

CONTENTS

1. THE HISTORY AND DEVELOPMENT OF MICROBIOLOGY.....	1
2. LABORATORY METHODS.....	7
<i>Sterilization.....</i>	7
<i>Preparation of Culture Media.....</i>	8
<i>Microscopic Examination.....</i>	12
Motility, 12; Staining, 12; The Gram Stain, 13.	
<i>Culture of Bacteria.....</i>	15
Methods of Obtaining Pure Cultures, 15; Carbon Dioxide Tension, 16;	
Cultivation of Obligate Anaerobes, 16.	
<i>Systematic Study of Bacteria in Pure Culture.....</i>	17
<i>Animal Inoculation.....</i>	18
Routes of Inoculation, 18.	
<i>Immunological Methods.....</i>	19
The Precipitin Reaction, 21; Agglutination, 22; Complement Fixation, 24.	
3. MORPHOLOGY, CELL STRUCTURE AND GROWTH OF BACTERIA	27
Size, 27; Morphology, 28; Shape, 28; Involution Forms, 29.	
<i>The Structure of Bacterial Cells.....</i>	30
The Compound Microscope, 30; The Darkfield or Ultramicroscope, 30;	
The Electron Microscope, 31; Capsules, 32; Flagella, 32; Spores, 34.	
<i>The Finer Structure of the Bacterial Cell.....</i>	36
The Gram Stain, 38; Bacterial Protoplasm, 39; Intracellular Structures,	
40; The Bacterial Nucleus, 41.	
<i>Colonial Morphology.....</i>	43
<i>Bacterial Growth.....</i>	44
Growth and Cell Division, 44; The Growth of Bacterial Populations, 45;	
Morphologic Variation During Growth, 48.	
4. BACTERIAL PHYSIOLOGY.....	49
<i>By JAMES W. MOULDER, PH.D.</i>	
<i>Respiration.....</i>	50
Some Basic Concepts of Respiration, 51; Energy Sources for Bacteria,	
51; Mechanism of Biological Oxidation, 51; Respiratory Enzymes in Bac-	
teria, 52; The Relation of Bacteria to Molecular Oxygen, 56; Conserva-	
tion and Transfer of the Energy Released in Biological Oxidations, 57.	
<i>Carbohydrate Metabolism.....</i>	60
Metabolism of Complex Carbohydrates, 60; Anaerobic Breakdown of	
Glucose and Other Hexoses, 63; Breakdown of Pyruvic Acid, 66; Com-	
plete Aerobic Oxidation of Carbohydrates, 69; Oxidative Assimilation, 72;	

Metabolism of Pentoses, 73; Heterotrophic Assimilation of CO ₂ , 74; Bacterial Fermentations, 76.	
<i>Fat Metabolism</i>	78
Fatty Acid Synthesis in Clostridium Kluyverii, 78.	
<i>Metabolism of Amino Acids and Proteins</i>	79
Breakdown of Proteins, 80; Breakdown of Amino Acids, 80; Synthesis of Amino Acids, 84; Synthesis of the Peptide Bond, 88.	
<i>Metabolism of Nucleic Acids and Related Substances</i>	91
Breakdown of Nucleic Acids, 92; Primary Synthesis of Purines and Pyrimidines, 92; Interconversion of Purines, Pyrimidines and Their Nu- cleosides and Nucleotides, 93; Synthesis of Nucleic Acids, 94.	
<i>Nutrition of Bacteria</i>	94
Growth Factors, 95; The Vitamin B Group, 95; Amino Acids, 102; Purines and Pyrimidines, 103; Miscellaneous Organic Growth Factors, 103; The Inorganic Elements, 104; Microbiological Assay, 104.	
<i>Nitrogen Fixation</i>	105
Agents of Biological Nitrogen Fixation, 105; Mechanism of Nitrogen Fixation, 107.	
<i>Autotrophic and Photosynthetic Bacteria</i>	108
Chemoautotrophes, 109.	
<i>Nitrogen and Carbon Cycles</i>	113
5. THE ACTION OF PHYSICAL AGENTS, BACTERICIDAL SUBSTANCES (DISINFECTANTS) AND CHEMOTHERAPEUTIC DRUGS	115
<i>Physical Agents</i>	115
Temperature Relations, 115; The Lethal Effects of Heat, 117; Cold, 118; Drying, 119; Light and Other Radiations, 120; Other Physical Agents, 121.	
<i>The Bactericidal Substances (Disinfectants)</i>	122
Water, 122; Acids and Alkalies, 123; Salts, 123; Oxidizing Agents, 124; Organic Compounds, 125; Gaseous Disinfectants, 126; Dyes, 127; The Mechanisms of Bactericidal Action, 128; The Standardization of Disin- fectants, 131.	
<i>The Chemotherapeutic Drugs</i>	133
SYNTHETIC COMPOUNDS.....	135
The Sulfones, 135; Aminohydroxy Benzoic Acids, 136; Thiosemicarba- zones, 136; Pyridine Carboxylic Acid Compounds, 136; Sulfonamide Compounds, 136.	
THE COMPETITIVE INHIBITION THEORY OF ANTIBACTERIAL ACTIVITY.....	137
ANTIBIOTIC SUBSTANCES.....	139
Antibiotic Substances from Bacteria, 140; Antibiotics Produced by Higher Fungi, 140; Hormesis, 145.	
ASSAY OF BACTERIAL SENSITIVITY TO CHEMOTHERAPEUTIC AGENTS.....	145
DRUG SYNERGISM AND ANTAGONISM.....	146
6. BACTERIAL VARIATION	148
<i>Observed Variations of Bacteria</i>	150
MORPHOLOGICAL VARIATION.....	150
Bacterial Dissociation, 150; Variation in Cell Structures, 153; Involution Forms, 154; Bacterial Life Cycles, 155.	

PHYSIOLOGICAL VARIATION.....	157
Attenuation, 157; Biochemical Variation, 158; Mutation-like Variation, 158; Variation by Adaptation or Training, 159; Drug-Resistance, 161; Mechanisms of Drug-Resistance, 162; Recombination, 165; Immunological Variation, 166; Transformation of Immunologic Types, 167; Transduction, 168.	
The Nature of Bacterial Variations.....	168
MUTATION.....	169
INDUCTION.....	170
Enzyme Balance, 171.	
CLONAL VARIATION AND SELECTION.....	173
Parasitism.....	174
 7. THE CLASSIFICATION OF BACTERIA.....	175
Nomenclature, 177.	
 8. THE PATHOGENIC BACTERIA AND DISEASE.....	181
<i>Koch's Postulates</i>	181
<i>Virulence</i>	183
The Use of Mucin in Experimental Infections, 184; The Measurement of Virulence, 184; Toxins, 185; The "Invasiveness" of Bacteria, 188; Capsules, 194; Miscellaneous Factors, 195; Relative Pathogenicity of Bacteria, 195; Mixed and Secondary Infections, 196.	
<i>Resistance</i>	197
Species, Racial and Inherited Resistance, 197; Races of Man, 199; Age, 200; Sex, 201; Climate and Season, 202; General Physiological Well-being, 202; The External Defenses of the Organism, 204; Normal Flora, 207.	
 9. THE EPIDEMIOLOGY OF INFECTIOUS DISEASE.....	208
The Carrier, 209.	
<i>Epidemiological Types of Infectious Disease</i>	210
Air-Borne Infection, 211.	
<i>The Bacterial Population</i>	213
<i>The Host Population</i>	214
Intrinsic Factors, 214; Extrinsic Factors, 215.	
<i>The Interaction of Host and Parasite Populations</i>	216
Theoretical Analysis, 216; Herd Immunity, 217; Long-Term Relationship, 218.	
<i>Experimental Epidemiology</i>	219
<i>Epidemiological Data and Their Interpretation</i>	221
Geographical Distribution, 221; Prevalence of Disease, 221; Seasonal Distribution, 221; Age Distribution, 222.	
<i>The Control of Infectious Disease</i>	222
Diseases of Lower Animals Transmissible to Man, 223; Insect-Borne Diseases, 223; Diseases Transmitted from Man to Man, 223.	

10. THE BACTERIOLOGY OF WATER AND SEWAGE.....	224
<i>Water</i>	224
Bacteria Native to Natural Waters, 225; Bacterial Contamination of Natural Waters, 225; Factors Influencing the Kinds and Numbers of Bacteria, 227; The Bacteriological Analysis of Water, 228; Chemical Analysis, 230; The Assay of the Sanitary Quality of Water, 230; The Purification of Water Supplies, 231.	
<i>Sewage</i>	234
11. THE BACTERIOLOGY OF MILK AND FOOD.....	236
<i>Milk</i>	236
Sources of Bacteria in Milk, 236; Bacteria from Infected Cattle, 236; Bacteria from External Sources, 237; The Pathogenic Bacteria from External Sources, 238; The Bactericidal Property of Fresh Milk, 239; The Determination of the Quality of Milk, 239; The Hygienic Control of Milk, 241; The Regulation of Milk Quality, 242; Milk Products, 243.	
<i>Food Poisoning and Food-Borne Infection</i>	243
Food Poisons of Bacterial Origin, 243; Food-Borne Bacterial Infections, 245; Shellfish and Disease, 245; Food-Borne Parasitic Infections, 246.	
12. IMMUNITY: ANTIGENS, ANTIBODIES AND THE ANTIGEN-ANTIBODY REACTION. 247	
<i>Antigens</i>	247
Iso-Antigens, 248; Species-Specific Antigens, 248; Heterogenetic Antigens, 249; Organ-Specific Antigens, 249.	
ADJUVANTS.....	250
THE CHEMICAL BASIS OF SPECIFICITY.....	250
Haptenes, 251.	
NON-PROTEIN ANTIGENS.....	252
Polysaccharides, 253; Lipids, 253.	
THE ANTIGENIC STRUCTURE OF BACTERIA.....	253
<i>Antibodies</i>	254
ANTITOXINS.....	255
The Toxin-Antitoxin Reaction, 255; The Standardization of Antitoxins, 256.	
THE BACTERICIDAL SUBSTANCES—LYSINS.....	258
Pfeiffer Phenomenon, 258; Hemolysis, 258; The Mechanism of Lytic Reaction, 259; Complement, 259.	
OPSONINS.....	262
The Opsonic Index, 262; The Factors Influencing Phagocytosis, 263; The Process of Phagocytosis, 264; The Fate of Ingested Bacteria, 264; The Nature of the Opsonic Activity, 265.	
AGGLUTININS.....	266
Conglutination and Conglutinating Complement Adsorption, 266; Passive Agglutination and Antiglobulin Reactions, 267; Cross Reactions, 267; Agglutinin Absorption, 267; The Prozone Phenomenon, 268; "H" and "O" Agglutination, 268; Spontaneous Agglutination, 269; Cold Agglutinins, 269.	

Contents

ix

THE MECHANISM OF AGGLUTINATION.....	269
PRECIPITINS.....	271
Precipitin Reactions in Gels, 271; Precipitin Reactions with Haptenes, 272; Cross Reactions, 272.	
ABLASTIN.....	273
NEUTRALIZING ANTIBODIES.....	273
THE NATURE OF ANTIBODIES.....	274
Antibody Formation, 275; The "Unitarian" Hypothesis, 275.	
THE ANTIGEN-ANTIBODY REACTION.....	276
Ehrlich's Receptor Theory, 276; The Antigen-Antibody Reaction as an Adsorption Phenomenon, 278; The Present Concept, 279; Valence of An- tigen and Antibody, 279; The Second Stage of the Antigen-Antibody Reaction, 280.	
13. IMMUNITY: THE IMMUNE STATE.....	283
<i>Humoral Immunity</i>	283
Effective Immunity, 284.	
<i>Cellular Immunity</i>	285
The Systems of Cells, 286; Local Defense, 286; General Defense, 287; The Cellular Response in Immunity, 287; The Site of Formation of Anti- bodies, 287; Local Immunity, 290.	
<i>Natural Immunity</i>	291
Specific Immunity, 292; Other Antibacterial Substances, 293.	
<i>Acquired Immunity</i>	293
<i>Hypersensitivity</i>	296
ANAPHYLAXIS.....	297
Anaphylactic Shock, 297; Serum Sickness, 300.	
ALLERGY AND ATOPY.....	301
Heredity, 301; Forms of Allergy, 302; Allergic Antigen and Antibody, 303.	
HYPERSENSITIVITY IN INFECTION.....	304
THE RELATIONSHIP OF HYPERSENSITIVITY AND IMMUNITY.....	305
14. THE STAPHYLOCOCCI.....	306
Morphology and Staining, 306; Physiology, 306; Toxins, 307; Variation, 309; Differentiation and Classification, 310; Pathogenicity, 311; Bacterio- logical Diagnosis, 313; Immunity, 314; Chemotherapy, 314.	
<i>Other Micrococci</i>	315
15. THE STREPTOCOCCI.....	317
Morphology and Staining, 317; Physiology, 318; The Formation of Toxic Substances, 319; Variation, 320; Classification, 321; Pathogenicity for Animals, 326; Pathogenicity for Man, 327; Epidemiology of Strepto- coccal Disease, 328; Immunity to Streptococcus Infection, 329; Chemo- therapy, 330; Bacteriological Diagnosis of Streptococcal Infection, 330.	
<i>Streptococcal Infection of the Skin and Subcutaneous Tissues</i>	331
Erysipelas, 331; Wound Infection, 331.	

<i>Streptococcal Infection of the Upper Respiratory Tract</i>	332
<i>Streptococcus Sore Throat (Septic Sore Throat)</i> , 332.	
<i>Scarlet Fever</i>	333
<i>The Erythrogenic Toxin</i> , 334; <i>Scarlet Fever Antitoxin</i> , 334; <i>Prophylactic Inoculation</i> , 335.	
<i>Rheumatic Fever</i>	336
<i>Subacute Bacterial Endocarditis</i>	337
<i>Puerperal Fever</i>	338
16. THE PNEUMOCOCCI	339
Morphology and Staining, 339; Physiology, 340; Toxins, 341; Classification, 343; Variation, 344; Pathogenicity for Man, 345; Bacteriological Diagnosis of Pneumococcus Infections, 348; Chemotherapy, 348; Pathogenicity for Lower Animals, 349; Immunity, 349.	
17. THE GRAM-NEGATIVE PATHOGENIC COCCI (NEISSERIA): THE GONOCOCCUS AND THE MENINGOCOCCUS	351
<i>The Gonococcus</i>	351
Morphology and Staining, 351; Physiology, 352; Toxins, 353; Variation, 354; Classification, 354; Pathogenicity for Man, 354; Bacteriological Diagnosis of Gonococcus Infection, 356; Chemotherapy, 357; Pathogenicity for Lower Animals, 357; Immunity, 357.	
<i>The Meningococcus</i>	358
Morphology and Staining, 358; Physiology, 359; Toxins, 360; Variation, 360; Classification, 360; Pathogenicity for Man, 361; Bacteriological Diagnosis of Meningococcus Infection, 364; Pathogenicity for Lower Animals, 365; Immunity, 365.	
<i>Other Gram-Negative Diplococci</i>	366
The Pigmented Forms, 366; The Obligate Anaerobic Species, 366.	
18. THE ENTERIC BACILLI: THE COLIFORM BACTERIA, FRIEDLÄNDER'S BACILLUS, AND PROTEUS	367
<i>Bacterium Coli</i>	370
Morphology and Staining, 370; Physiology, 371; Variation, 371; Toxins, 371; Pathogenicity for Man, 372; Pathogenicity for Lower Animals, 372; Varieties of <i>Bacterium Coli</i> , 372.	
<i>Bacterium Aerogenes</i>	373
THE COLON-AEROGENES INTERMEDIATES.....	374
THE ECOLOGY OF THE COLIFORM BACTERIA.....	375
THE IMMUNOLOGICAL RELATIONSHIPS OF THE COLIFORM BACTERIA.....	375
THE PARACOLON BACILLI.....	376
The Ballerup-Bethesda Group, 376; The Arizona Group, 376; The Providence Group, 377.	
<i>Friedländer's Bacillus (Klebsiella Pneumoniae)</i>	377
Morphology and Staining, 377; Physiology, 378; Variation, 378; Classification, 378; Pathogenicity, 379; Related Bacteria, 379.	

<i>Proteus</i>	379
Morphology and Staining, 380; Physiology, 380; Antigenic Structure, 381; Pathogenicity, 381; Morgan's Bacillus, 382.	
19. THE ENTERIC BACILLI: THE SALMONELLA GROUP.....	383
Morphology and Staining, 383; Physiology, 383; Toxins, 383; Immunological Differentiation, 383; Classification, 389; Variation, 390; Bacteriological Diagnosis of Salmonella Infection, 391; Ecology, 392; Pathogenicity for Man, 393; The Paratyphoid Fevers, 393; Paratyphoid Gastroenteritis, 395; Pathogenicity for Lower Animals, 396.	
20. THE ENTERIC BACILLI: THE TYPHOID BACILLUS (SALMONELLA TYPHI) ..	397
Morphology and Staining, 397; Physiology, 397; Toxins, 398; Classification and Antigenic Structure, 399; Variation, 400; Pathogenicity for Man, 400; Chemotherapy, 402; Carriers, 402; Bacteriological Diagnosis, 403; Epidemiology, 404; Pathogenicity for Lower Animals, 405; Immunity, 405.	
<i>Alcaligenes Fecal</i> s.....	409
21. THE ENTERIC BACILLI: THE DYSENTERY BACILLI (SHIGELLA).....	410
Classification, 410.	
<i>The Non-Mannitol-Fermenting Shigellae</i>	411
Shigella Shigae, 411; Shigella Parashigae, 411; Shigella Ambigua, 412.	
<i>The Mannitol-Fermenting Shigellae</i>	412
Shigella Flexneri, 412; Shigella Boydii, 414; Shigella Alkalescens, 414.	
<i>The Slow Lactose-Fermenting Shigellae</i>	415
Shigella Sonnei, 415; Shigella Dispar, 416.	
<i>Bacillary Dysentery</i>	416
Pathogenicity for Man, 416; Bacteriological Diagnosis, 417; Chemotherapy, 418; Epidemiology, 418; Immunity, 419; Pathogenicity for Lower Animals, 420.	
22. THE CHOLERA VIBRIO AND RELATED FORMS.....	421
<i>Vibrio Cholerae</i>	421
Morphology and Staining, 421; Physiology, 421; Toxin, 424; Antigenic Structure, 424; Variation, 425; Pathogenicity for Man, 426; Bacteriological Diagnosis, 427; Chemotherapy, 427; Epidemiology, 428; Immunity, 428; Pathogenicity for Lower Animals, 430.	
<i>Paracholera Vibrios and Non-cholera Vibrios</i>	431
The El Tor Vibrios, 431; The Celebes Vibrio, 431; Other Pathogenic Vibrios, 432.	
23. BRUCELLA: UNDULANT FEVER; CONTAGIOUS ABORTION OF CATTLE.....	433
Morphology and Staining, 433; Physiology, 433; Antigenic Structure, 435; Variation, 435; Pathogenicity for Lower Animals, 436; Pathogenicity for Man, 438; Bacteriological Diagnosis, 439; Chemotherapy, 440; Immunity, 440.	
<i>Brucella Bronchiseptica</i>	441

24. PASTEURELLA: HEMORRHAGIC SEPTICEMIA; PLAGUE; TULAREMIA; GLANDERS	442
<i>Pasteurella Pestis—The Plague Bacillus</i>	442
Morphology and Staining, 443; Physiology, 444; Toxin, 445; Pathogenicity for Man, 445; Bacteriological Diagnosis, 448; Chemotherapy, 449; Immunity, 449.	
<i>Pasteurella Pseudotuberculosis</i>	450
<i>Pasteurella Tularensis</i>	450
Morphology and Staining, 450; Physiology, 450; Pathogenicity, 451; Bacteriological Diagnosis, 453; Chemotherapy, 453; Immunity, 453.	
<i>The Glanders Bacillus (Malleomyces Mallei)</i>	453
Morphology and Staining, 453; Physiology, 454; Classification, 455; Pathogenicity for Lower Animals, 455; Pathogenicity for Man, 456; Bacteriological Diagnosis, 456; Chemotherapy, 457; Immunity and Prophylaxis, 457.	
MALLEOMYCES WHITMORI (MALLEOMYCES PSEUDOMALLEI).....	458
25. THE HEMOPHILIC BACTERIA	459
<i>Hemophilus Influenzae (Pfeiffer's Bacillus)</i>	459
Morphology and Staining, 459; Physiology, 459; Varieties, 461; Variation and Antigenic Structure, 461; Toxins, 461; Pathogenicity for Man, 461; Chemotherapy, 462; Pathogenicity for Lower Animals, 462.	
<i>The Koch-Weeks Bacillus</i>	462
<i>Hemophilus Pertussis</i>	463
Morphology and Staining, 463; Physiology, 464; Toxins, 464; Variation and Antigenic Structure, 464; Pathogenicity for Man, 465; Pathogenicity for Animals, 465; Bacteriological Diagnosis, 466; Chemotherapy, 466; Epidemiology, 466; Immunity, 466.	
<i>The Morax-Axenfeld Diplobacillus (Hemophilus Duplex)</i>	467
<i>Ducrey's Bacillus (Hemophilus Ducreyi)</i>	468
26. PSEUDOMONAS; LACTOBACILLUS; LISTERIA; BACTEROIDES; BARTONELLA; PLEUROPNEUMONIA GROUP; DONOVANIA ..	470
<i>Pseudomonas Aeruginosa (Pyocyannea)</i>	470
Morphology and Staining, 470; Physiology, 470; Pathogenicity, 471.	
<i>Lactobacillus</i>	471
Classification, 472; Physiology, 473; Pathogenicity, 473; Lactobacillus Acidophilus, 473; Lactobacillus Bifidus, 474; Lactobacillus Bulgaricus, 474.	
DENTAL CARIES.....	474
<i>Related Bacteria</i>	476
Microbacterium, 476; Propionic Acid Bacteria, 477.	
<i>Listeria</i>	477
Pathogenicity for Animals, 478; Pathogenicity for Man, 478.	
<i>Non-Spore-Forming Anaerobic Bacilli (Bacteroides)</i>	478
Bacteroides Fusiformis, 480; Bacteroides Fragilis, 480; Bacteroides Funduliformis, 481; Bacteroides Ramosus, 482; Bacteroides Melaninogenicus, 482; Bacteroides Pneumosintes, 482.	

Contents	xiii
<i>Bartonella</i>	482
Bartonella Bacilliformis, 482; Bartonellosis of Animals, 484; The Systematic Position of Bartonella, 484.	
<i>The Pleuropneumonia-Like Organisms</i>	485
Morphology and Staining, 485; Physiology, 487; Varieties, Strains or Species, 487.	
<i>Donovania Granulomatis</i>	490
27. BACILLUS—THE SPORE-FORMING AEROBES	492
<i>Bacillus Anthracis</i>	492
Morphology and Staining, 492; Physiology, 493; Variation, 494; Toxins, 494; Pathogenicity for Lower Animals, 495; Pathogenicity for Man, 496; Bacteriological Diagnosis, 496; Chemotherapy, 497; Immunity, 497.	
<i>Related Bacilli</i>	498
28. CLOSTRIDIUM—THE SPORE-FORMING ANAEROBES	501
<i>Clostridium Tetani</i>	502
Morphology, 502; Physiology, 503; Antigenic Structure, 504; Tetanus Toxin, 504; Pathogenicity, 505; Immunity, 506; Chemotherapy, 508.	
<i>Gaseous Gangrene</i>	508
1. THE VIBRION SEPTIQUE, CLOSTRIDIUM SEPTICUM.....	509
Morphology, 509; Physiology, 510; Antigenic Structure and Toxin, 510; Pathogenicity, 510.	
2. CLOSTRIDIUM WELCHII (CLOSTRIDIUM PERFRINGENS).....	511
Morphology, 511; Physiology, 511; Types, 512; Toxins, 512; Pathogenicity for Man, 514; Pathogenicity for Animals, 515.	
3. CLOSTRIDIUM NOVYI (CLOSTRIDIUM OEDEMATIENS).....	515
Morphology, 515; Physiology, 516; Antigenic Structure and Toxin, 516; Pathogenicity for Man, 516; Pathogenicity for Animals, 516.	
4. CLOSTRIDIUM HISTOLYTICUM	517
Morphology, 517; Physiology, 517; Pathogenicity, 518.	
5. CLOSTRIDIUM SPOROGENES.....	518
Morphology, 518; Pathogenicity, 519.	
<i>Blackleg (Clostridium Chauvei)</i>	520
Morphology, 520; Physiology, 520; Pathogenicity, 521; Immunization, 521.	
<i>Clostridium Botulinum</i>	521
Morphology, 521; Physiology, 521; Types, 522; Toxins, 523; Pathogenicity for Man, 523; Pathogenicity for Lower Animals, 525; Immunity, 525.	
29. CORYNEBACTERIUM (THE DIPHTHERIA BACILLUS)	526
Morphology and Staining, 526; Physiology, 527; Toxin, 529; Variation, 530; Types, 530; Pathogenicity for Man, 532; Pathogenicity for Lower Animals, 533; Bacteriological Diagnosis, 534; Immunity, 535; Prophylactic Immunization, 535; Passive Immunity, 537; Epidemiology, 537; The Control of Diphtheria, 539.	
<i>The Diphtheroid Bacilli</i>	540

30. MYCOBACTERIUM.....	542
<i>The Tubercle Bacilli.....</i>	542
Morphology and Staining, 542; Physiology, 543; Chemical Composition, 545; Resistance, 545; Variation, 546; Pathogenicity for Man, 546; Bacteriological Diagnosis, 550; Chemotherapy, 551; Immunity, 552; Pathogenicity for Lower Animals, 555; Epidemiology, 557.	
<i>The Bacillus of Leprosy (Mycobacterium Leprae).....</i>	559
Morphology and Staining, 559; Cultivation, 560; Pathogenicity, 560; Transmission, 561; Chemotherapy, 562; Immunity, 562; Rat Leprosy, 563.	
<i>Other Acid-Fast Bacilli.....</i>	563
Mycobacterium Paratuberculosis, 563; The Vole Bacillus, 563; The "Cold-Blooded" Mycobacteria, 564; The Saprophytic Acid-Fast Bacilli, 564.	
31. MEDICAL MYCOLOGY: THE PATHOGENIC ACTINOMYCETES, MOLDS, YEASTS AND RELATED MICROORGANISMS.....	565
I. The Actinomycetes.....	567
ACTINOMYCES BOVIS.....	568
Morphology and Staining, 569; Physiology, 571; Pathogenicity for Animals, 572; Pathogenicity for Man, 573; Immunity, 574; Isolation and Diagnosis, 574.	
MYCETOMA.....	575
Actinomycotic Mycetoma, 576; Maduromycosis, 576; Diagnosis, 576.	
OTHER ACTINOMYCETES.....	576
ACTINOMYCES MURIS-RATTI (RAT-BITE FEVER, HAVERHILL FEVER).....	578
ACTINOBACILLUS.....	579
Actinobacillus Lignieresii, 579; Actinobacillus Actinoides, 580; Actinobacillus Actinomycetem-Comitans, 580.	
ERYSIPEROLOTHRIX RHUSIOPATHIAE.....	580
Morphology and Physiology, 580; Pathogenicity, 581; Immunity, 582.	
II. The Molds and Mold-Like Fungi.....	582
Hyphae and Mycelium, 583; Spore Formation, 583; Fungi Imperfecti, 584; Differential Characteristics of Genera and Species, 584; Microscopic Examination, 586; Cultivation, 586.	
ASPERGILLUS (ASPERGILLOSIS).....	587
Pathogenicity for Animals, 587; Pathogenicity for Man, 588.	
FONSECAEA PEDROSOI (CHROMOBLASTOMYCOSIS).....	589
SPOROTRICHUM SCHENCKII (SPOROTRICHOSIS).....	590
Pathogenicity for Man, 590; Epidemiology, 591; Diagnosis, 591; Immunity, 591.	
THE DERMATOPHYTES.....	592
Differentiation of Genera and Species, 593; Pathogenicity, 596; Immunity, 600; Characteristics of Dermatophyte Species, 601; Diagnosis, 605.	
III. Yeasts and Yeast-Like Fungi.....	606
CRYPTOCOCCUS NEOFORMANS (TORULA HISTOLYTICA).....	607
European Blastomycosis, 608; Torula Meningitis, 608; The Causative Organism, 609.	

Contents

xv

BLASTOMYCES DERMATITIDIS (AMERICAN BLASTOMYCOSIS)	610
The Causative Organism, 610; Pathogenicity, 612; Immunity, 613; Diagnosis, 613.	
CANDIDA ALBICANS (MONILIA ALBICANS)	613
The Causative Organism, 614; Pathogenicity, 614.	
COCCIDIOIDES IMMITIS	617
The Causative Organism, 617; Pathogenicity, 617; Immunity, 619; Diagnosis, 620; Epidemiology, 620; Paracoccidioidomycosis, 621.	
HISTOPLASMA CAPSULATUM	621
The Causative Organism, 621; Pathogenicity, 622; Diagnosis, 623.	
 32. THE SPIROCHETES	624
<i>The Spirochetes of the Relapsing Fevers (Borrelia)</i>	624
Morphology, 624; Cultivation, 625; Classification, 625; Pathogenicity, 626; Immunity, 627; Diagnosis, 627; Epidemiology, 628.	
<i>Vincent's Angina (Borrelia Vincentii)</i>	629
<i>Syphilis (Treponema Pallidum)</i>	630
Morphology, 630; Cultivation, 630; Pathogenicity for Man, 631; Immunity, 633; Serodiagnosis, 633; Pathogenicity for Lower Animals, 636; Chemotherapy, 636.	
NON-VENEREAL SYPHILIS	637
<i>Yaws (Treponema Pertenue)</i>	637
<i>Pinta (Treponema Herrejoni, T. Carateum)</i>	639
Etiology, 639; The Disease in Man, 639; Transmission, 640.	
<i>Other Treponemas</i>	640
<i>Leptospira</i>	640
Morphology, 640; Cultivation, 640; Pathogenicity, 640; Bacteriological Diagnosis, 642; Chemotherapy, 642.	
WEIL'S DISEASE (INFECTIOUS JAUNDICE)	642
Disease in Man, 642; Immunity, 642; Transmission, 643.	
CANINE LEPTOSPIROSIS	643
SWAMP FEVER	643
LEPTOSPIRA INFECTIONS OF THE FAR EAST	644
SAPROPHYTIC LEPTOSPIRA	644
<i>Rat-Bite Fever (Spirillum Morsus Muris)</i>	645
 33. MEDICAL PARASITOLOGY	647
<i>By RICHARD J. PORTER, PH.D.</i>	
<i>The Protozoa</i>	647
THE INTESTINAL AMEBAE (RHIZOPODA)	648
Entamoeba Histolytica, 648; Other Species of Amebae Parasitic in Man, 652.	
CILIOPHORA	652
INTESTINAL FLAGELLATES (MASTIGOPHORA)	653
HEMOFLAGELLATES (MASTIGOPHORA)	654
The Trypanosomes, 655; Trypanosoma Gambiense, 655; Trypanosoma Cruzi, 657; Other Species of Trypanosoma, 659; The Leishmanias, 659;	

Leishmania Donovanii, 659; Leishmania Tropica, 662; Leishmania Brasilensis, 662.	
SPOROZOA	662
Malarial Parasites, 662.	
PARASITES OF UNCERTAIN AFFINITIES	670
Toxoplasma, 670; Sarcocystis, 670.	
The Metazoa	670
PLATYHELMINTHES	671
TREMATODA	671
Paragonimus Westermani, 671; Fasciolopsis Buski, 674; Heterophyes Heterophyes, 675; Other Intestinal Trematodes, 675; Clonorchis Sinensis, 675; The Human Blood Flukes, 676; Other Species, 678.	
CESTOIDEA	679
Taenia Solium, 679; Taenia Saginata, 681; Echinococcus Granulosus, 681; Hymenolepis Nana, 682; Tapeworms of Lower Animals, 683; Diphyllobothrium Latum, 683.	
NEMATODA	685
Enterobius Vermicularis, 685; Trichuris Trichiura, 686; Ascaris Lumbricoides, 687; Hookworms, 688; Strongyloides Stercoralis, 691; Trichinella Spiralis, 692; Wuchereria Bancrofti, 694; Other Species of Filarial Worms, 695.	
34. THE RICKETTSIAE	697
Morphology and Staining, 697; Cultivation, 698; Resistance, 700; Pathogenicity, 700; Chemotherapy, 700; Immunity, 701; Classification, 704.	
<i>The Typhus Fevers</i>	704
European Typhus Fever, 705; Murine Typhus, 706; The Weil-Felix Reaction in the Typhus Fevers, 707.	
<i>The Spotted Fevers</i>	708
Rocky Mountain Spotted Fever, 708; São Paulo Typhus, 709; Fièvre Boutonneuse, 709; Kenya Fever, 709; South African Tick Fever, 709; Q Fever, 709; Bullis Fever, 710; Rickettsialpox, 710.	
<i>Tsutsugamushi Disease (Scrub Typhus, Mite Typhus)</i>	710
<i>Trench Fever</i>	711
<i>Rickettsial Disease of Animals</i>	712
Heartwater Disease, 712; Other Animal Rickettsiae, 712.	
35. THE VIRUSES	713
<i>By F. B. GORDON, M.D., PH.D.</i>	
<i>Cytotropism</i>	713
Tissue Predilection, 713; Effect Upon Host Cells, 714; Viruses and Tumors, 715; Latent Infection, 715; Inclusion Bodies, 716; Elementary Bodies, 717.	
<i>The Physical Character of Viruses</i>	717
Size, 717; Filterability, 718; Ultracentrifugation, 718; Microscopy, 719.	
<i>The Effect of Physical and Chemical Agents</i>	721
Heat, 721; Radiation, 722; Desiccation, 722; Chemical Agents, 722.	

Contents

xvii

<i>Chemical Composition of Viruses</i>	722
Tobacco Mosaic Virus, 722; Animal Viruses, 723.	
<i>Cultivation of Viruses</i>	724
Laboratory Animals, 724; Embryonated Egg, 724; Tissue Culture, 725;	
Quantitation of Viral Activity, 725.	
<i>Reproduction of Viruses</i>	726
Influenza Virus, 726; Incomplete Virus, 727.	
<i>Drug Therapy in Virus Diseases</i>	727
<i>Viral Hemagglutination</i>	728
Cell Receptor, 728; Hemagglutination by Other Viruses, 728.	
<i>Immunity in Virus Infections</i>	729
Naturally Acquired Immunity, 729; Active Immunization, 729; Serological	
Tests, 729; Passive Immunization, 730; Hypersensitivity, 731; Virus Anti-	
gens, 731; Non-specific Factors in Resistance, 731; Interference, 732.	
<i>Genetics of Viruses</i>	733
Naturally Occurring Variations, 733; Adaptation, 733; Mutation, 734;	
Limit Dilution Passage, 734; Transformation, 734; Recombination, 735.	
<i>The Nature of Viruses (Summary)</i>	735
Question of Origin, 735; Taxonomy of Viruses, 736.	
 36. VIRUS DISEASES OF MAN	737
<i>By F. B. GORDON, M.D., PH.D.</i>	
<i>Introduction</i>	737
<i>Smallpox (Variola)</i>	737
Epidemiology, 737; The Virus, 738; Laboratory Diagnosis, 738.	
<i>Vaccinia</i>	738
The Virus, 738; Immunization Against Smallpox, 739.	
<i>Measles (Rubeola)</i>	740
The Virus, 740; Immunity, 741.	
<i>Rubella (German Measles)</i>	741
<i>Mumps (Epidemic Parotitis)</i>	741
The Virus, 742; Immunity, 742; Laboratory Diagnosis, 742.	
<i>Varicella (Chickenpox) and Herpes Zoster (Shingles)</i>	742
<i>Influenza</i>	743
Epidemiology, 743; Etiology, 743; Immunity, 744; Immunization, 745;	
Laboratory Diagnosis, 745; Swine Influenza, 745.	
<i>Primary Atypical Pneumonia</i>	746
Etiology, 746; Cold Hemagglutination, 747; Treatment, 747.	
<i>The Common Cold</i>	747
Etiology, 747; Epidemiology, 748; Immunity, 748.	
<i>Infectious Mononucleosis</i>	748
<i>The Psittacosis-Lymphogranuloma Venereum Group</i>	748
<i>PSITTACOSIS</i>	749
The Avian Disease, 750; The Human Disease, 750; Ornithosis, 750;	
Human Pneumonitis, 750; Laboratory Diagnosis, 750.	
<i>LYMPHOGRANULOMA VENEREUM</i>	751
The Virus, 751; Laboratory Diagnosis, 751; Cat-Scratch Disease, 751;	
Mouse Pneumonitis, 751; Feline Pneumonitis, 751.	

MORPHOLOGICAL STUDIES	752
ANTIGENIC RELATIONSHIPS	752
<i>Trachoma</i>	754
The Virus, 755.	
<i>Inclusion Conjunctivitis</i>	755
The Virus, 755.	
<i>Epidemic Keratoconjunctivitis</i>	755
<i>Poliomylitis</i>	756
EPIDEMIOLOGY	756
Transmission, 756; Geographic Distribution, 756; Age Incidence, 757; Seasonal Incidence, 757.	
PATHOGENESIS	758
PATHOLOGY	759
VIRUS	759
Immunological Types, 759; Animal Susceptibility, 760; Tissue Culture, 760.	
IMMUNITY	760
Active Immunization, 762; Passive Immunization, 762.	
SEROLOGICAL TESTS	762
Serum Neutralization, 762; Complement Fixation, 763.	
LABORATORY DIAGNOSIS	763
ENCEPHALOMYELITIS OF MICE	763
PORCINE ENCEPHALOMYELITIS (TESCHEN DISEASE)	763
<i>The Coxsackie Viruses</i>	763
The Viruses, 764; Immunity, 764; Epidemiology, 765.	
<i>Herpes Simplex</i>	765
The Virus, 766; Immunity, 767; Laboratory Diagnosis, 767; Similar Viruses of Animals, 767.	
<i>Infectious Hepatitis</i>	767
The Disease, 767; The Virus, 768; Serum Hepatitis, 768.	
<i>Yellow Fever</i>	768
Etiology, 769; Control of Urban Yellow Fever, 770; Jungle Yellow Fever, 770; The Virus, 771; Active Immunization, 771.	
<i>Dengue Fever</i>	772
<i>Phlebotomus Fever</i>	772
<i>Rift Valley Fever</i>	773
<i>Colorado Tick Fever</i>	773
<i>Epidemic Hemorrhagic Fever</i>	773
<i>Arthropod-Borne Viral Encephalitides</i>	773
Laboratory Diagnosis, 774.	
<i>EQUINE ENCEPHALOMYELITIS</i>	774
Western Equine Encephalomyelitis, 774; Eastern Equine Encephalomyelitis, 775; Venezuelan Equine Encephalomyelitis, 776; Active Immunization, 776.	
<i>ST. LOUIS ENCEPHALITIS</i>	776
The Virus, 777; Reservoir of Infection, 777.	
<i>OTHER ENCEPHALITIDES</i>	777
California Encephalitis, 777; Japanese B Encephalitis, 777; Murray Valley	

Encephalitis, 779; West Nile Virus, 779; Bwamba Fever, 779; Miscellaneous Viruses Found in Mosquitoes, 779; Encephalomyocarditis Group, 780; Russian Tick-Borne Encephalitis, 780; Louping Ill, 780.	
<i>Lethargic Encephalitis</i>	780
<i>Postinfection Encephalitis (Acute Disseminated Encephalomyelitis)</i>	780
<i>Lymphocytic Choriomeningitis</i>	781
Human Infection, 781; Experimental Arthropod Transmission, 781; The Virus, 781; Laboratory Diagnosis, 782.	
<i>Rabies (Hydrophobia)</i>	782
The Disease in Dogs, 782; The Virus, 782; Transmission to Man, 783; Laboratory Diagnosis, 783; Rabies Prophylaxis, 784.	
<i>Molluscum Contagiosum</i>	784
<i>Warts</i>	784
<i>Miscellaneous Animal Diseases Transmissible to Man</i>	784
Foot-and-Mouth Disease, 784; Vesicular Stomatitis, 784; Newcastle Disease, 785; Ovine Pustular Dermatitis (Contagious Ecthyma), 785; Infectious Anemia of Horses, 785.	
37. BACTERIOPHAGE (THE BACTERIAL VIRUSES).....	786
Demonstration of Bacteriophagy, 786; Characteristics of Bacteriophage, 786; Mechanism of Phage Action, 791; Effect of Phage on Bacteria, 793; Therapeutic Use of Phage, 794.	
INDEX.....	795