Sixth Edition

Tuberculosis
and Nontuberculous Mycobacterial Infections
NOTICE

Medicine is an ever-changing science. As new research and clinical experience broaden our knowledge, changes in treatment and drug therapy are required. The authors and the publisher of this work have checked with sources believed to be reliable in their efforts to provide information that is complete and generally in accord with the standards accepted at the time of publication. However, in view of the possibility of human error or changes in medical sciences, neither the editors nor the publisher nor any other party who has been involved in the preparation or publication of this work warrants that the information contained herein is in every respect accurate or complete, and they disclaim all responsibility for any errors or omissions or for the results obtained from use of the information contained in this work. Readers are encouraged to confirm the information contained herein with other sources. For example and in particular, readers are advised to check the product information sheet included in the package of each drug they plan to administer to be certain that the information contained in this work is accurate and that changes have not been made in the recommended dose or in the contraindications for administration. This recommendation is of particular importance in connection with new or infrequently used drugs.
Sixth Edition

Tuberculosis

and Nontuberculous Mycobacterial Infections

Edited by

David Schlossberg, MD, FACP
Professor of Medicine
Temple University School of Medicine

and

Medical Director
Tuberculosis Control Program
Philadelphia Department of Public Health
Philadelphia, Pennsylvania

Washington, DC
This book is dedicated to the memory of John Weil Uhlmann, who fought valiantly against an implacable foe. His wife, children, grandchildren, and loyal friends miss him profoundly. We hope he is finally at peace.
“The Captain of all these men of death that came against him to take him away, was the consumption; for it was that that brought him down to the grave.”

John Bunyan
The Life and Death of Mr. Badman

The weariness, the fever, and the fret
Here, where men sit and hear each other groan;
Where palsy shakes a few, sad, last gray hairs,
Where youth grows pale, and spectre-thin, and dies;
Where but to think is to be full of sorrow
And leaden-eyed despairs,
Where beauty cannot keep her lustrous eyes,
Or new love pine at them beyond tomorrow.

John Keats
Ode to a Nightingale

There is a dread disease which so prepares its victim, as it were, for death . . . a dread disease, in which the struggle between soul and body is so gradual, quiet, and solemn, and the results so sure, that day by day, and grain by grain, the mortal part wastes and withers away, so that the spirit grows light . . . a disease in which death and life are so strangely blended that death takes the glow and hue of life, and life the gaunt and grisly form of death—a disease which medicine never cured, wealth warded off, or poverty could boast exemption from—which sometimes moves in giant strides, or sometimes at a tardy sluggish pace, but, slow or quick, is ever sure and certain.

Charles Dickens
Nicholas Nickleby
# CONTENTS

Contributors • iv
Preface • xv

## I. General Considerations

1. Tuberculosis in History: Did It Change the Way We Live? • 3
   **Thomas M. Daniel**

2. Epidemiology and Host Factors • 11
   **Asim K. Dutt**

3. Pathophysiology and Immunology • 29
   **Arthur M. Dannenberg, Jr., and Paul J. Converse**

4. Laboratory Diagnosis and Susceptibility Testing • 66
   **Gary W. Procop and Glenn D. Roberts**

5. Diagnosis of Latent Tuberculosis Infection • 75
   **Alfred A. Lardizabal and Lee B. Reichman**

6. Treatment of Latent Tuberculosis Infection • 83
   **Connie A. Haley**

7. Chemotherapy of Tuberculosis • 107
   **Thomas E. Dobbs and Risa M. Webb**

8. Therapy of Multidrug-Resistant and Extensively Drug-Resistant Tuberculosis • 120
   **Barbara J. Seaworth and Robert N. Longfield**

9. Role of Surgery in the Diagnosis and Management of Tuberculosis • 141
   **Alan D. L. Siboe and Wing Wai Yew**

10. *Mycobacterium bovis* BCG and New Vaccines against Tuberculosis • 162
    **Timothy Lahey and C. Fordham von Reyn**

11. Tuberculosis—a WHO Perspective • 182
    **Marcos A. Espinal and Mario C. Raviglione**

12. Tuberculosis in Enclosed Populations • 205
    **Sorana Segal-Maurer**

13. Role of the Health Department—Legal and Public Health Considerations • 224
    **Melisa Thombley, Kashef Ijaz, Beverly Metchock, and Philip LoBue**

## II. Clinical Syndromes

14. Pulmonary Tuberculosis • 245
    **Mary E. Kreider and Milton D. Rossman**

15. Upper Respiratory Tract Tuberculosis • 257
    **Surinder K. Jindal and Ritesh Agarwal**

16. Tuberculous Otomastoiditis • 266
    **George A. Pankey**

17. Ocular Tuberculosis • 269
    **Daniel M. Albert, Robert J. Peralta, and Matthew J. Thompson**

18. Central Nervous System Tuberculosis • 283
    **John M. Leonard**

19. Tuberculous Lymphadenitis and Parotitis • 293
    **W. Garrett Hunt**

20. Urogenital Tuberculosis • 301
    **André A. Figueiredo, Antônio M. Lucon, and Miguel Srougi**

21. Musculoskeletal Tuberculosis • 315
    **Michael K. Leonard, Jr., and Henry M. Blumberg**

22. Cardiovascular Tuberculosis • 335
    **John A. Crocco**
<table>
<thead>
<tr>
<th>Chapter</th>
<th>Title</th>
<th>Authors</th>
</tr>
</thead>
<tbody>
<tr>
<td>23.</td>
<td>Gastrointestinal Tuberculosis</td>
<td>Eric H. Choi and Walter J. Coyle</td>
</tr>
<tr>
<td>24.</td>
<td>Tuberculous Peritonitis</td>
<td>Urvashi Vaid and Gregory C. Kane</td>
</tr>
<tr>
<td>26.</td>
<td>Cutaneous Tuberculosis</td>
<td>Michael K. Hill and Charles V. Sanders</td>
</tr>
<tr>
<td>27.</td>
<td>Miliary Tuberculosis</td>
<td>Surendra K. Sharma and Alladi Mohan</td>
</tr>
<tr>
<td>28.</td>
<td>Endocrine and Metabolic Aspects of Tuberculosis</td>
<td>Christopher Vinnard and Emily A. Blumberg</td>
</tr>
<tr>
<td>29.</td>
<td>Hematologic Complications of Tuberculosis</td>
<td>Randall A. Oyer and David Schlossberg</td>
</tr>
<tr>
<td>30.</td>
<td>Tuberculosis in Infants and Children</td>
<td>Jeffrey R. Starke</td>
</tr>
<tr>
<td>32.</td>
<td>Tuberculosis Associated with HIV Infection</td>
<td>Midori Kato-Maeda, Annie Luetkemeyer, and Peter M. Small</td>
</tr>
<tr>
<td>33.</td>
<td>Tuberculosis and Organ Transplantation</td>
<td>José M. Aguado and Nina Singh</td>
</tr>
<tr>
<td>34.</td>
<td>Paradoxical Reactions and the Immune Reconstitution Inflammatory Syndrome</td>
<td>Preston Church and Marc A. Judson</td>
</tr>
<tr>
<td>35.</td>
<td>Nontuberculous Mycobacteria—Introduction</td>
<td>Henry Yeager</td>
</tr>
<tr>
<td>36.</td>
<td>Mycobacterium avium Complex Disease</td>
<td>Jason E. Stout and Carol D. Hamilton</td>
</tr>
<tr>
<td>38.</td>
<td>Mycobacterium kansasii</td>
<td>James C. Johnston and Kevin Elwood</td>
</tr>
<tr>
<td>39.</td>
<td>Mycobacterium marinum</td>
<td>Emmanuelle Cambau and Alexandra Aubry</td>
</tr>
<tr>
<td>40.</td>
<td>Mycobacterium scrofulaceum</td>
<td>Edward A. Horowitz</td>
</tr>
<tr>
<td>41.</td>
<td>Mycobacterium bovis and Other Uncommon Members of the Mycobacterium tuberculosis Complex</td>
<td>Jaime Esteban and Noelia Alonso-Rodríguez</td>
</tr>
<tr>
<td>42.</td>
<td>Other Nontuberculous Mycobacteria</td>
<td>Marvin J. Bittner and Laurel C. Preheim</td>
</tr>
<tr>
<td></td>
<td>Index</td>
<td></td>
</tr>
</tbody>
</table>
CONTRIBUTORS

Ritesh Agarwal  
Department of Pulmonary Medicine  
Postgraduate Institute of Medical Education & Research  
Sector-12, Chandigarh 160012, India

José M. Aguado  
Unit of Infectious Diseases  
University Hospital 12 de Octubre  
Madrid, Spain

Daniel M. Albert  
Department of Ophthalmology and Visual Sciences  
University of Wisconsin School of Medicine and Public Health  
Madison, WI 53792-3284

Noelia Alonso-Rodríguez  
Department of Clinical Microbiology, IIS-Fundación Jiménez Díaz  
28040 Madrid, Spain

Stephen C. Aronoff  
Department of Pediatrics  
Temple University School of Medicine  
Philadelphia, PA 19140

Alexandra Aubry  
Centre National de Référence pour la résistance des Mycobactéries aux antituberculeux  
Université Pierre et Marie Curie  
AP-HP Hôpital Pitié-Salpêtrière, Paris, France

Marvin J. Bittner  
Department of Medicine  
Creighton University School of Medicine  
Omaha, NE 68131

Emily A. Blumberg  
Division of Infectious Diseases  
University of Pennsylvania School of Medicine  
Philadelphia, PA 19104

Henry M. Blumberg  
Division of Infectious Diseases  
Emory University School of Medicine  
Atlanta, GA 30303

Barbara A. Brown-Elliott  
Department of Microbiology  
University of Texas Health Science Center  
Tyler, TX 75708

Emmanuelle Cambau  
Centre National de Référence pour la résistance des Mycobactéries aux antituberculeux (laboratoire associé)  
Laboratoire de Bactériologie, Université Paris Diderot,  
AP-HP Hôpital Saint Louis, Paris, France

Eric H. Choi  
Division of Gastroenterology and Hepatology  
Scripps Clinic Torrey Pines  
10666 N. Torrey Pines Road, N203  
La Jolla, CA 92037

Preston Church  
Ralph H. Johnson VAMC  
Charleston, SC 29425

Paul J. Converse  
Department of Medicine, School of Medicine  
The Johns Hopkins University  
Baltimore, MD 21205

Walter J. Coyle  
Division of Gastroenterology and Hepatology  
Scripps Clinic Torrey Pines  
10666 N. Torrey Pines Road, N203  
La Jolla, CA 92037

John A. Crocco  
Department of Medicine  
UMDNJ—Robert Wood Johnson Medical School  
New Brunswick, NJ 08854

Thomas M. Daniel  
Department of Medicine  
Case Western Reserve University  
Cleveland, OH 44106

Arthur M. Dannenberg, Jr.  
Bloomberg School of Public Health  
The Johns Hopkins University  
Baltimore, MD 21205
Thomas E. Dobbs  
Mississippi State Department of Health  
University of Mississippi Medical Center  
Jackson, MI 39215

Asim K. Dutt  
Chief, Medical Service (retired)  
Alvin C. York Veterans Administration Medical Center, Murfreesboro, Tennessee  
Professor and Vice Chairman (retired)  
Department of Medicine  
 Meharry Medical College, Nashville, Tennessee  
4117 SW 30th Court  
Ocala, FL 34474

Kevin Elwood  
Division of Tuberculosis Control  
British Columbia Centre for Disease Control  
655 West 12th Avenue  
Vancouver, BC V5Z 4R4, Canada

Marcos A. Espinal  
Health Surveillance, Disease Control & Prevention  
Pan American Health Organization  
525 23rd St., NW  
Washington, DC 20037

Jaime Esteban  
Department of Clinical Microbiology  
 Fundación Jiménez Díaz  
Av. Reyes Católicos 2  
28040 Madrid, Spain

André A. Figueiredo  
Núcleo Interdisciplinar de Pesquisa em Urologia and Department of Morphology, Federal University of Juiz de Fora, Minas Gerais—Brazil  
Rua Irineu Marinho 365, apto 801—bloco 3  
Bom Pastor—Juiz de Fora, MG 36021-580, Brazil

David M. Fleece  
Department of Pediatrics  
Temple University School of Medicine  
Philadelphia, PA 19140

Connie A. Haley  
Division of Infectious Diseases  
Vanderbilt University Medical Center  
Nashville, TN 37203

Carol D. Hamilton  
Family Health International  
Duke University Medical Center  
Durham, NC 27710

Michael K. Hill  
56 Starbrush Circle  
Covington, LA 70433

Edward A. Horowitz  
Department of Medicine  
Creighton University School of Medicine  
Omaha, NE 68131

W. Garrett Hunt  
Section of Infectious Diseases  
Nationwide Children’s Hospital  
Columbus, OH 43205

Dalia Ibrahim  
Department of Internal Medicine  
Georgetown University Hospital  
Washington, DC 20007

Kashef Ijaz  
Division of Tuberculosis Elimination Centers for Disease Control and Prevention  
Mail Stop E-10, 1600 Clifton Road  
Atlanta, GA 30333

Surinder K. Jindal  
Department of Pulmonary Medicine  
Postgraduate Institute of Medical Education & Research, Sector-12  
Chandigarh 160012, India

James C. Johnston  
Division of Tuberculosis Control  
British Columbia Centre for Disease Control  
655 West 12th Avenue  
Vancouver, BC V5Z 4R4, Canada

Marc A. Judson  
Division of Pulmonary and Critical Care Medicine  
Medical University of South Carolina  
Charleston, SC 29425

Gregory C. Kane  
Department of Pulmonary and Critical Care Medicine  
Thomas Jefferson University  
Philadelphia, PA 19107

Midori Kato-Maeda  
Division of Pulmonary and Critical Care Medicine  
San Francisco General Hospital  
University of California, San Francisco  
1001 Potrero Avenue  
San Francisco, CA 94110
Glenn D. Roberts
Laboratory Medicine and Pathology
Mayo Clinic College of Medicine
200 First Street Southwest
Rochester, MN 55905

Miguel Srougi
Division of Urology
University of São Paulo Medical School
Av Dr. Enéas de Carvalho Aguiar, 255
7 Andar, sala 710 E.
São Paulo, SP 05403-000, Brazil

Milton D. Rossman
Pulmonary and Critical Care Section
Hospital of the University of Pennsylvania
Philadelphia, PA 19104-4283

Jeffrey R. Starke
Department of Pediatrics
Baylor College of Medicine
Houston, TX 77030

Charles V. Sanders
Department of Medicine
Louisiana State University School of Medicine
1542 Tulane Avenue, Suite 421, Box T4M-2
New Orleans, LA 70112

Jason E. Stout
Division of Infectious Diseases and International Health
Duke University Medical Center
Durham, NC 27710

David Schlossberg
Department of Medicine
Temple University School of Medicine
Philadelphia Department of Public Health
Philadelphia, PA 19140

Thomas H. Taylor
Division of Gastroenterology
Georgetown University Hospital
Washington, DC 20007

Barbara J. Seaworth
Heartland National TB Center
University of Texas Health Science Center
2303 Southeast Military Drive
San Antonio, TX 78223

Melisa Thombley
Division of Tuberculosis Elimination
Centers for Disease Control and Prevention
Mail Stop E-10, 1600 Clifton Road
Atlanta, GA 30333

Sorana Segal-Maurer
Division of Infectious Diseases
New York Hospital Queens
Flushing, NY 11355

Matthew J. Thompson
Tower Clock Eye Center
1087 West Mason Street
Green Bay, WI 54303

Surendra K. Sharma
Department of Medicine
All India Institute of Medical Sciences
New Delhi 110 029, India

Urvashi Vaid
Department of Pulmonary and Critical Care Medicine
Thomas Jefferson University
Philadelphia, PA 19107

Alan D. L. Siboe
Department of Cardiothoracic Surgery
Queen Mary Hospital
University of Hong Kong
Hong Kong, China

Christopher Vinnard
Division of Infectious Diseases
University of Pennsylvania School of Medicine
Philadelphia, PA 19104

Nina Singh
University of Pittsburgh Medical Center
2A 137 Infectious Diseases Section
VA Pittsburgh Healthcare System and University of Pittsburgh
University Drive C
Pittsburgh, PA 15240

C. Fordham von Reyn
Section of Infectious Diseases and International Health
Department of Medicine
Dartmouth Medical School
Lebanon, NH 03756

Peter M. Small
Institute for Systems Biology
1441 N. 34th Street
Seattle, WA 98103-8904

Richard J. Wallace, Jr.
Department of Microbiology
University of Texas Health Science Center
Tyler, TX 75708
Risa M. Webb
Department of Infectious Diseases
G. V. “Sonny” Montgomery VA Medical Center
University of Mississippi Medical Center
Mississippi State Department of Health
Jackson, MS 39216

Henry Yeager
Department of Medicine
Georgetown University Medical Center
Washington, DC 20007

Wing Wai Yew
Tuberculosis and Chest Unit
Grantham Hospital
Hong Kong, China
I am pleased to present the sixth edition of *Tuberculosis and Nontuberculous Mycobacterial Infections.*

Tuberculosis remains epidemic in much of the world, causing several million deaths each year. Although most of these deaths occur in developing nations, the developed world continues to struggle with tuberculosis, with evolving challenges from drug resistance, immigration, immunosuppression, and the expanding awareness of nontuberculous mycobacterial infection.

The previous structure of this book has been maintained. Section I presents basic concepts of epidemiology, pathophysiology, diagnosis, medical and surgical therapy, resistant tuberculosis, vaccines, tuberculosis in enclosed populations, and the role of the Health Department. Section II describes both classic and more recently described clinical manifestations of tuberculous infection. Virtually every organ system is included, as are the endocrinologic and hematologic complications of tuberculosis. Separate chapters address issues unique to pregnancy, infants and children, human immunodeficiency virus infection, and the immune reconstitution syndrome. Section III comprises nontuberculous mycobacterial infections, with an overview of clinical syndromes produced by these organisms as well as individual chapters on *Mycobacterium avium-intracellulare, Mycobacterium fortuitum,* and other rapidly growing mycobacteria; *Mycobacterium kansasii; Mycobacterium marinum; Mycobacterium scrofulaceum;* and additional, less common, pathogenic mycobacteria.

Three new chapters have been added. “Tuberculosis in History: Did It Change the Way We Live?” explores the influence of tuberculosis on our civilization’s history and culture, “Tuberculosis and Organ Transplantation” defines the challenges of tuberculous infection in the expanding world of transplantation, and “*Mycobacterium bovis* and Other Uncommon Members of the *Mycobacterium tuberculosis* Complex” updates the clinical significance of these mycobacteria.

In addition to the new chapters, every chapter has been thoroughly updated. New clinical data affect our understanding of gamma interferon release assays, the human immunodeficiency virus-tuberculosis interaction, immune reconstitution inflammatory syndrome, and extensively drug-resistant tuberculosis. The protean facets of pulmonary and extrapulmonary tuberculosis continue to challenge the clinician, as does the growing list of nontuberculous mycobacterial pathogens. Epidemiological issues include airline-associated infection, the explosion of tuberculosis in areas of the developing world, and the critical roles of the World Health Organization and departments of public health in tuberculosis control.

I hope that this text continues to provide a complete and user-friendly resource for everyone—clinician, scientist, and epidemiologist—in involved in the diagnosis and treatment of tuberculosis.

I am grateful for the guidance and support of the editorial staff at ASM Press, particularly Jeff Holtmeier, Ken April, Greg Payne, and John Bell.

David Schlossberg, MD, FACP
INDEX

Acid-fast staining, 69
Acute care facilities, air filtration in, 217–218
curtailment and prevention in, 213
tuberculosis in, 206–207
Addison's disease, 436
Adrenal tuberculosis, adrenal insufficiency in, 436–437
computed tomography in, 437
differential diagnosis of, 437
histopathological patterns of, 436
manifestations of, 436–437
treatment of, 437
Adults, tuberculosis in, 163
subapical localization of, 40
Advisory Council for Elimination of Tuberculosis (ACET), 224
AIDS. See HIV/AIDS
Air disinfection, air filtration for, 217–218
UV germicidal irradiation for, 216–217
ventilation for, 216
Air leak syndromes, miliary tuberculosis and, 423
Air travel, tuberculosis and, 23–24
Air travelers, infection transmission among, 210–211, 215, 218–219
Airborne disease, tuberculosis as, 14–15
Airway stenosis, following endobronchial tuberculosis, 156–158
Alcoholic hepatitis, 394
Alcoholism, 17
Alveolar macrophages (AM), 30
American Lung Association, 3
Amikacin, 112, 121, 132
Aminoglycosides, 121, 128
p-Aminosalicylic acid agents, 112
para-Aminosalicylic acid (PAS), in multidrug-resistant tuberculosis, 123, 133
Amplified Mycobacterium tuberculosis Direct (AMTD) test, 70–71
Amyloidosis, 395
Anatomic site, 20
Anemia, associated with tuberculosis, 448–450
following erythrocyte destruction, 448
in HIV/AIDS, 539–540
macrocytic, 448
myelophthisic, 449
normochromic normocytic, 448
sideroblastic, 448
Anesthesia, for thoracic surgery, 142
Animal studies, 41–42
Antibiotics, in Mycobacterium bovis disease, 610–611
susceptibility to, in Mycobacterium marinum infection, 593
Antibodies, 50
Antigen-presenting cells (APCs), 47
and major histocompatibility complex, 47–48
Antigens, critical, immunity to, vaccines and, 55–56
Antimicrobial susceptibility testing, 72
Antimicrobials, 51
in Mycobacterium avium complex disease, 545
in Mycobacterium marinum infection, 592–594
in rapidly growing mycobacterial disease, 570–571
new, in multidrug-resistant tuberculosis, 125
Antineoplastic agents, 25
Antiretroviral therapy, in miliary tuberculosis, 429, 430
tuberculosis in HIV infection and, 481–482, 483, 489
Antituberculous drugs, in childhood tuberculosis, 469–470
Antituberculous therapy, hematologic toxicity from, 449, 452–453
hepatic injury due to, 395–399
prophylaxis of, 399
in thyroid gland tuberculosis, 438
in transplant recipients, duration of, 505
Aorta, tuberculosis of, 345–346
Arachnoiditis, spinal tuberculosis, 289–290
Arthritis, tuberculous, 319–320
clinical features of, 321
diagnosis of, 324–326
treatment of, 331
tuberculous osteomyelitis and, 318–319
Arts, creativity in, impact of tuberculosis on, 7–9
Azithromycin, in Mycobacterium avium complex disease, 546, 549, 550
in Mycobacterium scrofulaceum, 604
B cells, 49
Bacillary strain, virulence of, 29–30
Bacillus Calmette-Guérin (BCG), 29, 33, 40, 52, 78, 83
administration of, 170
characteristics of, 172
current use of, 171–172
efficacy of, 167
against other diseases, 170
trials of, 169
variations of, 170
global tuberculosis in era of, 162
granulomatous hepatitis induced by, 385
history of, 166
immune response to, 166–167
in Chingleput, South India trial, 168
in HIV infection, 168–169
in mycobacterium-experienced subjects, 168
in mycobacterium-naïve subjects, 167
new vaccines and, 162–181
prevention of infection and, 169
side effects of, 170–171
strain variation, 166

BacT/Alert MP system, 68
BACTEC 460 TB system, 68, 72
Baker, Josephine, 5
Balanchine, George, 6, 7
Basophilia, 450
Bell, Alexander Graham, 6
Bernhardt, Sarah, 7
Bile ducts, tuberculosis of, 385–386
Biliary tract, tuberculosis of. See Hepatobiliary tuberculosis
Bladder tuberculosis, 306
Blood assays, 79–80
Bone marrow fibrosis, anemia due to, 449
Braille, Louis, 5–6
Breast, tuberculosis of, 412
British Medical Research Council, 4
Bronchial arterial embolization, 152, 153, 154
Bronchiectasis, surgery for, 152–153
Bronchoalveolar lavage, in miliary tuberculosis, 426
Bronchopleural fistula, after tuberculosis surgery, 152
Bronchoscopy, in miliary tuberculosis, 428
Brontë, Charlotte, 8
Brontë, Emily, 8
Brontë, Reverend Patrick, 8
Bruce, James, 4
Capreomycin, 112, 121, 132
Cardiopulmonary exercise testing, in miliary tuberculosis, 425–426
Cardiovascular complications, in miliary tuberculosis, 424
Cardiovascular tuberculosis, 335–349
Case rates, by age and sex, 15, 16
by race/ethnicity, 19
in foreign-born, 21–22
in United States, 17, 18
in U.S.-born versus foreign-born, 19
Caseous necrosis, 31, 34–37
Catheter-related infections, due to rapidly growing mycobacteria, 572
Cavity formation, liquefaction and, 38–40
prevention of, 39–40
CD4 cells, 49
CD8 cells, 49
Cell-mediated immunity (CMI), 15, 30, 31, 35–36, 37, 38, 43–44
and delayed-type hypersensitivity, synergism between, 44–47, 56
Centers for Disease Control (CDC), 23, 226, 227
Division of Global Migration and Quarantine (DGMQ), 232–234
Division of Tuberculosis Elimination (DTBE), 226, 233, 234
Central nervous system infections, due to rapidly growing mycobacteria, 573
Central nervous system tuberculosis, 283–292
epidemiology of, 283
treatment of, 289–290
response to, 290
Charles IX, 4
Chekhov, Anton, 7
Chemotherapy, 107–119, 190–191
adherence to, 108
adverse reactions to, 115–116
combination antituberculous, monitoring in, 398–399
drug monitoring during, 115
failure, 113–114
for management in low-income/high-incidence countries, 117
in cutaneous tuberculosis, 412–413
in renal dysfunction, 111
interruptions in, 114, 115
monitoring during, 113–114
principles of, 107–108
relapse following, 114
treatment regimens, 112–115
Chest radiography, during chemotherapy, 113, 114
in childhood tuberculosis, 461–463
in HIV infection, 486
in miliary tuberculosis, 426–428
in pulmonary tuberculosis, 246–249
Childhood tuberculosis, 163
adherence to treatment in, 470
case rates by age, 457
case rates by ethnicity, 458
case rates by season, 458
clinical manifestations of, 460–465
collapse-consolidation in, 462
diagnosis of, 465–467
diagnostic mycobacteriology in, 467
discovery of, 460
drug resistance in, 470
epidemiology of, 457
exposure and, 468
extrathoracic, 464–465
follow-up in, 470–471
HIV and, 458, 465
incubation period of, 459
infection in, 457–458
infection rates, 458
management of, 467–471
miliary, 464
nucleic acid amplification in, 467
pathogenesis of, 459–460
pharmacologic therapy in, 468–471
pleural disease in, 463–464
polymerase chain reaction test in, 467
public health aspects of, 471
pulmonary disease in, 460–463
reactivation-type, 463
terminology used in, 456–457
transmission of, 458–459
worldwide burden of, 457
<table>
<thead>
<tr>
<th>Term</th>
<th>Page Numbers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Children, tuberculosis in. See Childhood tuberculosis</td>
<td>629</td>
</tr>
<tr>
<td>Chopin, Frédéric, 7</td>
<td></td>
</tr>
<tr>
<td>Choroidal tuberculomas, 275–276</td>
<td></td>
</tr>
<tr>
<td>Choroiditis, tuberculous, 273–275</td>
<td></td>
</tr>
<tr>
<td>Cigarette smoking, 17</td>
<td></td>
</tr>
<tr>
<td>Ciliary body tuberculomas, 276</td>
<td></td>
</tr>
<tr>
<td>Ciprofloxacin, 122</td>
<td></td>
</tr>
<tr>
<td>in Mycobacterium avium complex disease, 547, 552</td>
<td></td>
</tr>
<tr>
<td>Cirrhosis, 395</td>
<td></td>
</tr>
<tr>
<td>Clarithromycin, cholestatic illness due to, 398</td>
<td></td>
</tr>
<tr>
<td>in Mycobacterium avium complex disease, 546, 549, 550, 552</td>
<td></td>
</tr>
<tr>
<td>in Mycobacterium kansasii infection, 581, 582</td>
<td></td>
</tr>
<tr>
<td>in rapidly growing mycobacteria disease, 570</td>
<td></td>
</tr>
<tr>
<td>Clark, Sir James, 3</td>
<td></td>
</tr>
<tr>
<td>Clofazimine, in multidrug-resistant tuberculosis, 124, 133</td>
<td></td>
</tr>
<tr>
<td>Coagulation system abnormalities, in tuberculosis, 452</td>
<td></td>
</tr>
<tr>
<td>Colonic tuberculosis, 357–358</td>
<td></td>
</tr>
<tr>
<td>Community partnerships, 198</td>
<td></td>
</tr>
<tr>
<td>Computed tomography, high-resolution, in</td>
<td></td>
</tr>
<tr>
<td>nontuberculous mycobacteria, 529</td>
<td></td>
</tr>
<tr>
<td>in adrenal tuberculosis, 437</td>
<td></td>
</tr>
<tr>
<td>in childhood tuberculosis, 461</td>
<td></td>
</tr>
<tr>
<td>in gastrointestinal tuberculosis, 358–360</td>
<td></td>
</tr>
<tr>
<td>in miliary tuberculosis, 428</td>
<td></td>
</tr>
<tr>
<td>in pulmonary tuberculosis, 248–249</td>
<td></td>
</tr>
<tr>
<td>Congenital tuberculosis, 384–385</td>
<td></td>
</tr>
<tr>
<td>Contagion, prevention of, methods of, 29</td>
<td></td>
</tr>
<tr>
<td>Control, administrative, 212</td>
<td></td>
</tr>
<tr>
<td>and prevention, strategies for, 224</td>
<td></td>
</tr>
<tr>
<td>current status of, 190</td>
<td></td>
</tr>
<tr>
<td>environmental, 215–216</td>
<td></td>
</tr>
<tr>
<td>evolution of, 190–191</td>
<td></td>
</tr>
<tr>
<td>federal and international authority for, 226–228</td>
<td></td>
</tr>
<tr>
<td>funding for, 200</td>
<td></td>
</tr>
<tr>
<td>historical and epidemiological context of, 224–225</td>
<td></td>
</tr>
<tr>
<td>planning and development of policy for, 230–232</td>
<td></td>
</tr>
<tr>
<td>public health programs for, organization of, 225–226</td>
<td></td>
</tr>
<tr>
<td>state authority for, 228–230</td>
<td></td>
</tr>
<tr>
<td>Correctional facilities, air filtration in, 218</td>
<td></td>
</tr>
<tr>
<td>tuberculosis in, 207–208, 213–214</td>
<td></td>
</tr>
<tr>
<td>Corticosteroids, development of tuberculosis and, 442–443</td>
<td></td>
</tr>
<tr>
<td>in immune reconstitution inflammatory syndrome, 514, 548</td>
<td></td>
</tr>
<tr>
<td>in miliary tuberculosis, 429</td>
<td></td>
</tr>
<tr>
<td>in Mycobacterium avium complex disease, 547</td>
<td></td>
</tr>
<tr>
<td>in pericardial tuberculosis, 340–343</td>
<td></td>
</tr>
<tr>
<td>Cosmetic surgery procedures, rapidly growing mycobacteria and, 568</td>
<td></td>
</tr>
<tr>
<td>Crane, Stephen, 7</td>
<td></td>
</tr>
<tr>
<td>Crofton, Sir John, 190</td>
<td></td>
</tr>
<tr>
<td>Crohn's disease, ileal tuberculosis versus, 357</td>
<td></td>
</tr>
<tr>
<td>Cutaneous infections, disseminated, due to rapidly growing mycobacteria, 572</td>
<td></td>
</tr>
<tr>
<td>Cutaneous tuberculosis, 409–414</td>
<td></td>
</tr>
<tr>
<td>diagnosis of, 412</td>
<td></td>
</tr>
<tr>
<td>from endogenous source, 410–411</td>
<td></td>
</tr>
<tr>
<td>from exogenous source, 409–410</td>
<td></td>
</tr>
<tr>
<td>from hematogenous source, 411–412</td>
<td></td>
</tr>
<tr>
<td>synonomous for, 410</td>
<td></td>
</tr>
<tr>
<td>therapy of, 412–413</td>
<td></td>
</tr>
<tr>
<td>Cycloserine, 112, 123, 133</td>
<td></td>
</tr>
<tr>
<td>Cystic bone lesions, differential diagnosis of, 327</td>
<td></td>
</tr>
<tr>
<td>Cystic fibrosis, chronic pulmonary infections in, 573</td>
<td></td>
</tr>
<tr>
<td>Cystic fibrosis transmembrane conductance regulator, 537</td>
<td></td>
</tr>
<tr>
<td>Cytokines, 50</td>
<td></td>
</tr>
<tr>
<td>Deaths, worldwide annual, 11</td>
<td></td>
</tr>
<tr>
<td>Detection, 20</td>
<td></td>
</tr>
<tr>
<td>Development in community, concept of, 11–12</td>
<td></td>
</tr>
<tr>
<td>Diabetes mellitus, tuberculosis in, 441–442</td>
<td></td>
</tr>
<tr>
<td>treatment of, 442</td>
<td></td>
</tr>
<tr>
<td>Diagnosis, surgery for, 145–149</td>
<td></td>
</tr>
<tr>
<td>Directly observed treatment short course (DOTS), 182, 190–193</td>
<td></td>
</tr>
<tr>
<td>dnaJ gene sequencing, rapidly growing mycobacteria and, 569</td>
<td></td>
</tr>
<tr>
<td>Do Not Board (DNB) list, 215, 227</td>
<td></td>
</tr>
<tr>
<td>Drug interactions, 546</td>
<td></td>
</tr>
<tr>
<td>Drug resistance, mechanisms of, 120–121</td>
<td></td>
</tr>
<tr>
<td>Echocardiography, in miliary tuberculosis, 428</td>
<td></td>
</tr>
<tr>
<td>Economic burden, 189</td>
<td></td>
</tr>
<tr>
<td>Efavirenz, and rifampin, 489</td>
<td></td>
</tr>
<tr>
<td>Elderly, tuberculosis in, 163, 250–251</td>
<td></td>
</tr>
<tr>
<td>Empyema, 154–155, 253</td>
<td></td>
</tr>
<tr>
<td>Enclosed populations, tuberculosis in, 205–223</td>
<td></td>
</tr>
<tr>
<td>Endobronchial tuberculosis, airway stenosis following, 156–158</td>
<td></td>
</tr>
<tr>
<td>corticosteroids in, 299</td>
<td></td>
</tr>
<tr>
<td>Endoscopic ultrasound, in gastrointestinal tuberculosis, 359–360</td>
<td></td>
</tr>
<tr>
<td>Environmental control, 215–216</td>
<td></td>
</tr>
<tr>
<td>Eosinophilia, 450</td>
<td></td>
</tr>
<tr>
<td>Epidemic waves, 11–14</td>
<td></td>
</tr>
<tr>
<td>Epidemiology, 11–28</td>
<td></td>
</tr>
<tr>
<td>in United States, 17–20</td>
<td></td>
</tr>
<tr>
<td>Erythrocytes, 448–450</td>
<td></td>
</tr>
<tr>
<td>Esophageal tuberculosis, 353–354</td>
<td></td>
</tr>
<tr>
<td>Ethambutol (EMB), characteristics of, 107–108, 109</td>
<td></td>
</tr>
<tr>
<td>for tuberculin-positive transplant recipients, 503</td>
<td></td>
</tr>
<tr>
<td>in central nervous system tuberculosis, 290</td>
<td></td>
</tr>
<tr>
<td>in Mycobacterium avium complex disease, 546, 552, 553</td>
<td></td>
</tr>
<tr>
<td>in ocular tuberculosis, 279</td>
<td></td>
</tr>
<tr>
<td>toxicity of, 111</td>
<td></td>
</tr>
<tr>
<td>Ethionamide, 112, 123, 128–129, 132</td>
<td></td>
</tr>
<tr>
<td>Extensively drug-resistant tuberculosis (XDR-TB), epidemiology of, 120–121</td>
<td></td>
</tr>
<tr>
<td>treatment of, 129–130</td>
<td></td>
</tr>
<tr>
<td>Extrapulmonary tuberculosis, in children, 469–470</td>
<td></td>
</tr>
<tr>
<td>in HIV infection, 484</td>
<td></td>
</tr>
<tr>
<td>liver in, 381</td>
<td></td>
</tr>
<tr>
<td>treatment of, 116</td>
<td></td>
</tr>
<tr>
<td>Female genital tuberculosis, 307</td>
<td></td>
</tr>
<tr>
<td>Fever, as symptom of disseminated tuberculosis, 499</td>
<td></td>
</tr>
<tr>
<td>Fibrothorax, 154–155</td>
<td></td>
</tr>
<tr>
<td>Fine-needle aspiration, in thyroid gland tuberculosis, 438</td>
<td></td>
</tr>
</tbody>
</table>
Fish tank granuloma, 586
Fluorochrome staining, 69
Fluoroquinolones, 112
for organ transplant recipients with tuberculosis, 504
for tuberculin-positive transplant recipients, 503
hepatic dysfunction due to, 398
in multidrug-resistant tuberculosis, 122–123, 128
in Mycobacterium avium complex disease, 547, 552
in Mycobacterium kansasii infection, 581
Foreign-born persons, tuberculosis in, 209–210, 215, 218–219
Francis of Assisi, 5
Frost, Wade Hampton, 3–4
Gallbladder, tuberculosis of, 387
Gamma interferon, 15, 20
and tuberculin skin test, compared, 80–82
diagnostic accuracy of, 79–80
in HIV infection, 485, 486–487
in miliary tuberculosis, 425
in Mycobacterium kansasii infection, 580
negative, treatment of latent infection in, 101
Gas exchange abnormalities, in miliary tuberculosis, 425
Gastric tuberculosis, 354–355
Gastrointestinal complications, in miliary tuberculosis, 424
Gastrointestinal tuberculosis, 350–366
clinical manifestations of, 352–353
diagnosis of, 358–360
epidemiology and risk factors for, 351–352
laboratory testing in, 353
pathogenesis of, 350–351
treatment of, 360
Gastrointestinal upset, due to chemotherapy, 115
Gatifloxacin, in Mycobacterium avium complex disease, 547
Genetic factors, 17
Glucocorticosteroids, 24
Granulocytes, 450
Granulomas, hepatic, 372–376
in Mycobacterium marinum infection, 592
swimming pool, 586
Harvard, John, 5
Health care, primary, 196–197
Health care-associated disease, rapidly growing mycobacteria and, 566–568
Health care system, strengthening of, 196–197
Health care workers, in tuberculosis control, 197
personal protective equipment for, 219–220
tuberculosis in, 23, 164, 211
Health department, collection and analysis of data by, 238–239
laboratory and diagnostic services of, 238
legal and public health considerations, 224–241
management of persons with tuberculosis, 235
medical consultation by, 235–236
training and education by, 239
Hemophagocytic syndrome, pathological, 450
Hemophilia, secondary to tuberculosis, 389
Hemoptyis, massive, 153–154
Hemorrhage, 254
Hemosiderosis, 395
Hepatic complications, in miliary tuberculosis, 424
Hepatic granulomas, biopsy incidence of, 373, 374, 375
character of, 375–376
prevalence of, 372–375
Hepatic injury, due to antituberculous therapy, 395–399
Hepatic lesions, in tuberculosis, 394–395
nonspecific, in hepatobiliary tuberculosis, 377–379
Hepatic mycobacterial infection, in AIDS, 389–392
Hepatitis, alcoholic, 394
due to antituberculosis drugs, 491
granulomatous, due to Mycobacterium scrofulaceum, 604
induced by bacille Calmette-Guérin, 385
viral, 394–395
Hepatobiliary pancreatic tract, tuberculosis of, 385–389
Hepatobiliary tuberculosis, 372–408
and pancreatic tuberculosis, 372, 387–389
biochemical abnormalities in, 379–381
clinical symptoms and signs of, 381
evidence of hepatic involvement in, 372–381
histologic spectrum of, 372, 373
history of, 372
localized, liver in, 381–383
Hepatotoxicity, due to antituberculous therapy, prophylaxis of, 399
due to chemotherapy, 115–116
High-performance liquid chromatography (HPLC), rapidly growing mycobacteria and, 568
Highly active antiretroviral therapy (HAART), 509, 539
and HIV, effect on granulomatous response, 511
History, 3–10, 11
HIV/AIDS, anemia in, 539–540
as risk factor for tuberculosis, 476
chest radiography in, 486
childhood tuberculosis and, 458, 465
coinfection with tuberculosis, 15, 17, 18–19, 42, 163–164, 184–187, 250, 481–497
antiretroviral therapy in, 489
at all stages, 481
chemotherapy in, 117
clinical presentation of, 483–484
deaths attributed to, 483
diagnosis of, 484–487
diagnosis of tuberculosis in, 485–487
in homeless persons, 208
organs affected by, 484
pathogenesis of, 481–482
prevention of, 491–492
reduction of, 194–195
treatment of, 487–491
tuberculin test in, 79
drug interactions in, 489–491
epidemiology of, 482–483
hepatic mycobacterial infection in, 389–392
highly active antiretroviral therapy and, effect on
granulomatous response, 511
immune dysfunction and immune depletion in, 481
latent tuberculosis in, testing for, 484–485
treatment of, 487
miliary tuberculosis in, 423
multidrug-resistant and extensively drug-resistant
tuberculosis, 120–121
*Mycobacterium avium* complex disease and, 531–532,
533–534
prophylaxis of, 548–549
treatment of, 546–548
*Mycobacterium avium* complex in, 390–392, 538–540
*Mycobacterium kansasii* infection in, 579
Miliary tuberculosis in, 342, 344–345
sarcoidosis in, diagnosis of, 517
treatment of, 581–582
*Mycobacterium tuberculosis* in, 389–390, 481
pericardial tuberculosis in, 342, 344–345
sarcoidosis in, diagnosis of, 517
treatment of, 504–505
tuberculous meningitis and, 285
urogenital tuberculosis in, 308–309
with MDR- or XDR-TB, 130
Homeless shelters, tuberculosis in, 208, 214, 218
Host factors, 11–28
Host immune response, multiplication of tubercle bacilli
and, 57
Host-parasite interactions, 29
Hot tub lung, 542–543
*bsp65* gene sequencing, rapidly growing mycobacteria
and, 569
Hypercalcemia, tuberculosis-associated, 440–441
Hyperglycemia, in tuberculosis, 441
Hypersensitivity, delayed-type (DTH), 30, 35, 36, 37, 38,
43, 44
and cell-mediated immunity, synergism between,
44–47, 56
Hyponatremia, in tuberculosis, 439–440
Hypopituitarism, 439
Hypopituitarism, in tuberculosis, 439–440
IFN-γ, 51
in *Mycobacterial avium* complex disease, 552
IFN-γ release assays, 79–80
and tuberculin skin test, compared, 80–82
diagnostic accuracy of, 79–80
in childhood tuberculosis, 466
IL-12, 50
IL-17, 50
Ileal tuberculosis, versus Crohn’s disease, 357
Imipenem, in multidrug-resistant tuberculosis, 124–125
Immigrants, evaluation of, 232–234
Immune control, mechanisms of, 165–166
Immune protection, dysfunction of, and immune
depletion, in HIV/AIDS, 481
sources of, 164–165
Immune reconstitution inflammatory syndrome (IRIS),
antiretroviral therapy and, 484, 491
characteristics of, 491
clinical characteristics and incidence of, 513–514
development of, risk factors for, 514
due to *Mycobacterium avium* complex, case
presentation of, 514–515
in miliary tuberculosis, 424
in sarcoidosis, case presentation of, 516
clinical aspects of, 516–517
management of, 514
*Mycobacterium avium* complex disease and, 548
organ transplant recipients with tuberculosis and, 505
paradoxical reactions and, 509–521
clinical features of, 509, 510
risk factors for, 491
tuberculosis-associated, case presentations of, 511–512
typical, 513–514
Immune response, protective, antigen specificity of,
165–166
Immunity, acquired (adaptive), and innate immunity, 47
systemic, 51
Immunologic blood testing, in *Mycobacterium avium*
complex disease, 544
Immunologic considerations, 15
Immunological abnormalities, in miliary tuberculosis, 426
Immunology, 42–56
and pathophysiology, 29–65
Immunosuppression, iatrogenic, 24–25
urogenital tuberculosis in, 308–309
Incidence, global, 185, 186, 192–193
Infants, tuberculosis in. See *Childhood tuberculosis*
Infection, control of, 134
identification and management of persons with,
237–238
initial, manifestations of, 162–163
transmission of, 14, 15
Infectious particles, size of, 29–30
INNO-LiPA multiplex probe assay, 570
Interjurisdictional referrals, 236–237
Interleukin-12 receptor B1, 15
International Health Regulations (IHR), 227–228
Intracellular persistence, 165
Isocitrate lyase (ICL), 47
Isoniazid (INH), 14, 86, 87–93, 108, 125, 133
adherence to, 93
adverse effects of, 91, 108, 453
and rifampin, 86, 88, 89, 94–95
and rifapentine, 87, 88, 95–96
characteristics of, 107–108, 109
for organ transplant recipients with tuberculosis,
503–504, 505
for tuberculin-positive transplant recipients, 502
hepatic injury due to, 396–397
in central nervous system tuberculosis, 289
in childhood tuberculosis, 469
in *Mycobacterium avium* complex disease, 549
in *Mycobacterium kansasii* infection, 581
in ocular tuberculosis, 279
in tuberculosis and HIV infection, 489
in tuberculosis in pregnancy, 478–479
monitoring in use of, 398–399
resistance to, 22
Jaundice, due to hepatobiliary tuberculosis, 386–387
Kanamycin, 112, 121
32-kDa protein gene sequencing, rapidly growing mycobacteria and, 569
Keats, John, 7, 9
Koch, Robert, 531, 607
Laboratory diagnosis, and susceptibility testing, 66–74
Lady Windermere Syndrome, 541–542
Laënnec, René Théophile Hyacinthe, 4
Laparoscopy, in miliary tuberculosis, 428
Laparoscopy infections, rapidly growing mycobacteria and, 568
Larynx, tuberculosis of, 259–262
Laser therapy, in ocular tuberculosis, 279
Latent infection, characteristics of, 83
diagnosis of, 75–82
hepatotoxicity and, 91–93
in correctional facilities, 207–208
in immunosuppression in HIV, 482
in organ transplantation candidates, treatment of, 501–502
pretreatment evaluation and counseling in, 96–97
progression to active, 84–85
risk of, 83–85
screening for, 212–213
targeted testing and treatment in, 237–238
testing for, in HIV, 484–485
treatment of, 85–106, 487
adherence to, 97–100
cost-effectiveness of, 99
in exposure to drug-resistant tuberculosis, 100–101
in negative TST or IGRA, 101
in silicosis, 93, 94
in transplant recipient, 502–503
monitoring during, 96–97
Levofloxacin, 109, 110, 122, 132
for tuberculin-positive transplant recipients, 503
in Mycobacterium avium complex disease, 530
Linezolid, for organ transplant recipients with tuberculosis, 504
in multidrug-resistant tuberculosis, 124, 133
in Mycobacterium avium complex disease, 552
in rapidly growing mycobacterial disease, 571
side effects of, 453
Liquifaction, and cavity formation, 37–39
prevention of, 38–39
Literature, creativity in, impact of tuberculosis on, 7–9
Liver, site of tuberculosis and, 381–394
tuberculosis of. See Hepatobiliary tuberculosis
Liver dysfunction, tuberculosis in, treatment of, 117
Liver transplant patients, tuberculosis in, 392–394
Liver transplant recipients, latent tuberculosis in, 503
with tuberculosis, treatment of, 504
Lombard, Carol, 6–7
Long-term care facilities, tuberculosis in, 209, 215, 218
Lopinavir, and rifampin, 490
Louis XIII, 4
Lung cancer, and tuberculosis, 158
Lung macrophage, Mycobacterium avium complex and, 537
Lung parenchyma, diagnosis of tuberculosis in, 145–146
Lung resection surgery, for pulmonary tuberculosis, 149–154
Lungs, abnormal function of, in miliary tuberculosis, 425
Lupus vulgaris, 412
Lymphadenitis, and parotitis, tuberculous, 293–299
clinical illness in, 296–297
diagnosis of, 297–298
epidemiology of, 293–294
historical perspectives on, 293
pathology of, 294–296
treatment of, 298–299
due to Mycobacterium scrofulaceum, 602–603
nontuberculous, 603
tuberculous, paradoxical reactions in, 510
Lymphadenopathy, in childhood tuberculosis, 460, 463
Lymphocytes, 47–49
effects of tuberculosis on, 451–452
Lymphocytopenia, in tuberculosis, 451–452
Lymphocytosis, in tuberculosis, 451–452
Macrolide, in Mycobacterial avium complex disease, 553
Macrophage and T-cell containment, 165
Macrophages, alveolar, 30
killing of tubercle bacilli by, 46–47
lung, Mycobacterium avium complex and, 537
phagocytosis of tubercle bacilli by, 45–46
turnover of, in tuberculous lesions, 52
Magnetic resonance imaging, in miliary tuberculosis, 428
Major histocompatibility complex (MHC), 36–37
and antigen-presenting cells, 47–48
Malabsorptive disease, tuberculosis in, treatment of, 117
Mandela, Nelson, 4
Mansfield, Katherine, 7
Mantoux test, 20, 76, 77
in childhood tuberculosis, 465–466
tuberculosis in pregnancy and, 478
Marble, Alice, 6, 7
Mastitis, tuberculous, 412
Mathewson, Christopher, 6
Matrix metalloproteinase 9, in ocular tuberculosis, 279–280
Maugham, W. Somerset, 7
Mechanical ventilation, in miliary tuberculosis, 429, 430
Mediastinal lymphadenopathy, diagnosis of tuberculosis and, 147–149
Mediastinoscopy, cervical, 148
Mediastinotomy, anterior, 148–149
Medicine, practice of, impact of tuberculosis on, 3–4
Meningitis, due to Mycobacterium scrofulaceum, 603–604
tuberculous (TBM), 439
and HIV infection, 285
clinical presentation of, 285
diagnosis of, 285–288
differential diagnosis of, 288
in children, 464, 470
pathogenesis of, 283–284
pathology of, 284–285
response to treatment, 290
Meropenem-Clavulanate, in multidrug-resistant
tuberculosis, 125
MGIT 960 tube system, 68
Mielck, Ernst, 7
Migrant workers, TB control in, 218–219
Miliary tuberculosis, 384, 415–435
age and, 415–417
bone marrow in, 449
bronchoalveolar lavage in, 426
cardiopulmonary exercise testing in, 425–426
clinical manifestations of, atypical, 423–424
in adults, 421–422
in children, 422–423
conditions predisposing to, 419
diagnosis of, 424–429
dissemination of, molecular basis of, 419–420
epidemiology of, 415–419
ethnicity and, 417–419
fundus examination in, 424
gamma interferon release assays in, 425
gender and, 417
iatrogenic dissemination of, 419–420
imaging studies in, 426–428
immunological abnormalities in, 426
immunopathogenesis of, 419–420
in immunosuppressed individuals, 423
in infant, 464
laboratory abnormalities in, 424–425
mortality rate related to, 430
pathogenesis of, 419–420
pathology of, 420–421
presenting as fulminant hepatitis, 384
prevention of, 431
prognostic factors in, 430–431
pulmonary function and gas exchange abnormalities in,
425
sputum, body fluid, and tissue examination in, 424
symptoms and signs of, 422
treatment of, 429–431
tuberculin skin test in, 425
Modigliani, Amadeo, 7
Mortality, and morbidity data, 17–21, 183–184, 193
by age and sex, 15, 16
morbidity, and contacts, rate of, 12, 13
Moxifloxacin, 109, 110, 122, 132
in Mycobacterium avium complex disease, 547
Multidrug-resistant tuberculosis (MDR-TB), 187–189
clofazimine in, 124
cycloserine in, 123
drug resistance in, 121
epidemiology of, 120–121
ethionamide in, 123
gamma interferon in, 125
imipenem in, 124–125
infection control in, 134
isoniazid in, 125
latent infection due to, 135
linezolid in, 124
medication toxicity in, monitoring and managing of,
131–134
meropenem-clavulanate in, 125
new drugs in, 125
para-aminosalicylic acid in, 123–124
prevention of, 134–135, 195–196
rifabutin in, 123
surgical therapy of, 134
treatment of, 120–140, 195–196
case management in, 125–128
drug susceptibility testing during, 131
fluoroquinolones in, 122–123
radiology during, 131
second-line drugs in, 122
serum drug level testing during, 131–134
Munch, Edvard, 7, 9
Musculoskeletal tuberculosis, 315–334
clinical features of, 320–322
diagnosis of, 322–328
epidemiology of, 315–317
mycobacteriological and histologic diagnosis of, 327–328
pathogenesis of, 317
pathophysiology of, 318–320
treatment of, 328–331
Mycobacteria, culture of, in broth media, 68
on solid media, 67–68
host response to, 509–510
nontuberculous. See Nontuberculous mycobacteria
rapidly growing. See Rapidly growing mycobacteria
(RGM)
Mycobacterial infection, atypical, of liver, 385
Mycobacteriology, diagnostic, in children, 467
Mycobacterium abscessus, 565, 569, 574
Mycobacterium africanum, 612
Mycobacterium avium, 385
and Mycobacterium intracellulare, 531, 532
in AIDS, 390–392
Mycobacterium avium complex, and nontuberculous
mycobacteria, 534–535
as cause of nontuberculous mycobacteria, 527
as respiratory pathogen, 542
clinical syndromes associated with, 538–539
cutaneous disease caused by, 543
disseminated (DMAC), 533–534, 539–540
extrapulmonary disease caused by, 543
gastrointestinal tract and, 531–532
immune reconstitution inflammatory syndrome due to,
514–515
isolation rates of, 531, 533
lung macrophage and, 537
organisms belonging to, 531, 532
pathogen factors in, 537–538
pulmonary disease caused by, 540–543
substrain speciation of, 538
virulence of, 538
Mycobacterium avium complex disease, 531–564
and general population, 532–533, 534–535, 540–543
diagnosis of, microbiologic, 543–544
radiographic, 544
disseminated, treatment of, 546–548
drug susceptibility testing in, 545–546
ecology and epidemiology of, 531–535
environmental exposure, host susceptibility, and pathogen virulence in, 536–537
extrapulmonary, treatment of, 553
HIV-infected populations and, 531–532, 533–534, 538–540
host and pathogen factors associated with, 535–538
immune reconstitution inflammatory syndrome and, treatment of, 548
in Caucasian females, 541
medical treatment of, 547
pulmonary, macrolide-based multiple-drug treatment of, 551
therapy for, 544–553
*Mycobacterium bolletii*, 565
*Mycobacterium bovis*, 14, 607–617
bacillus Calmette-Guérin strain of, 611–612
complete genome sequence of, 610
epidemiology of, 607–608
hosts of, 607
microcolonies of, 609
molecular typing methods in, 607–609
spoligotyping in, 608
transmission of, 607
variable-number tandem repeat sequences in, 608–609
*Mycobacterium bovis* disease, diagnosis of, 609–610
disseminated, treatment of, 612
drug-resistant strains of, 611
susceptibility of, and treatment of, 610–611
*Mycobacterium canettii*, 613
*Mycobacterium caprae*, 612
*Mycobacterium celatum*, 620
*Mycobacterium chelonae*, 565, 568–569, 574
*Mycobacterium fortuitum*, 565, 569
*Mycobacterium gordonae*, 620
*Mycobacterium haemophilum*, 620
*Mycobacterium haemophilum*, 620
*Mycobacterium intracellulare*, and *Mycobacterium avium*, 531, 532
*Mycobacterium kansasii*, 385, 578–585
background of, 578
epidemiology of, 578
microbiology of, 579
prevalence of, 578
*Mycobacterium kansasii* infection, clinical characteristics of, 579
diagnosis of, 580
extrapulmonary, 579–580
treatment of, 581–582
gamma interferon assays in, 580
in HIV-positive patients, treatment of, 581–582
musculoskeletal manifestations of, 580
radiology of, 580
rifampin-resistant, treatment of, 582
signs and symptoms of, 579
treatment of, 580–581
*Mycobacterium malmoense*, 621
*Mycobacterium marinum*, 586–600
culture of, 588
fundamental biology of, 586–587
genetics of, 587
phenotyping of, 588–589
history of, 586
microbiological characters of, 588–589
molecular biology of, 587
molecular identification of, 588
natural habitats of, 594–595
pathogenesis of, 587
taxonomy of, 586–587
*Mycobacterium marinum* infection, antibiotic susceptibility in, 593
antimicrobial susceptibilities in, 592–594
bacteriological findings in, 591–592
clinical presentations of, 589–591
epidemiology of, 594–596
following tumor necrosis factor alpha inhibitor therapy, 589
granulomas in, 592
histological findings in, 592
immunity and, 591
in fish, 589
in humans, 589–591
isolation procedures in, 591–592
manifestations of, 589–592
prevention of, 594–596
specimen collection in, 591–592
surgery in, 594
surveillance of, 596
*Mycobacterium massiliense*, 565
*Mycobacterium microti*, 164–165
*Mycobacterium neoaurum*, 621
*Mycobacterium pinnipedii*, 613
*Mycobacterium ranae*, 565
*Mycobacterium salmoniphilum*, 565–566
*Mycobacterium scrofulaceum*, 601–606
clinical syndromes of, 602–603
epidemiology of, 601
extrapulmonary disease due to, 603–604
human isolates, 601–602
microbiology of, 601
pulmonary disease due to, 603
sources in nature, 601
*Mycobacterium scrofulaceum* infection, antibiotic sensitivity in, 604
treatment of, 605
tuberculin skin test in, 602, 603
*Mycobacterium simiae*, 621
*Mycobacterium szulgai*, 621–622
*Mycobacterium terrae* complex, 622
*Mycobacterium tuberculosis*, association with HIV infection, 389–390, 481
HIV immunosuppression and, 481–482
infection and disease due to, manifestations of, 162–164
isolation rates of, 531, 532
molecular methods for detection of, 69–71
virulence factors, 51
*Mycobacterium tuberculosis* complex, members of, 608
Mycobacterium ulcerans, 622
Mycobacterium xenopi, 623
Myocardium, tuberculosis of, 346
Mycobacterium, 3
Mycobacterium tuberculosis, 3
Myositis, tuberculosis, diagnosis of, 327
tuberculous, 320
Nasal tuberculosis, 257–258
National Tuberculosis Controllers Association (NTCA), 226, 236
National Tuberculosis Indicators Project (NTIP), 231
Neuropathy, peripheral, due to chemotherapy, 116
Neutrophils, tuberculosis and, 450
Nevirapine, and rifampin, 489
NK cells, 48, 49–50
Nontuberculous lymphadenitis, 603
Nontuberculous mycobacteria, 525–530, 618–626
and Mycobacterium avium complex, 534–535
clinical diseases caused by, 619–623
conditions predisposing to, 527–528
diagnosis of, 529, 618–619
epidemiology of, 525–527, 618
extrapulmonary disease, Mycobacterium avium complex and, 535
immune-suppression-triggered, cause of, 528
increase of, 535
infection sites and etiologic species, 619
microbiology of, 618
natural infection with, 162, 164
pathogenesis of, 527–528
pathophysiology of, 618
research funding in, 529
taxonomy of, 523, 526
Nontuberculous mycobacterial lung disease, diagnostic criteria for, 544
Nosocomial outbreaks, of 1990s, 205–211
Nucleic acid amplification, 70–71
in children, 467
Nucleic acid probes, 69–70
rapidly growing mycobacteria and, 570
Nucleic acid probes, for mycobacterial species, 525
Ocular tuberculosis, diagnosis of, 277–279
external, 271–272
historical considerations in, 269
incidence of, 269–270
mechanisms of infection in, 270
treatment of, 277–279
Ofl oxacin, 109, 110, 122
in Mycobacterium avium complex disease, 550
side effects of, 453
O’Neill, Eugene, 8–9
Ophthalmic infections, due to rapidly growing mycobacteria, 573
Oral cavity, tuberculosis of, 258–259
Orbital tuberculosis, 277
Organ transplantation, and tuberculosis, mortality associated with, 505–506
candidates and donors for, evaluation of, 500–501
donors in, evaluation of, 501
in HIV infection, immune reconstitution syndrome and, 505
recipients, antituberculosis treatment in, duration of, 505
tuberculosis in, treatment of, 503–505
tuberculosis following, 498–508
clinical presentation of, 499–500
diagnostic considerations in, 500
epidemiology of, 498
incidence of, 498, 499
risk factors for, 498, 499
symptoms of, 499–500
Osler, Sir William, 3
Osteomyelitis, tuberculous, and arthritis, 318–319
clinical features of, 321
diagnosis of, 326–327
treatment of, 331
Osteomyelitis/tenosynovitis, due to Mycobacterium scrofulaceum, 604
Otomastoiditis, tuberculous, diagnosis of, 266–267
incidence of, 266
pathogenesis and pathology of, 266
signs and symptoms of, 267
treatment of, 267
Oxazolidinones, in rapidly growing mycobacterial disease, 571
Pancreatic tuberculosis, and hepatobiliary tuberculosis, 372, 387–389
Panophthalmitis, tuberculous, 277
Paradoxical reaction, clinical features of, 510–511
differential diagnosis of, 511
tuberculosis and, 510–511
Park, Mungo, 4
Pathogenesis, 29–42
Pathophysiology, and immunology, 29–65
PCR restriction fragment analysis (PRA), rapidly growing mycobacteria and, 568
Pediatric tuberculosis, treatment of, 116
Pericardectomy, 343–344
Pericardial effusion, in tuberculous pericarditis, 341–342
Pericardial tuberculosis, clinical features of, 335
corticosteroids in, 340–343
diagnosis of, 336–340
signs of, 335–336
treatment of, 340–345
with pericardial effusion, 341–342
Peritonitis, tuberculous, 367–371
clinical features of, 368
diagnosis of, 368–369
epidemiology of, 367
pathogenesis of, 368
treatment of, 369
Phagocytosis, of tubercle bacilli by macrophages, 45–46
Pharynx, tuberculosis of, 258–259
Pituitary gland tuberculosis, 438–439
Platelet factor 4 abnormality, in tuberculosis, 451
Platelets, effects of tuberculosis on, 451
Pleurale disease, in childhood tuberculosis, 463–464
Pleural effusion, diagnosis of tuberculosis in, 146–147
due to tuberculosis, 146–147, 252–253
Pleural space, complications in, 154–156
persistent, 155–156
Pneumothorax, 253
in childhood tuberculosis, 462
miliary tuberculosis and, 423
Politics, world, impact of tuberculosis on, 4–5
Polycthemia, 449
Polymerase chain reaction (PCR) systems, 70–71, 72
in childhood tuberculosis, 467
Poncet's disease, 320
Positron emission tomography, in miliary tuberculosis,
428–429
Pott, Sir Percivall, 318
Pregnancy, effect on tuberculosis, 476–477
tuberculosis in, 476–480
clinical manifestations of, 477–478
congenital infection of fetus in, 477
diagnosis of, 478
epidemiology of, 476–480
pathogenesis of, 477
prevention of, 478–479
treatment of, 117, 478–479
Prevalence of new cases, 188, 193
Prevention, and control, strategies for, 224
and curtailment, 211–220
Prosthetic devices, rapidly growing mycobacteria and, 566
Psoas muscle abscess, etiologies of, 327
Public health organizations, authority of, legal basis for,
225–226
pediatric tuberculosis and, 471
Pulmonary infections, chronic, due to rapidly growing
mycobacteria, 572–573
Pulmonary tuberculosis, 245–256
chest radiography in, 246–249
clinical, 41
complications of, 253–254
computed tomography in, 248–249
criteria for activity in, 248, 253
diagnosis of, 249–250
drug-susceptible, 112, 113
establishment of, effect of vaccines on, 53–54
first stage of, 32
five stages of, 30–37
in children, radiographic findings in, 461–463
symptoms and signs of, 461
in laboratory animals, 41–42
laboratory examination in, 246
liver in, 381
“primary,” 457
signs and symptoms of, 245–246
surgical lung resection in, 149–154
susceptibility to, 246
types of, 41
Purified protein derivative (PPD), 76
5 TU dose of, significance of reactivity to, 76–78
Pyrazinamide (PZA), adverse effects of, 91, 110–111
and rifampin, 86–87, 88, 96
characteristics of, 107–108, 109
for organ transplant recipients with tuberculosis,
503–504, 505
hepatotoxicity due to, 398
in central nervous system tuberculosis, 290
Pyridoxine, in tuberculosis in pregnancy, 478
QuantiFERON-TB Gold In-Tube (QFT-GIT), 79–80
QuantiFERON-TB Gold (QFT-G), 79–80
Quezon, Manuel, 5
Raltegravir, and rifampin, 490
Rapidly growing mycobacteria (RGM), 565–577
anti-TNF-α infections associated with, 566
anti-TNF-α therapy and, 566
community-acquired, 566
cosmetic surgery procedures and, 568
current classification of, 565–566
currently recognized species of, 567
disease caused by, 571–573
drug therapy/drug resistance in, 574
therapy of, 571
epidemiology of, 566–568
health care-associated disease and, 566–568
historical background of, 565
laboratory identification of, 568–570
laparoscopy infections and, 568
lower extremity skin infections associated with, 566
nucleic acid probes and, 570
postinjection abscesses and, 568
recognized species of, 567
taxonomy of, 565–566
Rash, due to chemotherapy, 116
Reactive nitrogen intermediates (RNIs), 47
Regional Training and Medical Consultation Centers
(RTMCCs), 226, 235–236
Renal dysfunction, chemotherapy in, 111
tuberculosis in, treatment of, 117
Renal failure, due to miliary tuberculosis, 423
Renal tuberculosis, 302, 303, 306, 310
Research, enabling and promoting, 198–199
Respiratory distress syndrome, acute, miliary tuberculosis
as cause of, 423
Respiratory route, contracting by, 29–30
Retinitis, tuberculous, 276–277
Rhodes, Cecil, 4–5
Rifabutin (RFB), 110, 112, 123, 134, 452
in Mycobacterium avium complex disease, 546–547,
549, 550
in tuberculosis and HIV infection, 488, 490–491
Rifampin (RIF), adverse effects of, 91, 110, 453
and antiretroviral drugs, dose adjustment in, 489–490
and efavirenz, 489
and isoniazid, 86, 88, 89, 94–95
and lopinavir, 490
and nevirapine, 489
and pyrazinamide, 86–87, 88, 96
and ritonavir, 489–490
characteristics of, 107–110
for tuberculin-positive transplant recipients, 502, 503,
505
hepatotoxicity due to, 397
in central nervous system tuberculosis, 289
in Mycobacterium avium complex disease, 549, 550
in Mycobacterium kansasii infection, 581, 582, 583
in Mycobacterium scrofulaceum, 604
in ocular tuberculosis, 279
in tuberculosis and HIV infection, 488, 489
monotherapy, 86, 88, 89, 93–94
Rifamycin, 86–87
in tuberculosis and HIV infection, 488
Rifapentine, and isoniazid, 87, 88, 95–96
characteristics of, 112
in tuberculosis and HIV infection, 488
side effects of, 453
Risk factors, 15–17
by clinical conditions, 21
Ritonavir, and rifampin, 489–490
Roche Amplicor Mycobacterium tuberculosis test, 70–71
Roosevelt, Eleanor, 6
rpo β gene sequencing, rapidly growing mycobacteria and, 569
16S rRNA gene sequencing, rapidly growing mycobacteria and, 568–569
Runyon, Ernest, 540, 578
Saint Thérè of Lisieux, 5
Sarcoidosis, granulomatous response to, 515–516
immune reconstitution inflammatory syndrome in, case presentation of, 516
clinical aspects of, 516–517
in HIV, diagnosis of, 517
Scrofula, 293
Serodiagnostic studies, in miliary tuberculosis, 428–429
Siebert, Florence, 76
Single-resident occupancy (SRO) hotels, tuberculosis in, 208, 214, 218
Skin, involvement in tuberculosis. See Cutaneous tuberculosis
lesions of, in Mycobacterium avium complex disease, 543
Skin disease, due to Mycobacterium scrofulaceum, 604
Small intestine, tuberculosis of, 355–357
Society, impact of tuberculosis on, 5
Socioeconomic status, and morbidity, 16–17
Specimens, collection of, 66–67
decontamination and processing of, 67
staining procedures and biochemical identification on, 68–69
Spondylitis, tuberculous, clinical features of, 320–321
diagnosis of, 323–324
historical perspective on, 329–330
modern therapy for, 330
pathophysiology of, 318
Stetson, John Batterson, 6
Stool specimens, mycobacterial culture of, 66
Stravinsky, Igor, 7
Streptomycin (SM), 107, 109, 111, 121, 132
for organ transplant recipients with tuberculosis, 505
in Mycobacterium avium complex disease, 550
resistance to, 22
side effects of, 453
toxicity to, 111
Styblo, Karel, 190
Substance abuse, 17
Superoxide dismutase gene sequencing, rapidly growing mycobacteria and, 569
Surgery, in diagnosis and management, 141–161
in miliary tuberculosis, 429, 430
Surgical wound infections, due to rapidly growing mycobacteria, 572
Susceptibility, human, 42
Susceptibility testing, laboratory diagnosis and, 66–74
Thrombocytopenia, in tuberculosis, 451
Thrombotic thrombocytopenic purpura, 451
Thyroid function tests, in thyroid gland tuberculosis, 438
Thyroid gland tuberculosis, 437–438
antituberculous therapy in, 438
fine-needle aspiration in, 438
thyroid function tests in, 438
Thyroiditis, bacterial nontuberculous, 437–438
tuberculous, 437–438
Tigecycline, in rapidly growing mycobacterial disease, 571
TNF-α, 51
Toll-like receptors (TLRs), 46
Transmission, 14–15
epidemiology of, 205
Travelers, international, tuberculosis in, 164
Treatment, success of, 192
Trudeau, Edward Livingston, 3
Tubercle bacilli, discovery of, 11
inhalation of, 29
killing by macrophages, 45–46
multiplication of, host immune response and, 56
phagocytosis by macrophages, 44–45
Tuberculids, 412
Tuberculin, historical perspective on, 75
PPD (5 TU), 76
significance of reactivity to, 76–78
Tuberculin skin test (TST), 14, 15, 20
accuracy in children, 466
and gamma interferon release assay, compared, 80–82
false-negative reactions to, 78–79
false-positive reactions to, 78
in childhood tuberculosis, 465–466
in corticosteroid therapy, 443
in latent infection, 75, 237
in miliary tuberculosis, 425
in *Mycobacterium scrofulaceum*, 602, 603
in posttransplant test for tuberculosis, 500
negative, in active tuberculosis, 52–53
  treatment of latent infection in, 101
negative result of, management of organ transplant candidates in, 501
of candidates for organ transplantation, 500
of close contacts, 20
of organ transplant donors, 501
positive, active tuberculosis and, 21
  management of organ transplant candidates in, 501
prognostic significance of, 52
repeat, booster effect of, 52, 79
tuberculosis in pregnancy and, 478
Tuberculoma(s), choroidal, 275–276
ciliary body, 276
in children, 464–465
in tuberculosis of liver, 383–384
of central nervous system, 288
Tuberculosis, active, identification of persons with, 232
  improved diagnostic tests for, 52
and HIV. See HIV/AIDS
and organ transplantation. See Organ transplantation and paradoxical reaction, 510–511
congenital, 384–385
cutaneous. See Cutaneous tuberculosis
effect on pregnancy, 477
endocrine and metabolic aspects of, 436–447
extensively drug-resistant, 483
five stage of, 38–40
fourth stage of, 31, 32, 36, 37–38
hematologic complications of, 448–455
hepatobiliary. See Hepatobiliary tuberculosis
hyponatremia in, 439–440
immune reconstitution inflammatory syndrome and, 484, 491
in elderly, 163, 250–251
in enclosed populations, 205–223
in infants and children. See Childhood tuberculosis
in liver transplant patients, 392–394
in use of TNF inhibitors, 251–252
in women of childbearing age, 477
latent. See Latent infection
multidrug-resistant. See Multidrug-resistant tuberculosis
musculoskeletal. See Musculoskeletal tuberculosis
ocular. See Ocular tuberculosis
of upper respiratory tract, 257–265
pulmonary. See Pulmonary tuberculosis
reactivation of, medical conditions causing, 84
renal, 302, 303, 306, 310
resurgence of, 315, 316, 318
second stage of, 31, 33–34, 35
syndrome of inappropriate antidiuretic hormone in, 439–440
third stage of, 31, 34–37
urogenital. See Urogenital tuberculosis
vertebral, due to *Mycobacterium bovis*, 610
Tuberculosis Epidemiologic Studies Consortium (TBESC), 226
Tuberculosis Program Evaluation Network (TB-PEN), 232
Tuberculosis Trials Consortium (TBTC), 95, 226
Tuberculous lesions, turnover of macrophages in, 52
Tuberculous mastitis, 412
Tumor necrosis factor alpha inhibitor therapy, in *
Mycobacterium marinum* infection, 589
Tumor necrosis factor alpha (TNF-α), therapy of, infections associated with, 566
Tumor necrosis factor (TNF), 15
Tumor necrosis factor (TNF) inhibitors, 24–25
tuberculosis in patients taking, 251–252
Tutu, Desmond, 6
Ultrasonography, in miliary tuberculosis, 428
United States, tuberculosis in, 11–14
Upper respiratory tract, tuberculosis of, 257–265
  signs and symptoms of, 257
Ureteral tuberculosis, 306
Urogenital tuberculosis, 301–314
  clinical features of, 307–308
  epidemiology of, 301
  etiopathogenesis of, 301–302, 303, 304
  in immunosuppression, 308–309
  laboratory and radiological workup in, 309–310
  mortality reduction in, 312
  organs affected by, 302–307
  frequency of, 303
  pharmacological treatment of, 310–311
  surgical treatment of, 311–312
UV germicidal irradiation, 216–217
Uveitis, tuberculous, 273
Vaccination, 29
Vaccines, and immunity to critical antigens, 55–56
  containing little or no tuberculin-like agents, advantages of, 55
  development of better, 53–55
  effect on establishment of pulmonary tuberculosis, 53–54
inactivated whole-cell mycobacterial, immunization with, 165
new, animal testing of, 172–173
bacillus Calmette-Guérin, 162–181
  candidate, 173–175
human trials of, 172–173
VersaTREK Myco system, 68
Viral hepatitis, 394–395
Wasting syndrome. See Mycobacterium avium complex, disseminated (DMAC)
Webb, Chick, 7
Wolinsky, Emanuel, 531
World Health Organization (WHO), 11
  and tuberculosis as global epidemic, 182–189
  perspective on tuberculosis, 182–204
Stop TB Strategy, 182, 183, 191
TB estimates by region, 183–184
Wound infections, localized posttraumatic, due to rapidly growing mycobacteria, 571–572
Wyeth, Andrew, 7