

Contents

Contributors ix

Preface xvii

I. GENOMES, GENOMICS, AND GENETIC EXCHANGE

1. Gene Transfer in *Mycobacterium tuberculosis*: Shuttle Plasmids to Enlightenment 3
WILLIAM R. JACOBS, JR.
2. Mycobacterial Pathogenomics and Evolution 27
DARIA BOTTAI, TIMOTHY P. STINEAR, PHILIP SUPPLY,
AND ROLAND BROSCH
3. BCG Vaccines 49
VANESSA TRAN, JUN LIU, AND MARCEL A. BEHR
4. Distributive Conjugal Transfer: New Insights into Horizontal Gene Transfer and Genetic Exchange in Mycobacteria 61
KEITH M. DERBYSHIRE AND TODD A. GRAY
5. Molecular Genetics of Mycobacteriophages 81
GRAHAM F. HATFULL
6. Genetics of Phage Lysis 121
MADALENA PIMENTEL

II. GENE EXPRESSION AND REGULATION

7. Sigma Factors: Key Molecules in *Mycobacterium tuberculosis* Physiology and Virulence 137
RICCARDO MANGANELLI
8. Transcription Factor Binding Site Mapping Using ChIP-Seq 161
SUMA JAINI, ANNA LYUBETSKAYA, ANTONIO GOMES,
MATTHEW PETERSON, SANG TAE PARK, SAHADEVAN RAMAN,
GARY SCHOOLNIK, AND JAMES GALAGAN
9. Noncoding RNA in Mycobacteria 183
KRISTINE B. ARNVIG, TERESA CORTES, AND DOUGLAS B. YOUNG
10. Two-Component Regulatory Systems of Mycobacteria 209
TANYA PARISH
11. Regulated Expression Systems for Mycobacteria and Their Applications 225
DIRK SCHNAPPINGER AND SABINE EHRT

III. THE MYCOBACTERIAL PROTEOME

12. *Mycobacterium tuberculosis* in the Proteomics Era 241
MARTIN GENGENBACHER, JEPPE MOURITSEN, OLGA T. SCHUBERT,
RUEDE AEBERSOLD, AND STEFAN H. E. KAUFMANN
13. Structural Annotation of the *Mycobacterium tuberculosis* Proteome 261
NAGASUMA CHANDRA, SANKARAN SANDHYA, AND PRAVEEN ANAND
14. Cyclic AMP Signaling in Mycobacteria 281
GWENDOLYN S. KNAPP AND KATHLEEN A. McDONOUGH

IV. METABOLISM

15. The Physiology and Genetics of Oxidative Stress in Mycobacteria 299
BRIDGETTE M. CUMMING, DIRK LAMPRECHT, RYAN M. WELLS,
VIKRAM SAINI, JAMES H. MAZORODZE, AND ADRIE J. C. STEYN
16. Metabolomics of Central Carbon Metabolism in *Mycobacterium tuberculosis* 323
ANTHONY D. BAUGHN AND KYU Y. RHEE
17. Mycobacterial Lipidomics 341
EMILIE LAYRE, REEM AL-MUBARAK, JOHN T. BELISLE,
AND D. BRANCH MOODY
18. Genetics of Mycobacterial Trehalose Metabolism 361
RAINER KALSCHUEER AND HENDRIK KOLIWER-BRANDL

19. Metallobiology of Tuberculosis 377
G. MARCELA RODRIGUEZ AND OLIVIER NEYROLLES
20. Energetics of Respiration and Oxidative Phosphorylation
in *Mycobacteria* 389
GREGORY M. COOK, KIEL HARDS, CATHERINE VILCHÈZE,
TRAVIS HARTMAN, AND MICHAEL BERNEY

V. GENETICS OF DRUG RESISTANCE

21. Molecular Basis of Drug Resistance in
Mycobacterium tuberculosis 413
KEIRA A. COHEN, WILLIAM R. BISHAI, AND ALEXANDER S. PYM
22. Resistance to Isoniazid and Ethionamide in *Mycobacterium
tuberculosis*: Genes, Mutations, and Causalities 431
CATHERINE VILCHÈZE AND WILLIAM R. JACOBS, JR.
23. The Molecular Genetics of Fluoroquinolone Resistance in
Mycobacterium tuberculosis 455
CLAUDINE MAYER AND HOWARD TAKIFF
24. Mechanisms of Pyrazinamide Action and Resistance 479
YING ZHANG, WANLIANG SHI, WENHONG ZHANG,
AND DENIS MITCHISON
25. Genetic Strategies for Identifying New Drug Targets 493
ANDREJ TRAUNER, CHRISTOPHER M. SASSETTI, AND ERIC J. RUBIN

VI. GENETICS OF MEMBRANE AND CELL WALL BIOSYNTHESIS

26. Genetics of Peptidoglycan Biosynthesis 513
MARTIN S. PAVELKA, JR., SEBABRATA MAHAPATRA,
AND DEAN C. CRICK
27. Genetics of Mycobacterial Arabinogalactan and
Lipoarabinomannan Assembly 535
MONIKA JANKUTE, SHIPRA GROVER, HELEN L. BIRCH,
AND GURDYAL S. BESRA
28. Genetics of Capsular Polysaccharides and
Cell Envelope (Glyco)lipids 559
MAMADOU DAFFÉ, DEAN C. CRICK, AND MARY JACKSON
29. The Molecular Genetics of Mycolic Acid Biosynthesis 611
JAKUB PAWEŁCZYK AND LAURENT KREMER

VII. GENETICS OF MACROMOLECULAR BIOSYNTHESIS

30. Nucleotide Metabolism and DNA Replication 635
DIGBY F. WARNER, JOANNA C. EVANS, AND VALERIE MIZRAHI
31. Double-Strand DNA Break Repair in Mycobacteria 657
MICHAEL S. GLICKMAN
32. The Pup-Proteasome System of Mycobacteria 667
NADINE J. BODE AND K. HERAN DARWIN
33. *Mycobacterium tuberculosis* Serine/Threonine
Protein Kinases 681
SLADJANA PRISIC AND ROBERT N. HUSSON

**VIII. THE MYCOBACTERIAL LIFESTYLE, PERSISTENCE,
AND MACROPHAGE SURVIVAL**

34. The Spectrum of Drug Susceptibility in Mycobacteria 711
BREE B. ALDRIDGE, IRIS KEREN, AND SARAH M. FORTUNE
35. The Sculpting of the *Mycobacterium tuberculosis* Genome by Host
Cell-Derived Pressures 727
DAVID G. RUSSELL, WONSIK LEE, SHUMIN TAN, NEELIMA SUKUMAR,
MARIA PODINOVSKAIA, RUTH J. FAHEY, AND BRIAN C. VANDERVEN
36. Evasion of Innate and Adaptive Immunity by
Mycobacterium tuberculosis 747
MICHAEL F. GOLDBERG, NEERAJ K. SAINI, AND STEVEN A. PORCELLI
37. Mycobacterial Biofilms 773
JACOBS P. RICHARDS AND ANIL K. OJHA

Index 785