

Contents

| | |
|--|----|
| Introduction | xi |
| Chapter 1 Aerosol Physical Attributes | 1 |
| 1.1 Introduction | 1 |
| 1.2 Brownian motion | 1 |
| 1.3 Electrical gradient | 2 |
| 1.4 Gravitational field | 4 |
| 1.5 Inertial forces | 8 |
| 1.6 Electromagnetic radiation | 12 |
| 1.7 Particle refractive index and particle density | 13 |
| 1.8 Thermal gradients | 14 |
| 1.9 Hygroscopicity and humidity | 14 |
| 1.10 Conclusions | 22 |
| References | 22 |
| Chapter 2 Laboratory Techniques | 24 |
| 2.1 Introduction | 24 |
| 2.2 Strain of microorganism | 25 |
| 2.3 Growth of microorganisms | 26 |
| 2.4 Aerosol generation | 27 |
| 2.5 Aerosol particle size | 28 |
| 2.6 Spray fluids | 30 |
| 2.7 Aerosol storage | 31 |
| 2.8 Aerosol collection | 34 |
| 2.9 Collecting fluids | 37 |
| 2.10 Rehumidification | 41 |
| 2.11 Viability assay and tracers | 42 |
| 2.12 Infectivity assay | 45 |
| 2.13 Conclusions | 46 |
| References | 46 |
| Chapter 3 Aerosol Samplers | 50 |
| 3.1 Introduction | 50 |
| 3.2 Efficiency of sampling | 50 |
| 3.3 Isokinetic sampling | 52 |

| | | |
|------------------|--|------------|
| 3.4 | Stagnation point sampling | 55 |
| 3.5 | Impingers | 55 |
| 3.6 | Impactors | 59 |
| 3.7 | Stacked sieve samplers | 65 |
| 3.8 | Centrifugal samplers | 66 |
| 3.9 | Electrostatic samplers | 69 |
| 3.10 | Thermal precipitators | 71 |
| 3.11 | Filters | 72 |
| 3.12 | Sequential and tape samplers | 73 |
| 3.13 | High volume samplers | 74 |
| 3.14 | Calibration methods | 75 |
| 3.15 | Conclusions | 76 |
| | References | 77 |
| Chapter 4 | Aerosol Monitoring Methods | 80 |
| 4.1 | Introduction | 80 |
| 4.2 | Physical methods | 80 |
| 4.3 | Microbiological methods | 85 |
| 4.4 | Conclusions | 86 |
| | References | 87 |
| Chapter 5 | Aerosol Particle Sizing | 88 |
| 5.1 | Introduction | 88 |
| 5.2 | Aerosol dispersity | 88 |
| 5.3 | Definition of size | 89 |
| 5.4 | Particle size distributions | 90 |
| 5.5 | Inertial classification | 95 |
| 5.6 | Microscopic and image analysis | 100 |
| 5.7 | Real time particle sizers and counters | 103 |
| 5.8 | Particle sizes of inhaled particles | 106 |
| 5.9 | Conclusions | 106 |
| | References | 107 |
| Chapter 6 | Biohazard Control: Containment, Ventilation and Isolation | 108 |
| 6.1 | Introduction | 108 |
| 6.2 | Air purification | 112 |
| 6.2.1 | Purification processes | 112 |
| 6.2.2 | Air sterilization processes | 118 |
| 6.3 | Containment | 120 |
| 6.3.1 | Laboratory systems | 120 |
| 6.3.2 | Testing safety cabinets | 124 |
| 6.3.3 | Aerosol holding chambers | 126 |
| 6.3.4 | Rooms and buildings | 126 |
| 6.3.5 | Animal holding facilities | 127 |
| 6.4 | Air curtains and douches | 127 |

| | | |
|-------------------|--|------------|
| 6.5 | Transmission in hospitals | 128 |
| 6.6 | Ventilation systems | 130 |
| 6.7 | Isolation systems | 131 |
| 6.8 | Conclusions | 133 |
| | References | 134 |
| Chapter 7 | Field Techniques | 138 |
| 7.1 | Introduction | 138 |
| 7.2 | Agricultural aerosols | 138 |
| 7.3 | Field aerosol sampling and sizing techniques | 140 |
| 7.4 | Conclusions | 141 |
| | References | 141 |
| Chapter 8 | Aerial Transport | 143 |
| 8.1 | Introduction | 143 |
| 8.2 | Air movements indoors | 143 |
| 8.3 | Atmospheric layers | 143 |
| 8.4 | Air movements outdoors | 143 |
| 8.5 | Theoretical models | 148 |
| 8.6 | Comparisons between practice and theory | 152 |
| 8.7 | Conclusions | 154 |
| | References | 154 |
| Chapter 9 | Take-off and Landing | 157 |
| 9.1 | Introduction | 157 |
| 9.2 | Take-off processes | 157 |
| 9.2.1 | Talking, coughing and sneezing | 157 |
| 9.2.2 | Dispersal from surfaces | 158 |
| 9.3 | Landing on surfaces | 159 |
| 9.4 | Respiratory system | 160 |
| 9.4.1 | Regions | 160 |
| 9.4.2 | Cells and tissues | 163 |
| 9.5 | Inhalation and deposition | 164 |
| 9.6 | Respiratory tract clearance | 167 |
| 9.7 | Conclusions | 169 |
| | References | 170 |
| Chapter 10 | Relative Humidity and Temperature | 172 |
| 10.1 | Introduction | 172 |
| 10.2 | Phages | 172 |
| 10.3 | Viruses | 177 |
| 10.4 | Bacteria | 180 |
| 10.5 | Biochemical studies with bacteria | 189 |
| 10.6 | Other microorganisms | 193 |
| 10.7 | Kinetic model | 194 |

| | | |
|-------------------|---|------------|
| 10.8 | Temperature | 198 |
| 10.9 | Conclusions | 199 |
| | References | 201 |
| Chapter 11 | Oxygen | 206 |
| 11.1 | Introduction | 206 |
| 11.2 | Biochemical studies | 207 |
| 11.3 | Kinetic models | 210 |
| 11.4 | Free radicals | 214 |
| 11.5 | Conclusions | 217 |
| | References | 217 |
| Chapter 12 | The Open Air Factor | 218 |
| 12.1 | Introduction | 218 |
| 12.2 | Kinetic model | 222 |
| 12.3 | Nature of OAF | 226 |
| 12.4 | Causes of death | 227 |
| 12.5 | Conclusions | 228 |
| | References | 229 |
| Chapter 13 | Other Environmental Parameters | 230 |
| 13.1 | Introduction | 230 |
| 13.2 | Air movements | 230 |
| 13.3 | Pressure fluctuations | 231 |
| 13.4 | Air ions | 232 |
| 13.5 | Radiation | 232 |
| 13.6 | Pollutants | 234 |
| 13.7 | Conclusions | 235 |
| | References | 235 |
| Chapter 14 | Repair | 238 |
| 14.1 | Introduction | 238 |
| 14.2 | Repair of surface structures | 238 |
| 14.3 | Repair of transport activity | 240 |
| 14.4 | Repair of radiation damage | 241 |
| 14.5 | Repair-deficient mutants | 242 |
| 14.6 | Effects due to repair | 242 |
| 14.7 | Conclusions | 242 |
| | References | 242 |
| Chapter 15 | Infectivity | 244 |
| 15.1 | Introduction | 244 |
| 15.2 | Aerosol particle size and host susceptibility | 244 |
| 15.3 | Virulence | 247 |
| 15.4 | Natural resistance | 248 |

| | | |
|-------------------|--|------------|
| 15.5 | Immunological factors | 248 |
| 15.6 | Respiratory immunization | 249 |
| 15.7 | Microbial survival in animals | 250 |
| 15.8 | Experimental pathogenicity | 250 |
| 15.9 | Conclusions | 251 |
| | References | 252 |
| Chapter 16 | Catastrophe Theory | 255 |
| 16.1 | Introduction | 255 |
| 16.2 | Catastrophe theory and denaturation kinetics | 259 |
| 16.3 | Catastrophe theory applied to analysis of the role of temperature | 262 |
| 16.4 | Catastrophe theory and more complex denaturation kinetics | 270 |
| 16.5 | Catastrophe theory and oxygen-induced loss of viability | 271 |
| 16.6 | Catastrophe theory and OAF-induced loss of viability | 271 |
| 16.7 | Catastrophe theory and repair | 272 |
| 16.8 | Conclusions | 273 |
| | References | 274 |
| Chapter 17 | The Aerobiological Pathway in Practice | 275 |
| 17.1 | Introduction | 275 |
| 17.2 | Human health | 275 |
| 17.3 | Animal and crop disease | 276 |
| 17.4 | Microbiology | 276 |
| 17.5 | Microbial contamination | 277 |
| 17.6 | Genetic engineering | 278 |
| 17.7 | Biological control of insects and pests | 278 |
| 17.8 | Conclusions | 279 |
| | Glossary of terms | 280 |
| | Index | 285 |