

# CONTENTS

|   |            |
|---|------------|
| <b>PART I INTRODUCTION TO INDUSTRIAL HYGIENE</b>  | <b>1</b>   |
| <b>1. Industrial Hygiene: Retrospect and Prospect—Hippocrates to Nanotechnology</b>   | <b>3</b>   |
| <i>John A. Pendergrass, PE, CIH (Retired), CSP</i>  |            |
| <b>2. Rationale for Industrial Hygiene Practice</b>   | <b>11</b>  |
| <i>Robert L. Harris, Ph.D., CIH (Retired), Lewis J. Cralley, Ph.D., CIH (Deceased), Lester V. Cralley, Ph.D., CIH (Deceased), and Vernon E. Rose, DrPH., CIH, CSP, PE</i> |            |
| <b>PART II CHEMICAL AGENTS</b>  | <b>39</b>  |
| <b>3. The Mode of Absorption, Distribution, and Elimination of Toxic Materials</b>  | <b>41</b>  |
| <i>Franklin E. Mirer, Ph.D., CIH</i>  |            |
| <b>4. Occupational Epidemiology: Some Guideposts</b>  | <b>89</b>  |
| <i>John F. Gamble, Ph.D., MA, MSPH</i>  |            |
| <b>5. Atypical Human Responses to Low-Level Environmental Contaminants: The Problem of Multiple Chemical Sensitivities</b>  | <b>161</b> |
| <i>Mark R. Cullen, MD</i>   |            |
| <b>6. Basic Aerosol Science</b>   | <b>189</b> |
| <i>Parker C. Reist, ScD, PE</i>   |            |

|   |            |
|---|------------|
| <b>7. Pulmonary Effects of Inhaled Mineral Dusts</b>  | <b>241</b> |
| <i>David Fishwick, MD</i>   |            |
| <b>8. Assessment of Exposure to Respirable Dusts</b>  | <b>287</b> |
| <i>Ronald S. Ratney, Ph.D., CIH (Retired)</i>   |            |
| <b>9. Man-Made Mineral Fibers</b>   | <b>333</b> |
| <i>Jaswant Singh, Ph.D., CIH and Andreas Wagner, CIH</i>  |            |
| <b>10. Engineered Nanomaterials</b>   | <b>373</b> |
| <i>Thomas M. Peters, Ph.D. and Vicki H. Grassian, Ph.D.</i>   |            |
| <b>11. Sampling and Analysis of Gases and Vapors</b>  | <b>405</b> |
| <i>Martin Harper, Ph.D., CIH, CChem, MRSC</i>   |            |
| <b>12. Analytical Methods</b>   | <b>427</b> |
| <i>Robert G. Lieckfield, Jr., CIH</i>   |            |
| <b>13. Biological Monitoring of Exposure to Industrial Chemicals</b>                                  | <b>455</b> |
| <i>Michèle Berode Ph.D., Pierre-Olivier Droz, Ph.D. (Deceased)<br/>and Michel P. Guillemin, Ph.D.</i> |            |
| <b>14. Odors: Measurement and Control</b>   | <b>523</b> |
| <i>Amos Turk, Ph.D., Angela Merlo, MD, Ph.D., and Samuel Cha, MS</i>                                  |            |
| <b>INDEX</b>  | <b>565</b> |

# CONTENTS

|   |            |
|---|------------|
| <b>PART III CHEMICAL EXPOSURE EVALUATION</b>  | <b>585</b> |
| <b>15. Real-Time Assessment of Air Contaminants Using Video Exposure Monitoring Methods and Techniques</b>  | <b>587</b> |
| <i>James D. McGlothlin, Ph.D., MPH, CPE, Fan Xu, Ph.D., CIH, and Sandra S. Cole, MS</i>   |            |
| <b>16. Computed Tomography in Industrial Hygiene</b>  | <b>621</b> |
| <i>Lori A. Todd, Ph.D., CIH</i>   |            |
| <b>17. Mathematical Modeling of Indoor Air Contaminant Concentrations</b>   | <b>661</b> |
| <i>Mark Nicas, Ph.D., MPH, CIH</i>  |            |
| <b>18. Human Health Risk Assessment</b>   | <b>695</b> |
| <i>Chris Laszcz-Davis, MS, CIH, REA, Fred W. Boelter, CIH, PE, BCEE, Frank Hearl, MS, PE, Michael Jayjock, Ph.D., CIH, Perry Logan, CIH, Cristina Ford McLaughlin, Mary O'Reilly, Ph.D., CIH, CPE, R. Thomas Radcliffe, Jr., Esquire, and Mark Stenzel, MS, CIH</i> |            |
| <b>19. Interpreting Levels of Exposures to Chemical Agents</b>  | <b>827</b> |
| <i>Stephen M. Rappaport, Ph.D., CIH and Lawrence L. Kupper, Ph.D.</i>   |            |
| <b>20. The History and Biological Basis of Occupational Exposure Limits for Chemical Agents</b>   | <b>865</b> |
| <i>Dennis J. Paustenbach, Ph.D., CIH, DABT, Dallas M. Cowan, Ph.D., and Jennifer Sahmel, CIH</i>  |            |

|   |             |
|---|-------------|
| <b>21. Pharmacokinetics and Unusual Work Schedules</b><br><i>Dennis J. Paustenbach, Ph.D., CIH, DABT</i>  | <b>957</b>  |
| <b>PART IV CHEMICAL EXPOSURE CONTROL</b> <b>1047</b>  |             |
| <b>22. Characterizing Air Contaminant Emission Sources</b><br><i>Robert L. Harris, Ph.D., CIH (Retired), Earl W. Arp, Jr., Ph.D., CIH, and D. Jeff Burton, PE, CIH</i>        | <b>1049</b> |
| <b>23. Engineering Control of Airborne Contaminants: History, Philosophy, and Primary Approaches</b><br><i>William A. Burgess, CIH (Retired), and D. Jeff Burton, CIH, PE</i> | <b>1073</b> |
| <b>24. Industrial Ventilation</b><br><i>Robert D. Soule, CIH, CSP and D. Jeff Burton, CIH, PE</i>   | <b>1111</b> |
| <b>25. Administrative Controls</b><br><i>Lisa Simkins Barnes, CIH, PE</i>   | <b>1155</b> |
| <b>26. Respiratory Protective Equipment</b><br><i>Jeffrey S. Birkner, Ph.D., CIH and Craig E. Colton, CIH</i>   | <b>1169</b> |
| <b>27. Chemical Protective Clothing</b><br><i>Krister Forsberg</i>  | <b>1235</b> |
| <b>28. Control Banding: Background, Critique, and Evolution</b><br><i>Deborah Imel Nelson, Ph.D., CIH and David M. Zalk, MPH, CIH</i>   | <b>1263</b> |
| <b>INDEX</b>  | <b>1323</b> |

# CONTENTS

|   |             |
|---|-------------|
| <b>PART V PHYSICAL AGENTS</b>   | <b>1343</b> |
| <b>29. Ionizing Radiation</b>   | <b>1345</b> |
| <i>Herman Cember, Ph.D., PE, CHP (Deceased) and<br/>Thomas E. Johnson, Ph.D., CHP</i>         |             |
| <b>30. Nonionizing Radiation: Lasers</b>  | <b>1379</b> |
| <i>David H. Sliney, Ph.D.</i>   |             |
| <b>31. Nonionizing Radiation: Broadband Optical</b>   | <b>1401</b> |
| <i>Margaret Levin Phillips, Ph.D., CIH and<br/>Allene "Scotty" Butler, MA, CIH, CSP, CHMM</i> |             |
| <b>32. Nonionizing Radiation: Radiofrequency</b>  | <b>1443</b> |
| <i>Robert Timothy Hitchcock, CIH, CLSO</i>  |             |
| <b>33. Nonionizing Radiation: Extremely Low Frequency</b>                                     | <b>1483</b> |
| <i>Dave Baron, PE</i>   |             |
| <b>34. Industrial Noise and Hearing Conservation</b>  | <b>1507</b> |
| <i>David C. Byrne, MS, CCC-A, Kevin L. Michael, Ph.D., and<br/>Jennifer B. Tufts, Ph.D.</i>   |             |
| <b>35. Physiological Effects of Altered Barometric Pressure</b>                               | <b>1565</b> |
| <i>Claude A. Piantadosi, MD</i>   |             |
| <b>36. Vibration</b>  | <b>1595</b> |
| <i>Christopher M. Nelson, BSc (Hons), Ph.D., MIOA</i>   |             |

|  |             |
|--|-------------|
| <b>37. Cold Stress</b>   | <b>1639</b> |
| <i>Ingvar Holmér, Ph.D.</i>  |             |
| <b>38. Heat Stress</b>   | <b>1685</b> |
| <i>Michael D. Larrañaga, Ph.D., PE, CIH, CSP and Thomas E. Bernard, Ph.D., CIH</i>                 |             |
| <b>39. Occupational Ergonomics: Past, Present, and Future</b>                                      | <b>1753</b> |
| <i>Susan Kotowski, MS, Ph.D., AEP, Kermit Davis, Ph.D., CPE, and Amit Bhattacharya, Ph.D., CPE</i> |             |
| <b>PART VI BIOLOGICAL AGENTS</b>   | <b>1785</b> |
| <b>40. Biohazards and Occupational Disease</b>   | <b>1787</b> |
| <i>Patricia A. Heinsohn, Ph.D., MPH, CIH</i>   |             |
| <b>41. Control of Biohazards</b>   | <b>1891</b> |
| <i>Patricia A. Heinsohn, Ph.D., MPH, CIH</i>   |             |
| <b>42. Airborne Infectious Diseases</b>  | <b>1949</b> |
| <i>Tara N. Palmore, MD and Kent A. Sepkowitz, MD</i>   |             |
| <b>INDEX</b>   | <b>1979</b> |

# CONTENTS

|  |             |
|--|-------------|
| <b>PART VII PROGRAM MANAGEMENT</b>   | <b>1995</b> |
| <b>43. Occupational Safety and Health Laws</b>   | <b>1997</b> |
| <i>John Howard, MD, MPH, JD and Steve C. Smith, CIH</i>  |             |
| <b>44. Occupational Health and Safety Management Systems</b>   | <b>2109</b> |
| <i>Charles Redinger Ph.D., MPA, CIH, Kyle Dotson MS, CIH, CSP, BCEE, and Alan Leibowitz MS, CIH, CSP</i>   |             |
| <b>45. Management of International EH&amp;S Programs</b>   | <b>2163</b> |
| <i>S. Zack Mansdorf, Ph.D., CIH, CSP, QEP</i>  |             |
| <b>46. Product Stewardship: A Viable Practice for The Industrial Hygienist</b>   | <b>2177</b> |
| <i>Daniel E. Agopsowicz, MS, CIH and Thomas G. Grumbles, MS, CIH</i>   |             |
| <b>PART VIII SPECIALTY AREAS</b>   | <b>2209</b> |
| <b>47. Emergency and Disaster: Preparedness, Response and Recovery</b>   | <b>2211</b> |
| <i>Chris Laszcz-Davis, MS, CIH, REA, Diane Akers, RN, MBA, Karen J. Nardi, Esquire Margaret D. Buckalew, MPH, Lawrence M. Gibbs, MED, MPH, CIH, Jim Jabara CIH, CSP, Fabrice Lebourgeois, Ron R. McHaney, CSP, and Steven P. Pereira , CSP</i> |             |
| <b>48. Hazardous Wastes</b>  | <b>2355</b> |
| <i>Lisa Simkins Barnes, PE, CIH</i>  |             |

|   |             |
|---|-------------|
| <b>49.</b> <b>Indoor Air Quality in Nonindustrial Occupational Environments</b>   | <b>2377</b> |
| <i>Philip R. Morey, Ph.D., CIH, Gary N. Crawford, CIH, and Robert B. Rottersman, CIH</i>  |             |
| <b>50.</b> <b>Agricultural Hygiene</b>  | <b>2469</b> |
| <i>William Popendorf Ph.D., CIH and Kelley J. Donham, DVM, MS, DACVPM</i>   |             |
| <b>51.</b> <b>Contemporary Industrial Hygiene Considerations for Health Care Work Settings</b>  | <b>2525</b> |
| <i>Robert J. Emery, DrPH, CHP, CIH, CSP, RBP, CHMM, CPP, Michael A. Charlton, Ph.D., CHP, CIH, CSP, CHMM and Bruce J. Brown, MPH, CBSP, CHMM, ARM</i>           |             |
| <b>52.</b> <b>Air Pollution</b>   | <b>2549</b> |
| <i>Paul G. Reinhart Ph.D., DABT, Lori D. White, Ph.D., Jee-Young Kim, ScD, Lindsay Wickers Stanek, Ph.D., MSPH, Mary Ross Ph.D., and Barbara Buckley, Ph.D.</i> |             |
| <b>53.</b> <b>Health and Safety Factors in Designing an Industrial Hygiene Laboratory</b>   | <b>2621</b> |
| <i>Robert G. Lieckfield, Jr., CIH and Margaret M. Macomber, CIH</i>   |             |
| <b>54.</b> <b>The Industrial Hygienist in Litigation</b>  | <b>2661</b> |
| <i>Herschel L. Hobson, JD, Ph.D., CIH (Retired), CSP (Retired), PE (TX) (Retired) and Kirk Martin, JD, CIH, CSP</i>   |             |
| <b>55.</b> <b>Fire Safety in the Workplace</b>  | <b>2671</b> |
| <i>Richard L. P. Custer, MS, FSF, PE and Pamela A. Powell</i>   |             |
| <b>56.</b> <b>Work Site Health Promotion</b>  | <b>2699</b> |
| <i>Gary Olmstead, MS, Ph.D., CIH, CSP, CHMM, CPEA, QE</i>   |             |
| <b>INDEX</b>  | <b>2717</b> |
| <b>CUMULATIVE INDEX</b>   | <b>2737</b> |