Germ Theory
Medical Pioneers in Infectious Diseases
Germ Theory

Medical Pioneers in Infectious Diseases

Robert P. Gaynes, MD
Department of Medicine
Emory University School of Medicine
Atlanta, Georgia
CONTENTS

Acknowledgments vii
Preface ix
About the Author xi

Chapter 1 Introduction 1
Chapter 2 Hippocrates, the Father of Modern Medicine 11
Chapter 3 Avicenna, a Thousand Years Ahead of His Time 31
Chapter 4 Girolamo Fracastoro and Contagion in Renaissance Medicine 45
Chapter 5 Antony van Leeuwenhoek and the Birth of Microscopy 63
Chapter 6 The Demise of the Humoral Theory of Medicine 79
Chapter 7 Edward Jenner and the Discovery of Vaccination 93
Chapter 8 Ignaz Semmelweis and the Control of Puerperal Sepsis 117
Chapter 9 Louis Pasteur and the Germ Theory of Disease 143
<table>
<thead>
<tr>
<th>Chapter 10</th>
<th>Robert Koch and the Rise of Bacteriology</th>
<th>173</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chapter 11</td>
<td>Joseph Lister, the Man Who Made Surgery Safe</td>
<td>207</td>
</tr>
<tr>
<td>Chapter 12</td>
<td>Paul Ehrlich and the Magic Bullet</td>
<td>235</td>
</tr>
<tr>
<td>Chapter 13</td>
<td>Alexander Fleming and the Discovery of Penicillin</td>
<td>265</td>
</tr>
<tr>
<td>Chapter 14</td>
<td>Lillian Wald and the Foundations of Modern Public Health</td>
<td>295</td>
</tr>
<tr>
<td>Chapter 15</td>
<td>Conclusions</td>
<td>311</td>
</tr>
<tr>
<td>Index</td>
<td></td>
<td>319</td>
</tr>
</tbody>
</table>
ACKNOWLEDGMENTS

Anyone who has been capable of attaining any accomplishment has had at least one person help but usually many people who have helped. In writing this book, I have been fortunate to have many people review, edit, and inspire. I want to acknowledge Kirvin Gilbert, Lisa Macklin, James Curran, Alicia Hidron, Elissa Meites, Abeer Moanna, Mark Mulligan, David Rimland, Robert Rosman, and Michael Schlossberg for their help and encouragement. I also want to recognize the love and support from my children, Sara and Matthew, and most of all, my wife, Sherry.
PREFACE

History is simply the biography of the mind of man; and our interest in history, and its educational value to us, is directly proportionate to the completeness of our study of the individuals through whom this mind has been manifested. To understand clearly our position in any science today, we must go back to its beginnings, and trace its gradual development.

Sir William Osler

In 2008, I gave a seminar to the Emory Division of Infectious Diseases on the history of our field using short biographies of the people who changed it. I began at the initial stages of Western medicine in ancient Greece and ended with the discovery of penicillin and the beginnings of modern antimicrobial therapy. The reaction that I received was the inspiration for this book. Faculty, fellows, post-doctoral students, residents, and medical students all appreciated the seminar and commented on their lack of acquaintance with the historical roots of their chosen discipline. A presentation at the Centers for Disease Control and Prevention (CDC) some months later yielded similar comments from those in public health. Designed to describe the genesis of the germ theory of disease by those whose discoveries shaped our understanding of it, this book is intended not just for physicians or students of medicine but to be accessible to anyone with an interest in microbiology, infectious diseases, medical history, and, to a degree, biography.

I have chosen to weave the narrative of the origins of the germ theory of disease through short biographies of the 11 men and 1 woman who changed the very fabric of our knowledge. Guided by
others who followed a similar path—notably Sherwin Nuland, author of *Doctors: The Biography of Medicine*—I selected the biographical approach to humanize further the persons who made the significant discoveries. Their stories demonstrate both the impact of their early life influences on their innovations and their frustrations with their societies’ inability to accept some of the greatest discoveries in the history of medicine. The biographical approach illustrates how change in medical thought has occurred. Since paradigm shifts in our scientific thinking will continue, the study of historical transformations functions to encourage a requisite open-mindedness to new shifts in medical thinking.

No book is the creation of just one person. I am indebted to those individuals whose comments helped to shape this text. Their constructive criticisms came with remarkable enthusiasm for the topic and the writing—an enthusiasm that encouraged me to persevere through my research and editing. I hope that the final product will impart to the reader the knowledge, understanding, and passion that I discovered in writing it.

ROBERT P. GAYNES, M.D.
ABOUT THE AUTHOR

Robert P. Gaynes, MD, is a Professor of Medicine (Infectious Diseases) at Emory University School of Medicine, where he teaches a course on the history of medicine. He also serves as an Attending Physician and the Chair of the Infection Control Committee at the Atlanta VA Hospital. Dr. Gaynes has authored or coauthored over 135 papers and book chapters on infectious disease topics.

Board certified in Internal Medicine and in Infectious Diseases, Dr. Gaynes is a Fellow in both the Infectious Disease Society of America and the Society of Healthcare Epidemiology of America. In addition, he is a reviewer for numerous scientific journals and served on the Editorial Board of *Infection Control and Hospital Epidemiology*.

Until 2009, Dr. Gaynes worked in the Office of the Director of the Division of Healthcare Quality Promotion at the Centers for Disease Control and Prevention (CDC). Prior to that post, he served for over a decade as the Chief of the Surveillance Activity in the Hospital Infections Program and as the Director of CDC’s National Nosocomial Infection Surveillance System.

After graduating *magna cum laude* from the University of Illinois in Urbana, Dr. Gaynes earned his medical degree from the University of Chicago Pritzker School of Medicine with Honors in 1979. He completed a residency in Internal Medicine at Michael Reese Hospital in Chicago. After serving for two years in CDC’s Epidemic Intelligence Service, he then returned to complete a Fellowship in
Infectious Diseases at the University of Chicago Hospitals and Clinics. In the 1980s he served as an Assistant Professor of Medicine and Hospital Epidemiologist at the University of Michigan Hospitals in Ann Arbor, MI.

He is a husband and father who enjoys history, racketball, and gourmet cooking.
INDEX

A
Abbe, Ernst, 179–180
Adudi Hospital, Baghdad, 36
AIDS, changes due to, 2
  first cases of, 1–2
  in 1990s, 3
  microorganisms causing, 2
Alcmaeon, 15
Alcoholic fermentation, 149, 150
Alexandrian school, 27–28
Allgemeines Krankenhaus, 119
American Red Cross, public health nursing and, 306
An Inquiry into Causes and Effects of Variolae Vaccinae, Edward Jenner, 107–108
Anaximander, 15
Anderson, Thomas, 218
Anesthesia, discovery of, 218
Anthrax bacilli, and discovery of toxin production, 162–163
  Pasteur and, 161–162
Anthrax spores, discovery, Robert Koch and, 177–179
Anthrax vaccine, Pasteur and, 165–166
Antibiotics, and treatment of infectious disease, 7
  resistance to, 7–8, 312
  untreatable antibiotic-resistant infections and, 8
Antibody production, first theory of, 248–249
Antisepsis, and asepsis, in surgery, 229–230
  and surgical wounds, 221
  first success with, 219–221
Antiseptic surgery, 219
  acceptance on European Continent, 224–225
  reaction to, 223–224
Antiseptics, work on by Fleming, 272
Arabists, contribution to medicine, 33
Asclepiea, in ancient Greece, 12
Asepsis, and antisepsis, in surgery, 229–230
Aseptic Treatment of Wounds, The, Shimmelbusch, 229–230
Atoxyl, 251
Avicenna, 31–43, 311
  autobiography of, 37
  Book of Healing, 39
  Canon of Medicine, 39
  education of, 37
  evidence-based clinical trials, 40
  life after 21 years of age, 37–39
B
Bacteria, antibiotic resistance and, 7–8
  van Leeuwenhoek description of, 69–70, 73

319
Bacterial cultures, true, development of, 182–183
Bacteriology, rise of, Robert Koch and, 173–205
Barré-Sinoussi, Françoise, 170
Bassi, Agostino, 160
Berle, Adolph A. Jr., 309
Bichat, Marie François Xavier, study of tissues by, 88
Biggs, Hermann, 307
Billroth, Theodor, 136, 224
Black Death, 31, 32 during Renaissance, 47
Bliss, Williard, 226, 227
Blood circulation, discovery by William Harvey, 82–86
Galen’s explanation of, 82
Blood clots, 215–216
Bloodletting, 19, 25–26 death of George Washington, 27
Boer, Lucas, 129
Book of Healing, Avicenna, 39
Boynton, Silas, 227
Brewster, Mary, 299, 300–301, 304
Bubonic plague, in Middle Ages, 32 transmission of, 47
Burnet, Frank Macfarlane, 249
Byzantine Empire, medicine in, 45

C
Canon of Medicine, Avicenna, 33, 38, 39–40
concept of contagion and, 41–42 influence in Western medicine, 42–43, 46
Carbolic acid, problems with, 221–223
Carbolic acid spray, 229
Cellular and humoral immunity, 245
Chain, Ernest, 279–283, 285, 287
Charité Hospital, Berlin, Paul Ehrlich and, 240–241
Chemotherapy, in infectious diseases, 249–251, 258, 266
Cheyne, Sir William Watson, 209
Childbed fever. See Puerperal fever
Cholera, 160 causative agent of, discovery of, 187–189
chicken, and attenuation of microorganisms, 163–165 in Germany in 1892, 200–201
Christian Church, in Middle Ages, physicians and, 31
Cinchona bark, 236–237, 249
Cline, Henry, vaccination and, 109
Cnidian school, 17
Coan school, 16, 17–19
Cocanut Grove nightspot, Boston, fire at, 284–285
Coghill, R. D., 283–284
Cohn, Ferdinand, 178–179, 181
Cohnheim, Julius, 179
Colebrook, Leonard, 277
Coleman, Leonard, 269
Columbia University, Department of Nursing and Health, 305
Comprehensive Book on Simple Drugs and Foodstuffs, Ibn al-Baytar, 35–36
Contagion, and Girolamo Fracastoro, in Renaissance medicine, 45–61
and infection, pre-germ theory and, 123
and smallpox in 18th century, 97–98
and 18th-century medicine, 89–90
concept of, and Avicenna’s Canon of Medicine, 41–42
in early 1800s, 123
deMonte theory of, 56–57 microorganisms and, 90 versus infection, in early 19th-century medicine, 124–125
Copernicus, Nicolaus, 51
Corn steep liquor, 284
Craddock, Stuart, 274–275, 281
Creosote, 237

D
Dale, Sir Henry, 245–246
Darwin, Charles, operations and, 207–208
Davaine, Casmir, 161, 178, 193
De Contagione, Girolamo Fracastoro, 54–57, 60
de Graaf, Reinier, van Leeuwenhoek and, 66
De Humani Corporis Fabrica, Andreas Vesalius, 80, 81
de la Tour, Cagniard, 149
De Motu Cordis, William Harvey, 84, 85
De Sedibus et Causis Morborum per Anatomen Indagatis, Giovanni Battista Morgagni, 87–88
Democritus, 16
deMonte, Giambattista, contagion theory and, 56–57
Diphtheria antitoxin, discovery of, and serum therapy, 243–245
standardization of, 245–247
Disease, and microorganisms, in Age of Enlightenment, 73–76
four humors and, 16–17
natural cause of, 14–16
three stages of, 19
Dissection of human bodies, in early 16th century, 80
Divine power of healing, 13–14
Dobell, C., on illumination of van Leeuwenhoek, 71–72
Doering, William, 237
Domagk, Gerhard, 266, 276–277
Dreyer, George, 280
Drugs, Islamic medicine and, 35–36
Dumas, Jean, 146, 156
Dye industry, European, 237
Dyscrasia, 18

E
Edington, G. H., 219
Ehrlich, Paul, 185–186, 235–263, 268, 311
chemotherapy and, 266
discovery of mast cell, 238–239
doctoral dissertation of, 239–240
early influences, 238
honorary degrees given to, 259
institute director, 247–248
last years, 259–262
marriage, 241
meeting with Robert Koch, 239
Nobel Prize in Medicine, 251–252
return to Berlin, 242–243
salvarsan (compound 606) and, 254–256
Empedocles, 15–16
Epidemic curve, 4
Epidemics, Hippocratic texts, 24
Erskine, J. A., 214
Erysipelas, 209–210
Etiology, the Concept and Prophylaxis of Childbed Fever, The, Ignaz Semmelweis, 139
“Etiology of Tuberculosis, The,” Robert Koch, 186–187
Evidence-based clinical trials, beginnings, 40–41
foundation of, 20–21

F
Federal Children’s Bureau, 307–308
Fermentation, 149, 218
Fever, four humors and, 19
Fischer, Bernhard, 187, 188, 189
Fleming, Alexander, 279–280, 281, 284, 286–287, 288–289, 313
Fleming, Alexander (Continued)
and discovery of penicillin, 265–293
and World War I, 269–270
at St. Mary’s Hospital medical school, 267
discovery of lysosomes, 270–272
ey early influences, 267–268
honors received by, 287–288
later years, 289–290
Florey, Howard Walter, 278–280, 281, 283, 284, 286–287
Fournier, Ernest, 277
Fracastoro, Girolamo
(Hieronymus Fracastorius), and contagion, in Renaissance medicine, 45–61
and Council of Trent, 57–59
and William Harvey, 83
burial place of, tumult over, 59
De Contagione and, 54–57, 60, 311
education, 50
learned colleagues, 50–51
Syphilus sive morbus Gallicus by, 52–53
Fractures, infection and, 217
treatment by Lister, 220
Freeman, J., 268
Freiberg, Hedwig, 199–200

G
Gaffky, Georg, 181, 187, 188, 199
Galen, as source of medical knowledge in Western Europe, 46
blood formation, 28
human body, 28–29
medical advances, 28–29
source of medical knowledge 16th century, 80
writings of, as self-promoting, 29
translated into Arabic, 35
Galenic physiology, challenge to, 82–87
Gangrene, 210
Garfield, James A. (President), death of, 226–227
Garrison, Fielding, on De Contagione, 60
Geison, G. L., 170
Georg Speyer Haus for Chemotherapeutical Research, 251
Gerhardt, Carl, 242
Germ theory of disease, diseases of silkworms and, 155–159
Louis Pasteur and, and medicine in 19th century, 159–161
Germ theory of medicine, Louis Pasteur and, 143–171
Gordon, Alexander, and puerperal fever in England, 121–124
Great Pox, 48
Greenlee, James, 220
Gross, Samuel, 225–226

H
Halstead, William Stewart, 227, 230
Hand washing, 215
puerperal sepsis and, 135–137
Harvey, William, discovery of circulation of blood, 82–86
marriage and career of, 83–84
Hata, Sahachiro, 253–254, 255
Heart, main function of, 19
Heatley, Norman, 280, 283
Hebra, Ferdinand, 136, 137
Henle, Jacob, 160, 175, 187
Henry Street Nurse’s Settlement House, 304, 308–309
Heraclides, 16
Heraclitos, 15
Hesse, Walther, 182
Hillman, Sidney, 309
Hippocrates, as father of modern medicine, 11–30
Coan school and, 16, 17–19
contemporaries of, 14
life of, 14
medicine before, 11–14
travels of, 16
Hippocratic Corpus, 16, 19–20
epidemics and, 23–25
infectious diseases and, 24
Hippocratic Oath, 21–23
Hoerlein, Heinrich, 266
Hoffmann, August, 237
Hoffmann, Erich, 253
Holmes, Oliver Wendell, and puerperal fever in America, 125–126
Hooke, Robert, as influence on van Leeuwenhoek, 66
Hospitals, as places of learning, 118
Church and, 118
development of, in Western medicine, 117–119
eye surgery efforts, 208
in Europe in 18th and 19th centuries, 207
in Middle East, in 10th century, 36
modern, rise of, 89
Hôtel-Dieu, 36, 118, 119
Human immunodeficiency virus (HIV), 2
change in medical thinking due to, 3–4
change in social attitudes and, 3
immune response to, 5
in Africa, 2, 5–6
incubation period, 3
treatment of, success of, 5
vaccine for, attempts to develop, 6, 8–9
challenge of, 315–316
Humoral immunity, and cellular immunity, 245
Humoral theory, evolution of, after Hippocrates, 27–28
lasting influence on medicine, 25–27
principle of, 18
reasons for appearance of disease, 25
Humoral theory of medicine, demise, 79–91
Humors, four, and disease, 16–17
fever and, 19
Hunter, John, 211
discoveries, 104–105
I
Iceberg effect, 8
Immunizations, impact of (1900–1999), 115
Infection(s), and contagion, pre-germ theory and, 123
following surgery, 208, 209–210
in oxygen entering wound, 217
versus contagion, in early 19th-century medicine, 124–125
wound, clue to, 218–219
Infectious disease practice, need for new paradigm, 313–314
Infectious diseases, 295, 311–312
antibiotics and, 7
attitudes toward—1981, 1
chemotherapy in, 249–251, 258, 266
childhood, in Africa, 2
epidemic paradigm, 4–5
history of, 9
HIV/AIDS changing attitudes toward, 4
new and reemerging pathogens, 314–315
Inoculation Department of St. Mary’s Hospital, Sir Almroth Wright and, 268–269
Institute for Infectious Diseases, Berlin, 200
Institute of Hygiene, Berlin, 194
Insurance coverage, nationwide, for home-based care, 305–306
Islamic medicine, medieval, 33 elements of, 35–36 medical education, 36–37 role of translation, 33–36
Iversen, Julius, 254, 255

J
Jaillard, Pierre-François, 162
Jefferson, Thomas, letter to Edward Jenner, 110–111
Jenner, Edward, 164, 211, 311, 316 and discovery of vaccination, 93–116 early influences on, 103–104 first inoculation against smallpox and, 106 John Hunter and, 104–105 later life of, 111–113
Jerné, Niels, 249
Jesty, Benjamin, 109
Joint Board of Sanitary Control, 307–308
Justinian plague, 47

K
Keith, Thomas, 228
Kitasato, Shibasaburo, 200, 244, 245, 253
Klebs, Edwin, 187
Klein, Johann, puerperal sepsis and, 129–132, 136, 137

L
Laënnec, René, stethoscope and, 89, 128
Lathrop, Julia, 308
LaTouche, C. J., 274
Lee, Roger, 289
Leeson, John Rudd, 214
Leplat, Claude, 162
Leprosy, 118
Lesch, John, 277
Lichtheim, Professor, 191
Lister, Agnes Syme, 215, 232
Index

Listerism, in the United States, 225–226
Liston, Robert, 213
Loeb, Mrs. Fanny, 298–299
Loeffler, Friedrich, 181
Lysozyme, discovery of, 270–272

M
Malaria, early treatment of, 236
fever and, Hippocratic physicians and, 24–25
forms of, 235
quinine and, 235
Marquardt, Martha, 248–249, 254
McFarlance, Gwyn, 278–279
Mechnikov, Ilya, 202, 245, 251
Medical education, medieval
Islamic medicine and, 36–37
Medical tests, Greek, translation of, 35
Meigs, Charles, puerperal fever and, 126
Meister, Joseph, 168, 169–170
Metchnikoff, Elie, 202, 245, 251
“Methods for the Study of Pathogenic Organisms,”
Robert Koch, 182
Methylene blue, 250
Metropolitan Life Insurance Company, 305–306
Miasma, plague and, 32
Microorganisms, and contagion, 90
attenuation of, chicken cholera and, 163–165
disease in the Age of Enlightenment, 73–76
fermentation, Louis Pasteur and, 150–151
undesired, removal of, 152
Microscope(s), compound, 66
high-powered, van Leeuwenhoek, 63–64,
68–69, 70–71
Microscopy, improvements in, Robert Koch, 179–181
Middle Ages, medicine in, 31,
32–33
Mitchell, Thomas, 123–124
Molyneux, Thomas, on van Leeuwenhoek, 70–71, 74
Montagnier, Luc, 170
Montagu, Lady Mary Wortley, variolation and, 100–103
Morgagni, Giovanni Battista, and anatomic basis of disease, 87–89
discoveries at University of Padua, 87
Morgenthau, Henry W., Jr., 309
Morton, William, 226
Moyer, A. J., 283
MRSA infections, 8
Mulligan, Mark, 316

N
Neelson, Friedrich, 186
Neosalvarsan (Compound 914), 258
New York, lower east side, 1890s, 299–300
Nobel Prize for Medicine, early recipients of, 252
Nobel Prize for Medicine (1945), 287
Nurses, public health, 300–303
in New York City schools, 303–304
Nursing service, public health, tuberculosis and, 302–303

O
Obstetrics, as specialty, 119
Oldburg, Henry, van Leeuwenhoek and, 67, 68
Osler, William, on Avicenna’s Canon of Medicine, 39
Oxygen, in wound, infection and, 217
P
Paratartrate, 147
Paré, Ambrose, 210–211
Pasteur, Louis, 182, 187, 188, 218, 231, 311, 314, 315
anthrax, 161–162
anthrax vaccine, 165–166
chemist, and discovery of crystals, 146–148
chicken cholera and, 163–165
“diseases” of fermentation, 148–151
eyearly influences on, 144–146
germs theory of disease, and medicine in 19th century, 159–161
germ theory of medicine, 143–171
last years, 169–170
microorganisms and fermentation, 150–151
rabies vaccine, 166–169
silkworms, 155–159, 314, 315
spontaneous generation, 152–155
Pasteurization, 152
Pavlov, Ivan Petrovich, 202
Pearson, George, vaccination and, 109–110
Penicillin, and patents, 285
attempt to purify, 275–276
beginnings of, 266–267
chemical structure, 290
discovery of, 272–274, 275
first human trials, 282
first penicillin patient, 281–282
impact on chemotherapy of bacterial disease, 290–291
partially purified, isolation of, 280–281
production in United States, 283–285
public awareness of, 286
resistance to, 312
testing in animals, 281
use in England, 286
Penicillium, large-scale cultivation, 283
Pericardium, 19
Peritonsillitus (quinsy), 26
Perkins, Frances, 309
Petri, R. J., 182
Pfeiffer, Richard, 200
Phipps, James, inoculation against smallpox, 106–107
Pinkus, Felix, 242, 258
Pinkus, Hedwig, 241
Plague, 118
during Renaissance, 47
Pneuma, doctrine of, 18–19
Galen and, 28–29
Pollender, Franz, 193
Poucet, Felix, 154
Prontosil (KI-730), 266
Proskauer, Bernhard, 200
Pryce, Merlin, 272
Public health nurses, 300–302, 303
Puerperal fever, Alexander Gordon and, 121–124
and breast milk, 120–121
diseases of, theories in 18th and 19th centuries, 120–121
in hospitals in 19th century, 123
incidence of, 119–120
Oliver Wendell Holmes and, 125–126
retained-lochia theory of, 120–121
Puerperal sepsis, clue to, found by Semmelweis, 134–135
diseases of, theories in 18th and 19th centuries, 120–121
in hospitals in 19th century, 123
incidence of, 119–120
Oliver Wendell Holmes and, 125–126
retained-lochia theory of, 120–121
Puerperal sepsis, clue to, found by Semmelweis, 134–135
diseases of, theories in 18th and 19th centuries, 120–121
in hospitals in 19th century, 123
incidence of, 119–120
Oliver Wendell Holmes and, 125–126
retained-lochia theory of, 120–121
Puerperal sepsis, clue to, found by Semmelweis, 134–135
diseases of, theories in 18th and 19th centuries, 120–121
in hospitals in 19th century, 123
incidence of, 119–120
Oliver Wendell Holmes and, 125–126
retained-lochia theory of, 120–121
Putrefaction, 149
Q
Quarantine, first use of, 47
Quinine, 237, 249
malaria and, 235
Index

R
Rabies vaccine, 166–168
  reactions to, 168–169
Raistrick, Harold, 275–276
Redi, Francesco, 153
Rhazes, smallpox and, 96
Rinderpest, 188
Rixens, Jean Andre, 231–232
Robert Koch Institute, 201–202
Robinson, Sir Robert, 286
Roosevelt, Eleanor, 309
Roosevelt, Franklin Delano, 309
Ross, Ronald, 202
Rossignol, 165–166
Roux, Émile, 167, 168, 187, 191, 244
Royal Prussian Institute for
  Experimental Therapy, 248
Ruel, Charles, 191

S
Salerno school, 45
Salvarsan (Compound 606),
  253–254, 255–256, 268
Sarton, George, on Avicenna’s
  concept of contagion,
  41–42
Schaudinn, Fritz Richard, 253
Schiff, Jacob, 299, 301–302, 304
School nurses, in New York City
  schools, 303–304
Schwann, Theodor, 149
Seminaria, 55–56
Semmelweis, Ignaz, 215, 311
  control of puerperal sepsis,
  117–141
  puerperal fever, prevention of,
  135–136
  two Divisions of hospital and,
  130–134
  at University of Vienna
  Hospital, 128–134
  early influences on, 127–128
  in Hungary and Vienna,
  137–138
  last years, 138–139
  opposition to theory of, 138–139
  schooling of, 127
Serum therapy, problems with,
  265
Sharpey, William, 212, 213
Side chain theory, 248–249
Silkworms, diseases of, and germ
  theory of disease, 155–159
Skoda, Joseph, 136, 137
Smallpox, as cause of blindness,
  94, 95
  contagion and, in 18th century,
  97–98
  “control” of, variolation and,
  98–100
  disease of, 94
  eradication of, vaccination and,
  112–113
  first inoculation against,
  106–107
  history of, 95
  in 18th century, 93, 96–97
  milkmaids and cowpox,
  104–106
  mortality rate due to, 94
Snow, John, cholera and, 160, 189,
  200
Spontaneous generation, Louis
  Pasteur and, 152–155
St. John’s Hospital, 118
Staphylococcus aureus, community-
  acquired methicillin-
  resistant, 8
Steglitz Institute, 247–248
Stethoscope, introduction by René
  Laënnec, 89, 128
Streptomycin, resistance to, 312
Sulfanilamide, discovery of, 277
Sulfonamides, beginning of, 266
Surgery, antisepsic, 219, 224–225,
  227–229
Sutures, cargut for, 230
Syphilis sive morbus Gallicus,
  Girolamo Fracastoro,
  52–54
Syme, James, 212, 213–214
Germ Theory: Medical Pioneers in Infectious Diseases

Syphilis, 253–254, 255, 258–259
before and after treatment, 260–261
contagion and, 49–50
in Renaissance, 48
stages of, 48–50

T
Taft, President William, 307–308
Tartaric acid, 146
Telavancin, 313
Thales, contributions of, 15
Thom, Charles, 283
Thuillier, Louis, 187, 188, 190
Trephination, 167
Treskow, Hermann, 187
Trypan red, 250–251
Trypanosomes, 250
Tubercle bacillus, discovery of, 183–186
identification of, 241–242
Tuberculin, 194–197, 198–199, 204
Tuberculosis, 295
cure for, Robert Koch and, 195–199
etiology of, 187–189
public health nursing service and, 302–303
Tuberculosis (phthisis), Canon of Medicine and, 41, 43

U
Universe, four basic elements, 15, 16
University of Vienna Hospital, maternal mortality at, by Division, 132–133

V
Vaccination, discovery of, Edward Jenner, 93–116
global application, 113
success of, 114, 115
Vaccines, development and utilization, 7
Vaccinia virus, 113
in contemporary smallpox inoculation, 113–114
van Leeuwenhoek, Antony, 311
birth of microscopy, 63–77, 143
description of bacteria, 69–70, 73
early influences, 64
government official, 65–66
high-powered microscope, 63–64, 68–69, 70–71
lens making, 66–67
linen draper, 64–65
Royal Society in London, 67–69
spontaneous generation, 72–73
van Rokitansky, Karl, 215
van Wassermann, August, 200
Variolation, Lady Mary Wortley Montagu and, 100–103
smallpox “control” and, 98–100
Vesalius, Andreas, as professor of anatomy, 81
challenge to Galenic anatomy, 79–81
human dissection by, 80
Villemin, Jean, 183
Virchow, Rudolf, 138, 160–161, 175, 183, 186, 189, 237
von Behring, Emile, 200, 202, 245, 246–247
von Flügge, Carl, 194
von Frerichs, Friedrich, 240, 242
von Hutten, Ulrich, on syphilis, 48
von Liebig, Justus, 149
von Nägeli, Carl, 180
von Nussbaum, Ritter, 224–225
von Rokitansky, Karl, 128–129, 136, 137

W
Wald, Lillian, 311
achievements and activities, 308–309
awards and honors, 309
early influences, 296–298
Index

foundations of modern public health, 295–310
later years, 309
nursing service proposed by, 298, 300–302
Women’s Medical College, New York, 298
Waldeyer, Heinrich, 239
Washington, George, death of, 26–27
Waterhouse, Benjamin, vaccination and, 110
Weigert, Carl, 180
Welch, William Henry, 203, 307
Wells, Spencer, 228
Wilcox, Philip, 288–289
Woodville, William, vaccination and, 109
Woodward, R. B., 290
Woodward, Robert, 237
Wounds, history of treatment of, 210–211
surgical, antisepsis and, 221
Wright, Sir Almroth, 268, 286, 288–289

Y
Yellow fever, 123–124
Yersin, Andre, 244
Yersinia pestis, 32

Z
Ziehl, Franz, 186