missouri
United States

David G. Baldwin, CIH
Corporate Industrial Hygiene Manager
Hewlett-Packard Company
Palo Alto, California
United States

Gail Coningsby Barazani, MPH
Former Environmental Health Consultant
Chicago, Illinois
United States

Hjálmar R. Bárðarson, MSc
State Director of Shipping
Gardabaer
Iceland

Donald Barnard, PhD
Supervisory Research Entomologist
Agricultural Research Service
United States Department of Agriculture
Gainesville, Florida
United States

Lynn Barroby
Breeder and Trainer of Thoroughbred Racehorses
Langley, British Columbia
Canada

Subhash K. Batra, PhD
Director
Nonwovens Cooperative Research Center
College of Textiles
North Carolina State University
Raleigh, North Carolina
United States

* Contributor to the 3rd edition of this *Encyclopaedia*. This biographical information has not been updated.
Giuseppe Battista, MD  
Professor of Preventive Workers’ Medicine  
Cattedra di Medicina Preventiva dei Lavoratori  
University of Siena  
Siena  
Italy

J.M. Baztarrica*  
Facultad de Servicio Social de Higiene  
Industrial y Medicina  
Buenos Aires  
Argentina

Thomas L. Bean, PhD  
Safety Leader, Professor  
Department of Food, Agricultural and Biological Engineering  
Ohio State University  
Columbus, Ohio  
United States

Luc Beauchamp  
ONRSA  
North Bay, Ontario  
Canada

Bernardo Bedrikow, MD, MPH  
Former Chief  
Occupational Safety and Health  
Serviço Social da Indústria  
São Paulo  
Brazil

Louis S. Beliczky, MS, MPH  
Consulting Industrial Hygienist  
Technical Advisors and Consultants to Trade Unions  
Wickliffe, Ohio  
United States

David M. Bell, MD  
Assistant to the Director  
National Center for Infectious Diseases  
Centers for Disease Control and Prevention  
Atlanta, Georgia  
United States

Joel Bender, MD, PhD  
Vice President, Chief Medical Officer  
Health Sciences  
Owens-Corning  
Toledo, Ohio  
United States

Deborah E. Berkowitz, BA  
Director  
Office of Safety and Health  
United Food and Commercial Workers, AFL-CIO  
Washington, DC  
United States

A.S. Bettenson, MA*  
Former Deputy Chief Inspector of Factories  
Cambridge  
United Kingdom

J.R. Bevan, Dr*  
Manager  
Coated Products Research  
British Steel Corporation, South Wales  
Group  
London  
United Kingdom

William Blackburn, MS  
Senior Research Associate  
College of Textiles  
North Carolina State University  
Raleigh, North Carolina  
United States

H.L. Boiteau  
Service d’Anesthésiologie  
Faculté de Médecine  
Nantes  
France

Denis Bourcier, PhD  
Senior Principle Scientist  
Environmental Affairs  
Boeing Defence and Space Group  
The Boeing Company  
Seattle, Washington  
United States

Madeleine Bourdouxhe, MSc  
Researcher  
Work Organization Programme  
Institute for Occupational Health and Safety Research  
Montreal, Quebec  
Canada

Carole Brabant, PhD  
Associate Editor  
Encyclopedia of Occupational Health and Safety  
International Labour Office  
Geneva  
Switzerland

P.E. Braid, PhD*  
Consultant  
Laboratory Services  
Occupational Health Unit  
Medical Services Branch  
Health and Welfare Canada  
Ottawa, Ontario  
Canada

Douglas F. Briggs, MPH, CIH  
Group Manager  
Safety and Health  
Boeing Commercial Airplane Group  
The Boeing Company  
Seattle, Washington  
United States

Jere A. Brittain, PhD  
Clemson University  
Clemson, South Carolina  
United States

T.J. Britton*  
Her Majesty’s Inspector of Factories  
Plastics National Industry Group  
Health and Safety Executive  
Northampton  
United Kingdom

Mary O. Brophy, PhD, CIH, CPE  
Former Environmental Toxicologist  
Syracuse Research Corporation  
North Syracuse, New York  
United States

Jeremy Brown, MD, CM, FRCPC, FACP  
Chief  
Occupational Health Section  
Health Services Directorate  
Royal Canadian Mounted Police  
Ottawa, Ontario  
Canada

Mary E. Brown, DVM, MPH  
Morsehead School of Medicine-Senior Research Fellow  
National Institute for Occupational Safety and Health  
Centers for Disease Control and Prevention  
Cincinnati, Ohio  
United States

Peter J. Bruno, MD, BS  
Associate Professor of Medicine  
New York University  
Senior Consultant  
Insall Scott Kelly Institute for Orthopedics  
New York, New York  
United States

Norman Brusk, JD, CIH, CSP  
Health and Safety Manager  
Health, Safety and Environment Resource Partner, Inc.  
Columbus, Ohio  
United States

* Contributor to the 3rd edition of this Encyclopedia. This biographical information has not been updated.
LaMont Byrd, MS
Director of Safety and Health
International Brotherhood of Teamsters
Washington, DC
United States

Roxanne Cabral, MPH
American Federation of State, County and
Municipal Employees
Washington, DC
United States

L.T. Cabrera, Ing Dipl*
Former Official
International Labour Office
Lima
Peru

Buck Cameron, CIH
Director
Health Effects
Carpenters Health and Safety Fund
Seattle, Washington
United States

Giovanni Capelli, MD
Assistant Professor
Istituto di Igiene
Università Cattolica Del Sacro Cuore
Rome
Italy

The Carpet and Rug Institute
Melbourne, Victoria
Australia

Melvin E. Cassidy, MS, CIH
Cassady Safety and Health Services
Southampton, Pennsylvania
United States

Cesare Catanante, MD
Medical Director
Policlinico “A. Gemelli” - Istituto di Igiene
Università Cattolica del Sacro Cuore
Rome
Italy

J.A. Catton*
Manager
Safety, Health and Welfare
British Steel Corporation
London
United Kingdom

Larry J. Chapman, PhD
Associate Scientist
College of Agricultural and Life Sciences
University of Wisconsin-Madison
Madison, Wisconsin
United States

Tsun-Jen Cheng, BM, ScD
Associate Professor
Institute of Occupational Medicine and
Industrial Hygiene
National Taiwan University
College of Public Health
Taipei
Taiwan, China

V.I. Chernyuk, MD, ScD
Professor, Scientific Director
Institute for Occupational Health
Kiev
Ukraine

Corky Chew, MPH, MBA
Program Manager
Environmental Technologies and
Strategies
Apple Computer, Inc.
Cupertino, California
United States

The Chlorine Institute, Inc.
Washington, DC
United States

John P. Chong, MD, FRCPC
Medical Director
Centre for Human Performance and
Health Promotion
Hamilton, Ontario
Canada

Nancy Clark, MA, CIH, CSP
Director
Center for Occupational and
Environmental Medicine
Mount Sinai School of Medicine
New York, New York
United States

Esther Cloutier, PhD
Researcher
Programme Organisation du Travail
Institute for Occupational Health and
Safety Research
Montreal, Quebec
Canada

Lenora Colbert
Vice-President
National Health and Human Services
Employees Union
New York, New York
United States

James J. Collins, CSP, CIH
General Mills
Minneapolis, Minnesota
United States

Zaida Colon, BS
Safety and Environmental Specialist
Concentrate Manufacturing Operations
PepsiCo PR, Inc.
Cidra
Puerto Rico

James Cone, MD
Assistant Clinical Professor
University of California-Berkeley
Berkeley, California
United States

F.L. Conradi*
Subdirector General
Medicina Laboral
Instituto Nacional de la Salud
Madrid
Spain

George A. Conway, MD, MPH
Chief
Alaska Activity Division of Safety Research
National Institute for Occupational Safety
and Health
Anchorage, Alaska
United States

Georges H. Coppée, MD
Chief of Medical Section
Occupational Safety and Health Branch
International Labour Office
Geneva
Switzerland

Michael Crane, MD, MPH
Assistant Vice-President
Occupational Health
Con Edison
Brooklyn, New York
United States

Charles Crocker
Safety Manager
Burlington Industries, Inc.
Greensboro, North Carolina
United States

Neil Dalhouse
General Manager
Health and Safety Education Program
Tourism and Hospitality Industry
Toronto, Ontario
Canada

Gianfranco Damiani, MD
Assistant Professor
Istituto di Igiene
Università Cattolica del Sacro Cuore
Rome
Italy

*Contributor to the 3rd edition of this Encyclopaedia. This biographical information has not been updated.
Hugh Davies, MSc
Occupational Hygienist
Occupational Hygiene Programme
University of British Columbia
Vancouver, British Columbia
Canada

L. DeBoer, Dr
Chief Medical Adviser
Shell International Petroleum
The Hague
Netherlands

Paul Demers, PhD
Assistant Professor
Occupational Hygiene Program
University of British Columbia
Vancouver, British Columbia
Canada

Louis DiBerardinis, MS
Associate Director
Environmental Medical Services
Massachusetts Institute of Technology
Cambridge, Massachusetts
United States

Bertram D. Dinman, MD, ScD
Clinical Professor of Occupational Medicine
Graduate School of Public Health
University of Pittsburgh
Pittsburgh, Pennsylvania
United States

Basil Dolphin, MD, MPH
Medical Director
Healthworks
Bethlehem, Pennsylvania
United States

Kelley Donham, DVM
Department of Preventive Medicine and
Environmental Health
Institute for Rural and Environmental Health
College of Medicine
University of Iowa
Iowa City, Iowa
United States

Kyle B. Dotson, CHI, CSP, PE
Group Vice-President, Safety and Health
BHP Copper
San Francisco, California
United States

Aluaro Durao, MD, OPHT
Chief
Occupational Health Department
Siderurgia Nacional
Lisbon
Portugal

Dennis Dykstra, PhD
Deputy Director General for Research
Centre for International Forestry Research
Jakarta
Indonesia

Gary S. Earnest, MS, PE, CSP
Engineer Officer
Engineering Control Technology Branch
Division of Physical Sciences and Engineering
National Institute for Occupational Safety and Health
Cincinnati, Ohio
United States

Alan Echt, MPH
Industrial Hygienist
Engineering Control Technology Branch
Division of Physical Sciences and Engineering
National Institute for Occupational Safety and Health
Cincinnati, Ohio
United States

Olli Eronenheim, MSc
Research Scientist
Finnish Forest Research Institute
Vanta
Finland

M.M. El-Attal, Dr, MB, ChB, DIH
Head
Occupational Health Department
Ministry of Health
Manama
Bahrain

M.A. El Kadeem, Prof
Head
Production Engineering Department
Faculty of Engineering
Alexandria University
Alexandria
Egypt

Carl G. Elinder, MD, PhD
Associate Professor
Department of Renal Medicine
Huddinge Hospital and Karolinska Institute
Karolinska
Sweden

Daniel R. English, PhD
Unit Director
Environmental Sciences Section
Eastman Kodak Company
Rochester, New York
United States

Claes-W. Englund, BLL
Director, Legal Advisor
Association of Swedish Theatres and Orchestras
Teatrarna Riksförening
Stockholm
Sweden

Madeleine R. Estryn-Béhar, MD, PhD
Occupational Health Practitioner
Hôpital Saint-Louis
Paris
France

J.F. Eastace, MB, DPH
Dean of Faculty
Occupational Medicine
Royal College of Physicians of Ireland
Dublin
Ireland

E. Evrard, Dr
Organisation européenne pour la sécurité de la navigation aérienne
Brussels
Belgium

Lynda Ewers, PhD, CHMM
Industrial Hygiene Studies Branch
Division of Surveillance, Hazard Evaluations and Field Studies
National Institute for Occupational Safety and Health
Cincinnati, Ohio
United States

Michael J. Fagel, PhD
Corporate Safety Director
Aurora Packaging Co., Inc.
North Aurora, Illinois
United States

John Fajen, MS
Director of Industrial Hygiene and Ergonomics
AIG Consultants, Inc.
Cincinnati, Ohio
United States

M. Joseph Fedoruk, MD
Medical Director
Center for Occupational and Environmental Health
University of California-Irvine
Irvine, California
United States

John B. Feldman, PE, CHI, CSP, MS
Corporate Occupational Safety and Health
Raytheon Company
Lexington, Massachusetts
United States
L.V.R. Fernando, MBBS, DPH, DHI*  
Advisor on Labour and Population  
International Labour Office  
New Delhi  
India

William E. Field, EdD  
Professor  
Agricultural and Biological Engineering  
Purdue University  
West Lafayette, Indiana  
United States

John Finklea, MD, Dr PH  
Medical Officer  
Center to Protect Workers’ Rights  
Former Director  
National Institute for Occupational Safety and Health  
Washington, DC  
United States

Manfred Fischer, Dr-ing  
Director of Technical Inspectorate  
Verwaltungs-Berufsgenossenschaft  
Hamburg  
Germany

N. Fish, MA*  
Her Majesty’s District Inspector of Factories  
Department of Employment and Productivity  
Watford  
United Kingdom

Stewart Forbes, BSc  
Executive Director  
Canadian Centre for Pollution Prevention  
Sarnia, Ontario  
Canada

Janet Fox, MA  
Director  
Safety and Industrial Hygiene  
Con Edison  
Brooklyn, New York  
United States

David Franson, CSP, ARM  
Occupational Health and Safety Consultant  
Safety Management Services Company  
Dubuque, Iowa  
United States

James S. Frederick  
Industrial Hygienist  
Health, Safety and Environment Department  
United Steelworkers of America  
Pittsburgh, Pennsylvania  
United States

Barry R. Friedlander, MD, MPH  
Senior Environmental Health Adviser  
Exxon Biomedical Sciences, Inc.  
East Millstone, New Jersey  
United States

I.D. Gadaskina*  
Doktor biologickich nauk  
Rukovoditel’ toksikologicheskoy laboratorii  
Leningradskogo Institut gigieny truda i profilabolevaniy  
Leningrad  
Former USSR

Nancy Garcia, MPH  
Airline Division  
International Brotherhood of Teamsters  
Fremont, California  
United States

H. Gartmann, Dr  
Medical Director  
Medical Services  
Swissair  
Zurich  
Switzerland

Joel C. Gaydos, MD  
Director  
Clinical Preventive Medicine  
United States Army Center for Health Promotion and Preventive Medicine  
Army Proving Ground, Maryland  
United States

E. Gelpi*  
Education Permanente  
Division des structures, contenus et méthodes  
United Nations Educational, Scientific and Cultural Organization  
Paris  
France

Afsaneh Gerami, BS  
Environmental Health and Safety Consultant  
Hewlett-Packard Company  
San Jose, California  
United States

Gary A. Gibson, MBA  
Chief Executive Officer  
Mines Rescue Board  
Sydney  
Australia

Gary Gibson, BSc  
Occupational Health and Safety Officer  
Durham Board of Education  
Whitby, Ontario  
Canada

Denis Giguère, MSc, DESS  
Ergonomist  
Safety-Ergonomics Research Program  
Institute for Occupational Health and Safety Research  
Montreal, Quebec  
Canada

David Gold, MOEd  
Occupational Safety and Health Officer  
Occupational Safety and Health Branch  
International Labour Office  
Geneva  
Switzerland

J.C. Graham, MFCM, MFOM, DIH*  
Chief Medical Officer  
H.J. Heinz Company, Ltd.  
London  
United Kingdom

Casey C. Grant, PE  
Assistant Vice-President  
Codes and Standards Administration  
National Fire Protection Association  
International  
Quincy, Massachusetts  
United States

Alfons Größhrink, Dipl-ing  
Leiter des Technischen Aufsichtsdienstes  
Bahnen-Berufsgenossenschaft  
Hamburg  
Germany

Xavier Guardino Solá, PhD  
Chief of Department  
National Centre for Working Conditions  
National Institute for Occupational Safety and Hygiene  
Barcelona  
Spain

Tee L. Guidotti, MD, MPH  
Professor, Director  
Occupational Health Program Faculty of Medicine  
University of Alberta  
Edmonton, Alberta  
Canada

Paul D. Gunderson, PhD  
Assistant Dean, National Farm Medicine Center  
Marshallfield, Wisconsin  
United States

J.C. Gunther, Jr.*  
Safety and Training Engineer  
Imperial Highway Authority  
Addis Ababa  
Ethiopia

* Contributor to the 3rd edition of this Encyclopaedia. This biographical information has not been updated.
John G. Hadley, PhD
Corporate Toxicologist
Health Sciences
Owens-Corning
Granville, Ohio
United States

Hans Hamrin, MSc
Senior Advisor
Mining
Atlas Copco Rock Drills AB
Stockholm
Sweden

Jonathan T. Haney, MS
Manlius, New York
United States

David L. Hard, PhD
Research Safety Engineer
Division of Safety Research
National Institute for Occupational Safety and Health
Morgantown, West Virginia
United States

Francis Hardy, P Eng
Project Coordinator
Construction Safety Association of Ontario
South Etobicoke, Ontario
Canada

D.A. Hargrave*
Her Majesty's District Inspector of Factories
Hamilton
United Kingdom

Susan Harman, MLS, MEd
Associate Librarian
Medical and Chirurgical Faculty of Maryland
Baltimore, Maryland
United States

Robert Harris, PhD CIH
Professor Emeritus
University of North Carolina at Chapel Hill
Chapel Hill, North Carolina
United States

Thomas E. Hawkinson, MS, CIH, ROH, CSP
Safety and Environmental Engineering Manager
General Mills
Minneapolis, Minnesota
United States

Dick Heederik, PhD, MSc
Associate Professor of Occupational Epidemiology
University of Wageningen
Wageningen
The Netherlands

Rudolf Heinrich, PhD
Chief
Forest Harvesting, Trade and Marketing Branch
Food and Agriculture Organization of the United Nations
Rome
Italy

Jonathan P. Hellerstein, MS, CIH, CSP
Leader
Occupational Health and Safety
Owens-Corning
Toledo, Ohio
United States

Samuel H. Henao
Principal Technical Assessor
National Manager of Occupational Health
Institute of Social Security
Bogotá
Colombia

Robin Herbert, MD
Medical Co-Director
Mount Sinai Center for Environmental and Occupational Medicine
New York, New York
United States

Fred W. Hermann, MSc, BSc, BA
Chief Inspector of Mines
Ministry of Employment and Investment Victoria, British Columbia
Canada

Thomas A. Hethmon, MS, CIH, ROH
Director
Occupational Health and Safety
Pepsi-Canada
Toronto, Ontario
Canada

Jeffrey Hinksman, BA Law
Health and Safety Consultant
Epsom, Surrey
United Kingdom

Matthew Hirshheimer, BS
National Safety Manager
Pepsi-Cola Company
Somers, New York
United States

Robert W. Hites, BS, AAS
Corporate Safety Analyst
Delta Airlines
Atlanta, Georgia
United States

Friedrich Hofmann, PhD, MD
Professor of Occupational Medicine
University of Wuppertal
Wuppertal
Germany

Charles M. Holman, BSME, MBA
Technical Consultant
East Ohio Machinery Company
Newark, Ohio
United States

Wendy Hord
Occupational Safety and Health Specialist
Civil Service Employees Association
Latham, New York
United States

Nina Howard, MS
Ergonomist
SHARP
Department of Labor and Industries
Olympia, Washington
United States

M. J. Howes, PhD
Partner
RHP Consultants
Cambridge, New York
United Kingdom

Gordon Hucie, MD
Insall Scott Kelly Institute
New York, New York
United States

Vilma Hunt, BDS, AM
Adjunct Professor
Department of Work Environment
University of Massachusetts-Lowell
Lowell, Massachusetts
United States

David L. Huntzinger, PhD, MSci
Vice-President
Corporate Safety
American Airlines
Phoenix, Arizona
United States

Marit Husmo, MSc
Research Fellow
Norwegian College of Fishery Science
University of Tromsø
Tromsø
Norway

William E. Irwin, MS, MBA
Health Physics Consultant, Radiation Safety Officer
Massachusetts Institute of Technology
Cambridge, Massachusetts
United States

* Contributor to the 3rd edition of this Encyclopaedia. This biographical information has not been updated.
A. Lee Ivester, MSPH
Director
Corporate Safety and Workers’ Compensation
Fieldcrest Cannon, Inc.
Kanopolis, North Carolina
United States

Anthony W. Jackson, PhD
Senior Health and Safety Advisor
Fossil Business Unit
Ontario Hydro-Fossil
Toronto, Ontario
Canada

Lars Järup, MD, PhD
Environmental Physician
Department of Environmental Health
Sundbyberg
Sweden

Norman S. Jennings, BSc
Senior Industrial Specialist
Sectoral Activities Department
International Labour Office
Geneva
Switzerland

G. Jensen*
Assistant Director
Danish Labour Inspection Service
Copenhagen
Denmark

Barry L. Johnson, PhD
Assistant Surgeon General, Assistant Administrator
Agency for Toxic Substances and Disease Registry
Atlanta, Georgia
United States

Steven Johnson, PhD
Specialist
Cooperative Extension
University of Maine
Presque Isle, Maine
Canada

Alan D. Jones,
Fire Services Advisor
Alberta Fire Training School
Alberta Labour
Vermillion, Alberta
Canada

J.G. Jones, Dr*
Group Medical Officer
British Steel Corporation, South Wales Group
London
United Kingdom

D.D. Joshi, DVM, MPVM
Director
National Zoonoses and Food Hygiene Research Center
Katmandu
Nepal

Marja-Liisa Juntunen, MSc
Research Scientist
Suonenjoki Research Station
Finnish Forest Research Institute
Suonenjoki
Finland

Mike Juvélieus, BSc
Senior Consultant
ENSO Forest Development
Imatra
Finland

Yu S. Kagan, MD, PhD
Head of Department of General Toxicology
National Institute of Health
Kiev
Ukraine

Juhani Kangas, PhD, Professor
Director of the Regional Institute
Finnish Institute of Occupational Health
Kuopio
Finland

Valery P. Kaptsov
Director
Russian Institute of Railway Transport Hygiene
Moscow
Russian Federation

Thomas Karsky, MS
Extension Safety Specialist
Department of Biological and Agricultural Engineering
University of Idaho
Moscow, Idaho
United States

Timo Kauppinen, PhD
Head of Register Unit
Finnish Institute of Occupational Health
Helsinki
Finland

Anya Keefe, MSc
Research Associate
Occupational Hygiene Program
University of British Columbia
Vancouver, British Columbia
Canada

Anat Keidar, PhD, CCC-SLP
Voice Laboratory Director
Vox Humana Voice Laboratory,
Head and Neck Surgical Group
New York Center for Voice and Swallowing Disorders
New York, New York
United States

Barry P. Kelley, PhD
Occupational Hygienist
Chloride Industrial Batteries, Ltd.
Manchester
United Kingdom

Susan Kennedy, PhD
Associate Professor, Director
Occupational Hygiene Programme
University of British Columbia
Vancouver, British Columbia
Canada

Robert W. Kilpper, PhD
Senior Toxologist
Xerox Corporation
Webster, New York
United States

W. Klost, Dipl-Ing*
Chief Engineer
Arbeitssicherheit Siemens AG
Berlin
Germany

L.W. Knapp, Jr.*
Department of Preventive Medicine and Environmental Health
Institute of Agricultural Medicine
University of Iowa
Iowa City, Iowa
United States

Stephanie Knopp, MFA
Associate Professor of Graphic Design
Tyler School of Art
Philadelphia, Pennsylvania
United States

Y.C. Ko, MD*
Institute of Public Health
College of Medicine
National Taiwan University
Taipei
Taiwan, China

Eero Korhonen, MSc
Senior Researcher
Institute of Occupational Health
Vantaa
Finland

* Contributor to the 3rd edition of this Encyclopaedia. This biographical information has not been updated.
Ludmila P. Korotich  
*Leading Scientific Researcher*  
Department of Hygienic Research  
RAMS Institute of Occupational Health  
Moscow  
Russian Federation

Richard S. Kraus, PE, CSP  
*Principal*  
Petroleum Safety Consultants  
Annandale, Virginia  
United States

J. Kroeger, Dipl-Chem*  
Mutual Accident Insurance Association of  
the Chemical Industry  
Heidelberg  
Germany

J. Kubota, MD  
*Director*  
Occupational Health Service Center  
Tokyo  
Japan

Yuri Kundiev, MD, Dr med sci  
*Director*  
Institute for Occupational Health  
Kiev  
Ukraine

Lucie Laflamme, PhD  
*Senior Researcher*  
Department of Public Health Sciences  
Karolinska Institute  
Sundbyberg  
Sweden

Paul A. Landsbergis, EdD, MPH  
*Assistant Professor of Epidemiology*  
Division of Hypertension  
Cornell University Medical College  
New York, New York  
United States

Sverre Langård  
Centre of Occupational and  
Environmental Medicine  
National Hospital  
Oslo  
Norway

Donald V. Lassiter, PhD, MSPH  
*Consultant*  
Environmental and Occupational Health  
San Jose, California  
United States

Wolfgang Laurig, Dr-Ing  
*Professor, Director*  
Department of Ergonomics  
Institut für Arbeitsphysiologie  
University of Dortmund  
Dortmund  
Germany

P.K. Law*  
*Group Manager*  
British Plastics Federation  
London  
United Kingdom

Pam Tau Lee  
Labor Occupational Health Program  
University of California-Berkeley  
Berkeley, California  
United States

Susan B. Lee, MBA, CIH  
*Manager*  
Environmental Health and Safety  
Biogen, Inc.  
Cambridge, Massachusetts  
United States

David LeGrande, MA  
*Director*  
Occupational Safety and Health  
Communications Workers of America  
Washington, DC  
United States

Carol J. Lehtola, PhD  
*Assistant Professor*  
Institute of Food and Agricultural Science  
Department of Agricultural and Biological Engineering  
University of Florida  
Gainesville, Florida  
United States

Steven W. Lenhart, CIH  
*Industrial Hygienist*  
Division of Surveillance, Hazard  
Evaluations and Field Studies  
National Institute for Occupational Safety  
and Health  
Cincinnati, Ohio  
United States

Yung Hian Leow, MD  
Section of Industrial Dermatology  
Cleveland Clinic Foundation  
Cleveland, Ohio  
United States

Charles Levenstein, PhD, MS  
*Professor of Work Environment Policy*  
Work Environment Department  
University of Massachusetts-Lowell  
Lowell, Massachusetts  
United States

Robert M. Lewy, MD, MPH  
*Director for Medical Affairs*  
Columbia Presbyterian Medical Center  
New York, New York  
United States

Norbert Lichtenstein, PhD  
Berufsgerichtschaftliches Institut für  
Arbeitssicherheit  
Sankt Augustin  
Germany

Hans Göran Linder, PhD  
National Board of Occupational Safety  
and Health  
Solna  
Sweden

Sydney Lipton, MS  
*Consultant*  
Port Townsend, Washington  
United States

J.W.G. Lund, MD*  
Freshwater Biological Association  
Windermere Laboratory  
Ambleside  
United Kingdom

John Lund, PhD  
*Professor*  
School for Workers  
University of Wisconsin-Extension  
Madison, Wisconsin  
United States

Paul V. Lynch, PE  
Chief, Safety Staff (Retired)  
Bureau of Land Management  
United States Department of the Interior  
Washington, DC  
United States

G.S. Lyndon*  
*Senior Area Director*  
West Midlands Area Office  
Health and Safety Executive  
Birmingham  
United Kingdom

Paul Mackenzie-Wood, BSc  
Manager, Technology  
Coal Mines Technical Services  
Mines Rescue Services  
Corrimal  
Australia

Susan Magor, RN, MSc  
*Director*  
Environment, Health and Safety  
Concordia University  
Montréal, Quebec  
Canada

*Contributor to the 3rd edition of this *Encyclopaedia*. This biographical information has not been updated.*
Andreas Mahr, Dipl.-Ing  
Technischer Aufsichtsbeamter  
Bahnen-Berufsgenossenschaft  
Hamburg  
Germany

Kathryn A. Makos, MPH, CIH  
Senior Industrial Hygienist  
Office of Environmental Management and Safety  
Smithsonian Institution  
Washington, DC  
United States

M. Malagie, Ing*  
Institut national de recherche et de  
securite pour la prevention des accidents  
du travail et des maladies  
professionnelles  
Paris  
France

Bohuslav Mälek  
Hygienic Institute of Prague  
Prague  
Czech Republic

David E. Malter, MS, CIH, CSP, ROH  
Malter Associates, Inc.  
Downer Grove, Illinois  
United States

Adrienne Markowitz, MSc  
Director of Health and Safety  
Retail, Wholesale and Department Store Union  
United Food and Commercial Workers, AFL-CIO  
New York, New York  
United States

William S. Marras, PhD  
Professor, Director  
Biodynamics Laboratory  
Department of Industrial and Systems Engineering  
Columbus, Ohio  
United States

Linda S. Martin, PhD  
Director, HIV Activity  
National Institute for Occupational Safety and Health  
Atlanta, Georgia  
United States

John Masaitis, CIH  
Consultant  
New Smyrna Beach, Florida  
United States

Steve Mason, BS  
Senior Manager, Chemical Technology  
Operations Technology  
Boeing Commercial Airplane Group  
The Boeing Company  
Seattle, Washington  
United States

K.R. Mathisen*  
Mechanical Engineering Division  
Swedish Standard Commission  
Stockholm  
Sweden

Toshio Matsushita, MD, PhD  
Professor  
Faculty of Medicine  
Kagoshima University  
Kagoshima  
Japan

Chester Matthews  
Bath Iron Works  
Brunswick, Maine  
United States

R. Matttussi, Dr*  
Direttore Sanitario  
Montedison  
Milan  
Italy

John May, MD  
Director  
New York Center for Agricultural Medicine and Health  
Mary Imogene Bassett Hospital  
Cooperstown, New York  
United States

Michael McCann, PhD, CIH  
Senior Associate Editor  
Encyclopedia of Occupational Health and Safety  
International Labour Office  
New York, New York  
United States

George J. McDonald  
Director of Safety and Health  
International Transport Workers Union of America  
New York, New York  
United States

Bruce McKay  
Senior Researcher  
SeaWeb  
Montreal, Quebec  
Canada

Shane McMahon, MSc  
Program Manager  
Liro Limited  
Rotorua  
New Zealand

Neil McManus, MSc, M Eng  
Consulting Industrial Hygienist  
NorthWest Occupational Health and Safety  
North Vancouver, British Columbia  
Canada

Nona McQuay, MS  
Health and Safety Specialist  
New York State Public Employees Federation, AFL-CIO  
Buffalo, New York  
United States

Doug J. McVittie, Dipl Eng  
Manager, Technical Services  
Construction Safety Association of Ontario  
Etobicoke, Ontario  
Canada

Karlheinz Meffert, Dr.-Ing  
Director  
Berufsgenossenschaftliches Institut für Arbeitssicherheit  
Hauptverband der gewerblichen Berufsgenossenschaften  
Sankt Augustin  
Germany

Ronald L. Melnick, PhD  
Toxicologist  
National Institute of Environmental Health Sciences  
Research Triangle Park, North Carolina  
United States

Raji Menon  
Research Officer  
Mining Association of Canada  
Ottawa, Ontario  
Canada

Karen Messing, PhD  
Professor of Biology  
CINBIOSE  
University of Quebec  
Montreal, Quebec  
Canada

Jacqueline Messite, MD  
Clinical Professor  
Department of Environmental Medicine  
New York University College of Medicine  
New York, New York  
United States
Mark M. Methner, PhD  
*Industrial Hygienist*  
Division of Surveillance, Hazard Evaluation and Field Studies  
National Institute for Occupational Safety and Health  
Cincinnati, Ohio  
United States

John D. Meyer, MD, MPH  
*Associate Residency Director*  
Institute of Occupational and Environmental Health  
West Virginia University School of Medicine  
Morgantown, West Virginia  
United States

Jack L. Mickle, PhD  
*Professor Emeritus, Consultant*  
Jack L. Mickle and Associates  
Boone, Iowa  
United States

John Miles, PhD  
Department of Agricultural Engineering  
University of California-Davis  
Davis, California  
United States

Frank Miller, PhD  
*Hazardous Materials Officer*  
Environmental Health and Safety Office  
Columbia University Health Sciences  
New York, New York  
United States

Gordon C. Miller, MSPH  
*Director*  
Health, Safety and Environment  
Rexam, Inc.  
Charlotte, North Carolina  
United States

Bruce A. Millies, JD, MS, CIH  
*Industrial Hygienist*  
International Brotherhood of Teamsters  
Bainbridge Island, Washington  
United States

Franklin E. Mirer, PhD  
*Director*  
Health and Safety Department  
International Union of United Auto Workers  
Detroit, Michigan  
United States

Courtney S. Mitchell, MSc, MA  
*Consultant*  
CSM Consulting  
Golden, Colorado  
United States

William S. Mitchell, MSc  
*Manager, Exploration Administration*  
BHP Minerals International Exploration, Inc.  
Golden, Colorado  
United States

Augustine Moffitt, ScD  
*Vice-President*  
Safety, Health and Environment  
Bethlehem Steel Corporation  
Pennsylvania  
United States

W.G. Morison, BSc, MSc  
*President*  
Morwil Inc.  
Ontario  
Canada

K.M. Morse*  
Industrial Health Engineers, Inc.  
Altamonte Springs, Florida  
United States

Robert J. Mullan, MD  
*Medical Officer*  
Centers for Disease Control and Prevention  
National Institute for Occupational Safety and Health  
Atlanta, Georgia  
United States

Kieran Mulvaney  
*Editor*  
Ocean Update  
SeaWeb  
Washington, DC  
United States

Eva Munk-Madsen, PhD  
*Teacher, Lecturer*  
Norwegian College of Fishery Science  
University of Tromso  
Tromso  
Norway

R.A. Munoz, MSW*  
*Subdirector*  
Technical Programming Department of Education  
Hato Rey  
Puerto Rico

Dennis Murphy, PhD, CSP  
*Professor*  
Department of Agricultural and Biological Engineering  
Pennsylvania State University  
University Park, Pennsylvania  
United States

Daniel Murphy, MB, FFOM, DIH  
*Director*  
Occupational Medical Services  
National Authority for Occupational Safety and Health  
Dublin  
Ireland

Joshua E. Muscat, MPH  
American Health Foundation  
New York, New York  
United States

Melvin L. Myers, BS, MPA  
*Deputy Director*  
Office of Extramural Coordination and Special Projects  
National Institute for Occupational Safety and Health  
Atlanta, Georgia  
United States

Pranab Kumar Nag, PhD, DSc, MSc  
*Deputy Director*  
Indian Council of Medical Research  
National Institute of Occupational Health  
Ahmedabad  
India

John D. Neefus, PhD, CIH  
*Industrial Hygiene Consultant*  
Durham, North Carolina  
United States

Barbara Neis, PhD  
*Associate Professor, Head*  
Department of Sociology  
Memorial University  
St. John’s, Newfoundland  
Canada

Christian E. Newcomer, VMD  
*Director, Research Associate Professor*  
Laboratory Animal Medicine  
University of North Carolina  
Chapel Hill, North Carolina  
United States

A.K. Niyogi, MBDPH, DIH+  
*University Grants Commission Fellow*  
Department of Preventive and Social Medicine  
Institute of Medical Sciences  
Varanasi  
India

Susan Nobel, MSW, CSW  
Mount Sinai-Irving J. Selikoff Center for Occupational and Environmental Medicine  
Mount Sinai Medical Center  
New York, New York  
United States

*Contributor to the 3rd edition of this *Encyclopaedia*. This biographical information has not been updated.
Gunnar Nordberg  
Department of Environmental Medicine  
University of Umeå  
Umeå  
Sweden

Jacqueline Nubé, Dr  
Department of Psychology  
Faculty of Methodology  
University of Amsterdam  
Amsterdam  
The Netherlands

Hulda Ólafsdóttir, MS  
Physiotherapist  
Department of Occupational Medicine  
Administration of Occupational Safety and Health  
Reykjavik  
Iceland

Edward A. Olmstead, CIH, CSP  
President  
Olsted Environmental Services  
Garrison, New York  
United States

Gary W. Olmstead, PhD, CIH, CSP  
Director  
Safety and Environmental Management  
General Mills  
Minneapolis, Minnesota  
United States

David A. O'Malley, MSc  
Managing Director  
Diamond Environmental Ltd.  
Chester  
United Kingdom

George R. Osborne, CIH, CSP  
Industrial Hygiene Manager  
Lucent Technologies  
Norcross, Georgia  
United States

Debra Osinsky, MPH  
Editorial Consultant  
Encyclopedia of Occupational Health and Safety  
International Labour Office  
Highland Park, New Jersey  
United States

Gary A. Page BS, MS, MBA  
Fertilizer and Agricultural Chemicals  
National Safety Council  
Ridgewood, New Jersey  
United States

N.M. Pant, Dr, MBBS, DPH*  
Medical Officer  
Hindustan Lever, Ltd.  
Bombay  
India

Jon Parish, BBA  
Director  
Loss Control and Environment  
Lane Corporation  
Aluista, Virginia  
United States

Robert M. Park, MS  
Project Epidemiologist  
Health and Safety Department  
International Union of United Auto Workers  
Detroit, Michigan  
United States

Relford Patterson, MD, MPH  
Medical Director  
GM Truck Group-Baltimore Assembly Plant  
General Motors Corporation  
Baltimore, Maryland  
United States

Gerald F. Peedin, PhD  
Philip Morris Professor  
Crop Science Department  
North Carolina State University  
Raleigh, North Carolina  
United States

Peter W. Pitcherill, BSc, M Eng, MBA  
Regional Director  
Asia and Australia  
MSA International  
Pittsburgh, Pennsylvania  
United States

Alexander C. Pittman, Jr., Dr  
Con Edison  
Brooklyn, New York  
United States

Philip A. Platcow, MS, CIH  
Vice-President, Senior Consultant  
Risk Management  
Sedgwick  
Boston, Massachusetts  
United States

James W. Plattner, PhD, CIH  
Industrial and Labor Relations  
Cornell University  
Albany, New York  
United States

Rebecca Plattus, JD  
Political Education Director  
Local 89-22-1  
Union of Needletrades, Industrial and Textile Employees  
New York, New York  
United States

Lou Piombino, BS  
Manager  
Safety, Health and Environment  
Lipton, Inc.  
Englewood Cliffs, New Jersey  
United States

Bengt Pontén  
Forest and Timber Group  
Dalarna University  
Bohleave  
Sweden

William Popendorf, PhD, CIH  
Professor  
Department of Biology  
Utah State University  
Logan, Utah  
United States

Paulo Portich  
Fundacentro  
Porte Alegro, Rio Grande do Sul  
Brazil

Peter Poschen, PhD  
Forestry and Wood Industries Specialist  
Industrial Activities Branch  
International Labour Office  
Geneva  
Switzerland

Christine Proctor, MS, CIH  
Proctor Occupational Safety and Health  
New York, New York  
United States

L. Prodan, Dr*  
CLUJ-NAPOCA  
Romania

John Quackenbush  
International Representative  
International Union of Elevator Constructors  
Springfield, Virginia  
United States

A.E. Quinn, BSc, LLB*  
Former Her Majesty's Inspector of Factories  
London  
United Kingdom

M.E. Rajabi, Ing*  
Assistant Director General, Labour Inspection  
Ministry of Labour and Social Affairs  
Tehran  
Islamic Republic of Iran

* Contributor to the 3rd edition of this Encyclopaedia. This biographical information has not been updated.
Vilhjalmur Rafnsson, MD, PhD  
Chief Medical Director  
Department of Occupational Medicine  
Administration of Occupational Safety and Health  
Reykjavik, Iceland

Ray RaLonde, MS  
Agriculture Specialist  
School of Fisheries and Ocean Sciences  
University of Alaska Anchorage, Alaska  
United States

Russell B. Rayman, MD, MPH  
Executive Director  
Aerospace Medical Association  
Alexandria, Virginia  
United States

Beth Donovan Reh, MHS  
Industrial Hygienist  
Hazard Evaluations and Technical Assistance Branch  
National Institute for Occupational Safety and Health  
Cincinnati, Ohio  
United States

John Reimer, P. Eng  
Environmental Protection Engineer  
Health Science Centre  
Winnipeg, Manitoba Canada

Toni Retsch, Dipl.-Ing, ETH  
Bereichsleiter-ALM 2  
Swiss National Accident Insurance Organization  
Luzern, Switzerland

Thomas Rhodarmer, BSc  
Corporate Director Environmental Health and Safety  
Mark IV Industries Worldwide  
Dayco/Mark IV  
Wayneville, North Carolina United States

David Richardson, MPH, DABT  
Unit Director, Applied and Regulatory Toxicology  
Health and Environment Laboratories  
Eastman Kodak Inc.  
Rochester, New York United States

Sandra Karen Richman  
Safety Consultant  
National Board of Directors  
American Federation of Television and Radio Artists  
New Hope, Pennsylvania United States

Ted Rickard, MLS, CRSP  
Manager of Health, Safety and Security  
Ontario College of Art & Design  
Toronto, Ontario Canada

Knut Ringen, Dr PH  
Director  
Center to Protect Workers' Rights  
Washington, DC United States

Richard D. Ringenwald, Jr., Dr  
Exide Corporation  
Reading, Pennsylvania United States

Jorge da Rocha Gomes  
Professor Emeritus  
Department of Environmental Health,  
School of Public Health  
University of São Paulo  
São Paulo Brazil

John G. Rodwan, Jr., MA  
International Labour Office  
Geneva Switzerland

T. A. Roschina, Dr*  
First Medical Moscow Institute  
Moscow Former USSR

Jonathan Rosen, MS, CIH  
Director  
Occupational Health and Safety Program  
New York State Public Employees Federation, AFL-CIO  
Albany, New York United States

Beth Rosenberg, ScD  
Assistant Professor  
Department of Family Medicine and Community Health  
Tufts School of Medicine  
Boston, Massachusetts United States

Monona Rossol, MS, MFA  
Industrial Hygienist  
Arts, Crafts and Theater Safety  
New York, New York United States

Pekka Roto, MD, MSc, PhD  
Medical Officer  
Tampere Regional Institute of Occupational Health  
Tampere Finland

James R. Rubin, MS  
Environmental Health and Safety Specialist  
Hewlett-Packard Company  
Fort Collins, Colorado United States

Avima M. Ruder, PhD  
Chief  
Division of Surveillance, Hazard Evaluations and Field Studies  
National Institute for Occupational Safety and Health  
Cincinnati, Ohio United States

L.A. Ryzik, Dr*  
Institute of Industrial Hygiene and Occupational Diseases  
Leningrad Former USSR

David M. Sack, MD  
Navy Environmental Health Center  
United States Navy  
Norfolk, Virginia United States

Joyce Salg, PhD  
Senior Research Scientist  
National Institute for Occupational Safety and Health  
Cincinnati, Ohio United States

Igor V. Sanotsky, MD, PhD, Prof  
Adviser for Science  
Institute of Occupational Health  
Russian Academy of Medical Sciences Moscow Russian Federation

Steven L. Sauter, PhD  
Chief  
Applied Psychology and Ergonomics Branch  
National Institute for Occupational Safety and Health  
Cincinnati, Ohio United States

E. Neil Schachter, MD  
Maurice Hexter Professor of Medicine  
Pulmonary Division  
Mount Sinai Medical Center  
New York, New York United States

* Contributor to the 3rd edition of this *Encyclopaedia*. This biographical information has not been updated.
Ted Scharf, PhD
Division of Biomedical and Behavioral Science
National Institute for Occupational Safety and Health
Cincinnati, Ohio
United States

Marc B. Schenker, MD, MPH
Director
University of California Agricultural Health and Safety Center
University of California-Davis
Davis, California
United States

H. Schneider, Dr med*
Former Medical Director
KRUPP Hüttenwerke AG
Duisburg
Germany

Scott P. Schneider, MSIH, CIH
Ergonomics Program Director
Center to Protect Workers’ Rights
Washington, DC
United States

Rudolf Scholbeck, Dipl-Ing Univ
Head
Tiefbau-Berufsgenossenschaft
Munich
Germany

Stanley H. Schuman, MD, PhD, MPH
Professor
Family Medicine
Agromedicine Program
Clemson University
Medical Director
Occupational and Environmental Medicine Office
Medical University of South Carolina
Charleston, South Carolina
United States

Charles Schwab, PhD
Associate Professor
Agricultural and Biosystems Engineering
Iowa State University
Ames, Iowa
United States

W. Norman Scott, MD
Director
Insall Scott Kelly Institute
New York, New York
United States

Jane L. Seegal
Editor
Center to Protect Workers’ Rights
Washington, DC
United States

Rita Seguin, BA
Safety and Disability Manager
Hiram Walker and Sons, Ltd.
Walkerville, Ontario
Canada

Logan C. Shelman, BS, ChE, MEA
Senior Environmental Engineer
Environmental Health and Safety Department
Newport News Shipbuilding
Newport News, Virginia
United States

Konstantin K. Sidorov, Dr med sci
Deputy Director
Russian Registry of Hazardous Chemical and Biological Substances
Moscow
Russian Federation

Itzhak Siev-Ner, MD
Orthopedic Surgeon, Physical Medicine and Rehabilitation
Sheba Medical Center, Tel-Hashomer
Israel Performing Arts Medicine Center
Tel Aviv
Israel

Ken Sims
Director
Thrigby Hall Wildlife Gardens
Great Yarmouth
United Kingdom

Donald L. Smith, CIH, CSP, PE, DEE
Nabisco, Inc.
East Hanover, New Jersey
United States

N.A. Smith, PhD
Lighting Consultant
Doncaster
United Kingdom

Marianne Smukowski, BS
Dairy Safety Applications Coordinator
Center for Dairy Research
University of Wisconsin-Madison
Madison, Wisconsin
United States

Jack W. Snyder, MD, JD, MPH, PhD
Associate Professor
Emergency Medicine and Laboratory Medicine
Thomas Jefferson University
Philadelphia, Pennsylvania
United States

Jerzy A. Sokal, Prof, PhD, DSc
Director
Institute of Occupational Medicine and Environmental Health
Sosnowiec
Poland

Colin L. Soskoline, PhD
Professor, Director of Graduate Training
Department of Public Health Sciences
University of Alberta
Edmonton, Alberta
Canada

Jerry Spiegel, MA, MSc
Director
Pollution Prevention
Manitoba Environment
Winnipeg, Manitoba
Canada

J. Staal*
Technical Secretary
Fédération européenne de la manutention,
Section VII: ascenseurs, lifts, Aufzüge
Amsterdam
The Netherlands

Lorann Stallones, PhD, MPH
Department of Environmental Health
Colorado State University
Fort Collins, Colorado
United States

Roger Stamm, Dr
Head of Central Department
Berufsgenossenschaftliches Institut für Arbeitssicherheit
Hauptverband der gewerblichen Berufsgenossenschaften
Sankt Augustin
Germany

William E. Steinke, PhD
Extension Agricultural Engineer
Biological and Agricultural Engineering Department
University of California-Davis
Davis, California
United States
Jeanne M. Stellman, PhD  
Editor-in-Chief  
Encyclopedia of Occupational Health and Safety  
International Labour Office  
Geneva  
Switzerland  
School of Public Health  
Columbia University  
New York, New York  
United States

Steven D. Stellman, PhD, MPH  
Chief  
Division of Epidemiology  
American Health Foundation  
New York, New York  
United States

Frank B. Stern, BBA, MS  
Senior Research Epidemiologist  
National Institute for Occupational Safety and Health  
Cincinnati, Ohio  
United States

Laura Stock, MPH  
Labor Occupational Health Program  
School of Public Health  
University of California-Berkeley  
Berkeley, California  
United States

Ulrich Stössel, Dr phil  
Academic Lecturer  
Department of Medical Sociology  
Medical Faculty  
University of Freiburg  
Freiburg  
Germany

J.M. Strother, BS  
Manager  
Research Analytical and Finishing Laboratory  
Fieldcrest Cannon, Inc.  
Kannapolis, North Carolina  
United States

Dean T. Stueland, MD, MPH  
Medical Director  
National Farm Medicine Center  
Marshfield Clinic  
Marshfield, Wisconsin  
United States

E.A. Suchman, PhD*  
Department of Sociology  
University of California  
Santa Barbara, California  
United States

F. William Sunderman, Jr., MD  
Professor  
Departments of Laboratory Medicine and Pharmacology  
University of Connecticut Medical School  
Farmington, Connecticut  
United States

John J. Svagr, CIH  
Manager  
Industrial Hygiene and Safety-North America  
Kraft Foods  
Rye Brook, New York  
United States

William B. Symons, PhD  
Associate Professor  
Biological Systems Engineering Department  
Washington State University  
Pullman, Washington  
United States

Keith Tait, CIH, CSP  
Assistant Director  
Corporate Health and Safety  
Pfizer, Inc.  
New York, New York  
United States

James S. Taylor, MD  
Head  
Industrial Dermatology  
Cleveland Clinic Foundation  
Cleveland, Ohio  
United States

Benedetto Terracini, MD  
Former Head  
Unit of Cancer Epidemiology  
University Hospital and University of Turin  
Turin  
Italy

Kay Teschke, PhD, MPH, CIH, ROH  
Associate Professor  
Department of Health Care and Epidemiology  
University of British Columbia  
Vancouver, British Columbia  
Canada

Jamie Tessler, MPH  
Occupational Health and Safety Consultant  
Brooklyn, New York  
United States

Richard J. Thomas, MD, MPH  
Office in Charge, Occupational Medicine Physician  
Navy Environmental and Preventive Medicine Unit  
Norfolk, Virginia  
United States

G. Thomas*  
Research Department  
British Steel Corporation  
Deeside  
United Kingdom

Frank H. Thorn, BS  
Manager, Environmental Engineering  
Environmental Health and Safety Department  
Newport News Shipbuilding  
Newport News, Virginia  
United States

James R. Thornton, MS, CIH, CSP  
Director, Environmental Health and Safety Department  
Newport News Shipbuilding  
Newport News, Virginia  
United States

Kendall Thu, PhD  
Institute for Rural and Environmental Health  
College of Medicine  
Iowa City, Iowa  
United States

Kjell Torén, MD  
Associate Professor  
Department of Occupational Medicine  
Sahlgrenska University Hospital  
Göteborg  
Sweden

James R. Townhill, CSP  
Piedmont Environmental, Inc.  
Kannapolis, North Carolina  
United States

John N. Trent, PhD  
Wildlife Biologist  
Division of Wildlife Conservation  
Alaska Department of Fish and Game  
Anchorage, Alaska  
United States

Don Trotter, M Eng  
Professor  
School of Engineering  
Laurentian University  
Sudbury, Ontario  
Canada

* Contributor to the 3rd edition of this Encyclopaedia. This biographical information has not been updated.
A. Türkdogan, Ing-Chim*
Former Industrial Safety Inspector
Istanbul
Turkey

Timothy J. Ungs, MD, MS
Commandant (G-WKS-3)
United States Coast Guard Headquarters
Washington, DC
United States

L.J.L.D. Van Griensven, PhD
Professor
Applied Mycology
Catholic University of Nijmegen
Director
Mushroom Experimental Station
Horst
The Netherlands

Anaide Vilasboas de Andrade
Chief of Technical Services
Centro Regional da Bahia
Fundação Jorge Duarte Figueredo de Segurança e Medicina do Trabalho
Salvador
Brazil

R.F. Villard*
Ingénieur EPUL
Chargé de cours à l’Ecole supérieure technique de Genève
Geneva
Switzerland

Phillip J. Wakelyn, PhD
Senior Scientist, Environmental Health Safety
National Cotton Council of America
Washington, DC
United States

Simon Walker, BSc, MSc
Principal
IETS
Oxford
United Kingdom

Anthony D. Walters, M Eng
Manager
Coal Division
Kilborn Engineering Pacific, Ltd.
Vancouver, British Columbia
Canada

Jung-Der Wang, MD, ScD, MIH
Professor
Institute of Occupational Medicine and Epidemiology
National Taiwan University College of Public Health
Taipei
Taiwan, China

Lance A. Ward, BA
Corporate Director of Health and Safety
Pepsi-Cola General Bottlers, Inc.
Rolling Meadows, Illinois
United States

Leon J. Warshaw, MD
Clinical Professor
Department of Environmental Medicine
New York University
New York, New York
United States

James L. Weeks, ScD, CIH
Department of Occupational and Environmental Health
School of Public Health and Health Services
George Washington University
Washington, DC
United States

Beat Wegmüller
Safety Engineer
Swiss National Accident Insurance Organization
Lausanne
Switzerland

Merrill Weinger, MPH
Office of Global and Integrated Environmental Health
World Health Organization
Geneva
Switzerland

K. Welinder*
Research Director
Stoffmaterial-Naxos
Vastervik
Sweden

Paul Westcott, B Eng
Director, Consulting Mining Engineer
MinesConsult
Chatswood, New South Wales
Australia

Othmar Wittmann, Dipl Forest Ing, ETH
Head
Forestry Section
Swiss National Accident Insurance Organization
Lausanne
Switzerland

Aidan White
General Secretary
International Federation of Journalists
Brussels
Belgium

Michael E. Williams, CIH, CSP, ARM
Principal
Health Safety and Risk Management Services
Sunnyvale, California
United States

Linda B. Wolfe, RRP
Associate Biosafety Officer
Environmental Medical Service
Massachusetts Institute of Technology
Cambridge, Massachusetts
United States

Malinee Wongphanich, MD
Consultant on Occupational Health
Department of Health
Ministry of Health
Nonthaburi Province
Thailand

Ray C. Woodcock, MS, CIH
Vice President
Safety and Hygiene Management, Inc.
Waynesville, North Carolina
United States

B. H. Xu, PhD, MD
Assistant Professor
Faculty of Medicine
Kagoshima University
Kagoshima
Japan

Anne Lee Yassi, MD, MSc
Director
Occupational and Environmental Medicine
Health Sciences Centre and Unit
University of Manitoba
Winnipeg, Manitoba
Canada

Dennis D. Zaebs, CIH
Industrial Hygienist
National Institute for Occupational Safety and Health
Cincinnati, Ohio
United States

Albert M. Zielinski, CIH
Senior Technical Leader, Industrial Hygiene
Lighting Environment
Safety and Health Department
GE Lighting
Cleveland, Ohio
United States

* Contributor to the 3rd edition of this Encyclopaedia. This biographical information has not been updated.
A. Zober, Dr*
Institute for Occupational Health and Social Medicine and Clinic for Occupational Diseases
University of Erlangen/Nuremberg
Erlangen
Germany

Craig Zwerling, MD, PhD, MPH
Injury Prevention Research Center
College of Medicine
Iowa City, Iowa
United States

* Contributor to the 3rd edition of this Encyclopedia. This biographical information has not been updated.
ENCYCLOPAEDIA OF OCCUPATIONAL HEALTH AND SAFETY
4TH EDITION

Editor-in-Chief
Jeanne Mager Stellman, PhD

Senior Associate Editor
Michael McCann, PhD, CIH

Associate Editors
Leon Warshaw, MD          Carole Brabant, PhD

Senior Editors
John Finklea, MD, Dr PH    Jacqueline Messite, MD
Georges H. Coppée, MD      Steven L. Sauter, PhD
Vilma R. Hunt, BDS, AM     Jerry Spiegel, MA, MSc
Richard S. Kraus, PE, CSP  Colin L. Soskolne, PhD
Wolfgang Laurig, Dr-Ing    Benedetto Terracini, MD
Melvin L. Myers, BS, MPA

Managing Editor
Chantal Dufresne, BA

INTERNATIONAL LABOUR OFFICE
GENEVA
The designations employed in ILO publications, which are in conformity with United Nations practice, and the presentation of material therein do not imply the expression of any opinion whatsoever on the part of the International Labour Office concerning the legal status of any country, area or territory or of its authorities, or concerning the delimitation of its frontiers.

The responsibility for opinions expressed in signed articles, studies and other contributions rests solely with their authors, and publication does not constitute an endorsement by the International Labour Office of the opinions expressed in them.

The reader accepts that the parties make this documentation available without warranty of any kind. The parties do not accept responsibility for the validity or completeness of any data including inaccuracies, errors or omissions or for any consequences arising from the use of such data. Neither the authors, nor the ILO or collaborating institutions shall be liable for damages or other claims and demands arising out of the use of the data.

Reference to names of firms and commercial products and processes does not imply their endorsement by the International Labour Office or any collaborating institution, and any failure to mention a particular firm, commercial product or process is not a sign of disapproval.

ILO publications can be obtained through major booksellers or ILO local offices in many countries, or direct from ILO Publications, International Labour Office, CH-1211 Geneva 22, Switzerland. Catalogues or lists of new publications are available free of charge from the above address.
Avraham Aladjem, DSc
Israel Institute of Occupational Safety and Hygiene
Tel Aviv
Israel

Janet L. Collins, MD, MPH
Medical Director
Division of Occupational Medicine
Sherman Health Systems
Elgin, Illinois
United States

Alexander Donagi, DSc, MPH
Professor
School of Medicine
Tel Aviv University
Director
Information Centre
Israel Institute of Occupational Safety and Hygiene
Tel Aviv
Israel

Linda S. Forst, MS, MD, MPH
Assistant Professor
School of Public Health
University of Illinois at Chicago
Chicago, Illinois
United States

David L. Hinkamp, MD, MPH
Visiting Assistant Professor
School of Public Health
University of Michigan
Ann Arbor, Michigan
United States

Niels Koehnecke, BSc (hon), MD
Resident, Occupational Medicine Program
Department of Public Health Sciences
University of Alberta
Edmonton, Alberta
Canada

Kari Kurppa, MD PhD
Assistant Departmental Director
Department of Epidemiology and Biostatistics
Institute of Occupational Health
Helsinki
Finland

Pia Markkanen, MSc, Eng
Associate Expert
International Labour Office
Bangkok
Thailand

Debra Osinsky, MPH
Editorial Consultant
Encyclopaedia of Occupational Health and Safety
International Labour Office
Highland Park, New Jersey
United States

Beth Donovan Reh, MHS
Industrial Hygienist
Hazard Evaluations and Technical Assistance Branch
National Institute for Occupational Safety and Health
Cincinnati, Ohio
United States

Menachem Schwartz, BSc, MSc
General Director
Israel Institute for Occupational Safety and Hygiene
Tel Aviv
Israel

Jeanne M. Stellman, PhD
Editor-in-Chief
Encyclopaedia of Occupational Health and Safety
International Labour Office
Geneva
Switzerland

School of Public Health
Columbia University
New York, New York
United States

Steven D. Stellman, PhD, MPH
Chief
Division of Epidemiology
American Health Foundation
New York, New York
United States
PRODUCTION TEAM

Sarah Alvarez
Maria Arleta
May Ballerio-Hofman
Francine Benjamin
Lillian Benjamin
Walter Benjamin
Michel Berka
Christian Boomer
Claude Chaperon
Kyle Creane
Denis Cullinan
Johanna de Vries
Robert Dees
Margaret Fennessy
Raymond Figuières
Geraldine Fitzgerald
Betty Goldman
Susan Guthridge
Kathleen Susan Hurst
Claudia Hommel
Rachael Horner
Sanna Immonen
Lisa Kellner
Diana Signe Kline
Nana-Ekua Leigh
Robert Leuze
Elizabeth Mahiga
Christiane Melin
Jacky Merteau
John McKenna

Julie Nayler
Catherine H. Perring
Peter Perring
Bodhani Pieris
Giles Reed
Kirsten Reed
John G. Rodwan, Jr.
Nancy J. Rodwan
Christian Rohrbach
David Rosenweig
David Rowley
Oriele Rovaletti
Daniel Ruffieux
Jacques P. Tremblet
Steven Sacks
Barbara Sandi
Gabor Sandi
Anneliese Shulte
Jonathan Stampf
Fred Stanton
Andrew B. Stellman
Emma D. Stellman
Prabha Sundaram
Juan Tenorio
Jennifer Valdes
Tracy Weber
Berit Widing-Pry
Sydney G. Williams
Su Zen
American Health Foundation
320 East 43rd Street
New York, NY 10017
United States
Tel: +1-212 531 2521
Fax: +1-212 687 2399

American Industrial Hygiene Association (AIHA)
2700 Prosperity Avenue
Fairfax, VA 22031
United States
Tel: +1-703 849 8888
Fax: +1-703 207 3561

American Petroleum Institute
1220 L Street NW
Washington DC 20005
United States
Tel: +1-202 682 8308
Fax: +1-202 682 8270

Bundesanstalt für Arbeitsschutz
und Arbeitsmedizin (BAuA)
Fachbereich Arbeitsmedizin
Nöldnerstraße 40/42
D-10317 Berlin
Germany
Tel: +49-30 5154 8180
Fax: +49-30 5154 8170

Bundesanstalt für Arbeitsschutz
und Arbeitsmedizin
Fachbereich Arbeitsschutz
Friedrich-Henkel-Weg 1-25
D-44149 Dortmund
Germany
Tel: +49-231 90 71 130
Fax: +49-231 90 71 454

Canadian Auto Workers Union (CAW)
205 Placer Court, North York
Willowdale, Ontario M2H 3H9
Canada
Tel: +1-416 497 4110
Fax: +1-416 495 3785

Canadian Centre for Occupational Health and Safety (CCOHS)
250 Main Street East
Hamilton, Ontario L8N 1H6
Canada
Tel: +1-905 572 2981
Fax: +1-905 572 2206

Canadian Labour Congress
2841 prom. Riverside Drive
Ottawa, Ontario K1V 8X7
Canada
Tel: +1-613 521 3400
Fax: +1-613 521 4655

Center to Protect Workers’ Rights
111 Massachusetts Avenue NW
Washington DC 20001
United States
Tel: +1-202 962 8490
Fax: +1-202 962 8499

CISL National Board
Dipartimento Politiche Internazionale
Via Po 21
Roma 00198
Italy
Tel: +39-6 847 3357
Fax: +39-6 841 3782

Columbia University
School of Public Health
New York, NY 10032
United States
Tel: +1-212 305 3464
Fax: +1-212 305 3405

Hauptverband der gewerblichen
Berufsgenossenschaften (HVBG)
Alte Heerstrasse 111
D-53754 Sankt Augustin
Germany
Tel: +49-2241 231 1150
Fax: +49-2241 231 1391

Health and Safety Executive (HSE)
Rose Court
2 Southwark Bridge
London SE1 9HS
United Kingdom
Tel: +44-171 717 6000
Fax: +44-171 717 6717

Institut für Arbeitsphysiologie
(IfAö)
Universität Dortmund
Ardewistrasse 67
D-44139 Dortmund
Germany
Tel: +49-231 10 84 361
Fax: +49-231 10 84 402

Institut National de Recherche
et de Sécurité (INRS)
30, rue Olivier Noyer
75680 Paris Cedex 14
France
Tel: +33-1 4044 3000
Fax: +33-1 4044 3099

Institut de Recherche en Santé
et en Sécurité du Travail (IRSST)
505, boulevard De Maisonneuve Ouest
Montréal, Québec H3A 3G2
Canada
Tel: +1-514 288 1551
Fax: +1-514 288 0998

Institut universitaire romand
de Santé au Travail (IRST)
1005 Lausanne
Switzerland
Tel: +41-21 314 7421
Fax: +41-21 314 7420

Institute of Occupational Medicine
Chinese Academy of Preventive Medicine
29 Nan Wei Road
Beijing 100050
People’s Republic of China
Tel: +86-10 6301 4323
Fax: +86-10 6301 4323

Institute of Occupational Medicine
and Environmental Health
13 Kosielnia Street
41-200 Sosnowiec
Poland
Tel: +48-3 266 0640
Fax: +48-3 266 1124

Institute for Science of Labour (ISL)
2-8-14 Sugao
Miyamae-ku
Kawasaki 216-8501
Japan
Tel: +81-4 4977 2121
Fax: +81-4 4977 7504

Istituto di Medicina del Lavoro
Università degli Studi di Milano
Via Suan Bernabò 8
I-20122 Milano
Italy
Tel: +39-2 55 11 610
Fax: +39-2 55 11 772

Instituto Nacional de Seguridad
y Higiene en el Trabajo
Torrelaguna 73
28027 Madrid
Spain
Tel: +34-1 403 7000
Fax: +34-1 403 0050

Instituto Seguros Sociales
Centro Administrativo Nacional
Diagonal 40, n.º 46-A-17
Bogotá
Colombia
Tel: +57-1 322 4491
Fax: +57-1 222 1315
International Agency for Research on Cancer (IARC)
150, cours Albert-Thomas
69372 Lyon Cedex 08
France
Tel. +33-4-7273 8485
Fax +33-4-7273 8373

International Commission on Occupational Health (ICOH)
Lower Kent Ridge Road
Singapore 0511
Singapore
Tel. +65 772 4290
Fax +65 779 1489

International Organization for Standardization (ISO)
1, rue de Varembe
PO Box 56
1211 Genève 20
Switzerland
Tel. +41-22 749 0111
Fax +41-22 733 3430

International Social Security Association (ISSA)
4, route des Morillons
1211 Genève 22
Switzerland
Tel. +41-22 799 6617
Fax +41-22 799 8509

Israel Institute for Occupational Safety and Hygiene
22 Maze Street
PO Box 1122
Tel-Aviv 61010
Israel
Tel. +972-3 629 7314
Fax +972-3 525 2448

National Fire Protection Association International
1 Batterymarch Park
PO Box 9101
Quincy, MA 02269-9101
United States
Tel. +1-617 770 3000
Fax +1-617 770 0700

National Institute for Occupational Safety and Health (NIOSH)
Hubert H. Humphrey Building
200 Independence Avenue SW
Washington DC 20201
United States
Tel. +1-202 401 0721
Fax +1-202 260 4464

National Institute for Working Life
Ekelylundsvägen 16
S-171 84 Solna
Sweden
Tel. +46-8 730 9100
Fax +46-8 730 1967

Nofer Institute of Occupational Medicine
8 Sw. Teresy Street
PO Box 199
90-950 Lodz
Poland
Tel. +48-42 314 502
Fax +48-42 568 331

Occupational Safety and Health Administration
US Department of Labor
National Office
200 Constitution Avenue NW
Washington DC 20201
United States
Tel. +1-202 596 1201
Fax +1-202 596 4872

Schweizerische Unfallversicherungs-Anstalt (SUVA)
Swiss Occupational Accident Insurance
PO Box 4358
6002 Luzern
Switzerland
Tel. +41-41 419 5111
Fax +41-41 419 6170

Scientific Research Institute of Occupational Health
Russian Academy of Medical Sciences (RAMS)
31, Prospekt Budennogo
105275 Moscow
Russian Federation
Tel. +7-095 365 0209
Fax +7-095 366 6503

Sheffield Occupational Health Project
Mudford's Buildings
37 Exchange Street
Sheffield S3 5TR
United Kingdom
Tel. +44-114 275 5760
Fax +44-114 249 1883

Työterveyslaitos
Institute of Occupational Health
Töpeliuksenkatu 41 a A
FIN-00250 Helsinki
Finland
Tel. +358-9 4747 383
Fax +358-9 4747 490

United Automobile, Aerospace and Agricultural Implement Workers of America (UAW)
8000 East Jefferson Avenue
Detroit, MI 48214
United States
Tel. +1-313 925 5563
Fax +1-313 824 4473

United Food and Commercial Workers
1775 K Street NW
Washington DC 20006-1598
United States
Tel. +1-202 223 3111
Fax +1-202 466 1562

University of Alberta
Faculty of Medicine and Oral Health Sciences
Department of Public Health Sciences
13-103 Clinical Sciences Building
Edmonton, Alberta T6G 2G3
Canada
Tel. +1-403 492 6013
Fax +1-403 492 0364

World Health Organization (WHO)
20, avenue Appia
1211 Genève 27
Switzerland
Tel. +41-22 791 2111
Fax +41-22 791 3111