

Contents

Preface to the Seventh Edition

Preface to the First Edition

Index of Competencies

vii

ix

xi

Section 1: General Bacteriology

1. Introduction	3	B. Chemical agents 42	
Origin of microbial life 3		1. Phenols 42	
The developing science of microbiology 4		2. Halogens 43	
Koch's postulates 4		3. Metallic salts 43	
The beginning of virology 5		4. Aldehydes 43	
Contributions of various scientists in the field of microbiology 5		5. Alcohols 43	
2. Morphology of Bacteria	9	6. Dyes 43	
Size of bacteria 9		7. Vapour-phase disinfectants 44	
Shape of bacteria 10		8. Surface active disinfectants 44	
Group patterns 11		Biomedical Waste Management Rules, 2016 45	
Anatomy of a bacterial cell 11		6. Hand Hygiene and Personal Protective Equipment (PPE)	50
3. Growth and Nutrition of Bacteria	20	7. Bacterial Genetics	55
Bacterial growth 20		Structure of DNA 55	
Bacterial growth curve 20		Structure of RNA 55	
Culture media 21		Extrachromosomal genetic elements 56	
Environmental factors influencing growth 23		Genotypic and phenotypic variations 56	
Culture methods 24		Lac operon (gene regulation) 57	
Aerobic culture 25		Mutation 57	
Culture in an atmosphere with added carbon dioxide 25		Acquisition of new genes 59	
Culture in microaerophilic atmosphere 25		Antibiotic resistance 62	
Anaerobic culture 25		Transposable genetic elements 63	
4. Collection of Specimens, Identification of Bacteria and Taxonomy	28	Genetic engineering (recombinant DNA technology) 63	
General rules for collection and transportation of specimen 28		DNA probes 65	
Identification of bacteria 30		Polymerase chain reaction (PCR) 65	
Bacterial taxonomy 34		8. Bacteria in Health and Disease	69
5. Sterilization, Disinfection and Biomedical Waste Management	37	Infection 69	
A. Physical agents 37		Sources of infection 70	
1. Sunlight 37		Modes of spread of infection 71	
2. Drying 37		9. Immunity	75
3. Heat 37		I. Innate immunity 75	
4. Filtration 41		II. Acquired immunity 78	
5. Radiations 42		Adoptive immunity 80	
		Local immunity 80	
		Herd immunity 80	

10. Antigens	82	16. Immunodeficiency Diseases	124
Superantigens 84		Primary immunodeficiency syndromes 124	
11. Antibodies	85	Secondary immunodeficiency 127	
Antibody structure 85		17. Hypersensitivity	128
Immunoglobulins as antigens 87		Type I hypersensitivity: Anaphylactic 128	
Immunoglobulin classes 87		Type II hypersensitivity: Cytotoxic 130	
Abnormal immunoglobulins 90		Type III hypersensitivity: Immune complex 131	
12. The Complement System	92	Type IV hypersensitivity: Cell-mediated or delayed 132	
13. Antigen–Antibody Reactions	97	Type V hypersensitivity: Stimulatory or anti-receptor 133	
Characteristics of antigen–antibody reactions 97		Shwartzman reaction 133	
Methods used to detect and quantitate antigen and antibody 98		18. Autoimmunity	135
14. Architecture of the Immune System	110	Mechanism of autoimmunity 135	
Primary lymphoid organs 110		Classification of autoimmune diseases 136	
Peripheral lymphoid organs 111		19. Histocompatibility Systems	139
Cells of the immune system 112		Types of grafts 139	
15. Immune Response	117	Allograft reaction 139	
Humoral or antibody-mediated immune response 117		Major histocompatibility complex 139	
Cell-mediated immune responses 120		Histocompatibility testing 140	
		Graft versus host reaction 141	
		Foetus as a graft 141	
		Tumour immunology 141	
		20. Immunohaematology	145

Section 2: Systemic Bacteriology

21. Staphylococcus	151	<i>Clostridium tetani</i> 199	
<i>Staphylococcus aureus</i> 151		<i>Clostridium botulinum</i> 202	
Coagulase-negative staphylococci 156		28. Mycobacterium tuberculosis	205
Other coagulase-negative staphylococci 157		<i>Mycobacterium tuberculosis</i> complex 205	
22. Streptococcus and Enterococcus	159	29. Non-tuberculous Mycobacteria	216
Classification 159		30. Mycobacterium leprae	220
23. Streptococcus pneumoniae (Pneumococcus)	169	<i>Mycobacterium lepraemurium</i> 226	
24. Neisseria, Moraxella and Acinetobacter	174	31. Non-sporing Anaerobes	228
<i>Neisseria meningitidis</i> (meningococcus) 174		Bacteroidaceae 230	
<i>Neisseria gonorrhoeae</i> (gonococcus) 177		32. Spirochaetes	233
Non-gonococcal urethritis (NGU) 180		<i>Treponema</i> 233	
<i>Kingella</i> 180		<i>Treponema pallidum</i> 234	
<i>Moraxella</i> 180		Non-venereal treponematoses 240	
<i>Acinetobacter</i> 181		<i>Borrelia</i> 241	
25. Corynebacterium	183	Relapsing fever 241	
<i>Corynebacterium diphtheriae</i> 183		<i>Borrelia vincentii</i> 242	
Non-diphtheria corynebacteria (diphtheroids) 188		<i>Borrelia burgdorferi</i> 242	
26. Bacillus	190	<i>Leptospira</i> 243	
<i>Bacillus anthracis</i> 190		<i>Leptospira interrogans</i> 243	
<i>Bacillus cereus</i> 192		33. Enterobacteriaceae: Escherichia, Klebsiella and Other Genera	247
27. Clostridium	195	34. Proteus, Morganella and Providencia	258
<i>Clostridium perfringens</i> (<i>Clostridium welchii</i>) 195			
<i>Clostridium difficile</i> 199			

35. <i>Shigella</i>	262	45. <i>Mycoplasma</i> and <i>Ureaplasma</i>	319
36. <i>Salmonella</i>	267	Atypical pneumonia	322
37. <i>Yersinia</i>	276	46. <i>Rickettsia</i>, <i>Orientia</i>, <i>Ehrlichia</i>, <i>Anaplasma</i>, <i>Neorickettsia</i>, <i>Coxiella</i> and <i>Bartonella</i>	324
38. <i>Vibrio</i>, <i>Aeromonas</i> and <i>Plesiomonas</i>	282	Rickettsiaceae	324
Halophilic vibrios	287	Anaplasmataceae	328
39. <i>Campylobacter</i>, <i>Helicobacter</i> and <i>Spirillum</i>	291	Coxiellaceae	328
<i>Campylobacter</i>	291	Bartonellaceae	329
<i>Helicobacter</i>	293	47. <i>Chlamydia</i> and <i>Chlamydophila</i>	332
<i>Spirillum minus</i>	294	48. <i>Actinomycetes</i>	338
40. <i>Pseudomonas</i> and <i>Burkholderia</i>	296	49. <i>Miscellaneous Bacteria</i>	342
41. <i>Legionella</i>	301	50. <i>Automation in Microbiology</i>	349
42. <i>Haemophilus</i>	304	1. Automated specimen processing	350
Other haemophili	307	2. Automated identification and antimicrobial susceptibility testing systems	350
43. <i>Bordetella</i>	310	3. Molecular automation	352
44. <i>Brucella</i>	314	4. Total laboratory automation (TLA)	353
		5. Proteomic-based automated identification system	353
		Criteria for evaluation and selection of automated system	353

Section 3: Virology

51. <i>General Properties of Viruses</i>	357	Human herpesvirus 7	392
Structure of the viruses	357	Human herpesvirus 8	392
Shape	358	Cercopithecine herpesvirus 1	392
Susceptibility to physical and chemical agents	358	56. <i>Adenoviruses</i>, <i>Parvoviruses</i>, <i>Papilloma- viruses</i> and <i>Polyomaviruses</i>	394
Viral haemagglutination	359	Adenoviruses	394
Replication of viruses	359	Parvoviruses	394
Virus isolation	362	Papillomaviruses and polyomaviruses	396
Viral assay	364	57. <i>Picornaviruses</i>	400
Viral genetics	365	Enteroviruses	400
Nomenclature of viruses	366	Rhinoviruses	403
Classification of viruses	366	Hepatovirus (hepatitis A virus)	404
52. <i>Virus–Host Interactions, Laboratory Diagnosis of Viral Infections, and Viral Vaccines</i>	370	58. <i>Rhabdoviruses</i>	406
Transmission of human virus infections	371	Rabies virus	406
Host response to virus infection	372	Vesiculovirus	410
Laboratory diagnosis of viral infections	373	59. <i>Orthomyxoviruses</i>	412
Viral vaccines	374	60. <i>Paramyxoviruses</i>, <i>Respiratory Syncytial Virus</i> and <i>Human Metapneumovirus</i>	418
Antiviral therapy	375	61. <i>Caliciviruses</i>, <i>Astroviruses</i> and <i>Corona- viruses</i>	422
53. <i>Bacteriophage</i>	378	Caliciviruses	422
54. <i>Poxviruses</i>	381	Astroviruses	422
55. <i>Herpesviruses</i>	386	Coronaviruses	422
Herpes simplex virus (HSV)	386		
Varicella-zoster virus (VZV)	388		
Epstein-Barr virus (EBV)	389		
Cytomegalovirus (CMV)	391		
Human herpesvirus 6	392		

62. Arboviruses	425	Hepatitis C virus (HCV)	454
Togaviridae	426	Hepatitis D virus (HDV)	455
Alphaviruses	426	Hepatitis E virus (HEV)	456
Rubella virus	427	Hepatitis G virus (HGV)	456
Flaviviridae	428	SEN virus (SEN-V)	457
Bunyaviridae	431	Transfusion-transmitted virus (TTV)	457
63. Filoviruses, Arenaviruses and Reoviridae	434	66. SARS-CoV-2 Virus	460
Filoviruses	434	67. Oncogenic (Tumour) Viruses	465
Arenaviruses	434	Oncogenic DNA viruses	467
Reoviridae	435	Oncogenic RNA viruses	467
64. Human Immunodeficiency Virus: AIDS	438	68. Slow Virus Infections and Prions	469
Human immunodeficiency viruses	438	Slow virus infections	469
65. Hepatitis Viruses	449	Prions	470
Hepatitis A virus (HAV)	449		
Hepatitis B virus (HBV)	450		

Section 4: Medical Mycology

69. Medical Mycology	475	III. Systemic mycoses	489
Classification of fungi	476	IV. Opportunistic mycoses	493
Laboratory diagnosis of mycoses	476	Superficial infections	493
Classification of mycoses	478	Deep infections	495
I. Superficial mycoses	479	Disseminated candidiasis and candidemia	495
II. Subcutaneous mycoses	483		

Section 5: Clinical Microbiology

70. Emerging and Reemerging Infectious Diseases	511	72. Nosocomial Infections	530
		Antibiotic policy	531
71. Infective Syndromes and Clinical Case Based Exercises	514	73. Antimicrobial Sensitivity Testing	533
		74. Prophylactic Immunization	539

Section 6: Bacteriology of Water, Milk and Air, and Biological Warfare

75. Bacteriology of Water, Milk and Air	545	76. Biological Warfare	551
Bacteriology of water	545	Hippocratic oath	551
Bacteriology of milk	547		
Bacteriology of air	548		

Section 7: Quality Assurance, Ethics and Overview of Microbiology

77. Quality Assurance in Microbiology Laboratory	559	79. Overview of Microbiology	567
78. Ethics in Laboratory Medicine	565		

Section 8: General Parasitology

80. General Parasitology 575

Parasite 575
 Why a human embryo or foetus is
 not a parasite? 575
 Host 575
 Host-parasite relationships 576
 Sources of infection 577

Portal of entry into the body 577
 Life cycle of human parasites 578
 Pathogenicity 578
 Immunity in parasitic infections 579
 Classification of parasites 582
 Nomenclature of parasites 582

Section 9: Protozoology

81. Unicellular Parasites 589

Kingdom Protozoa 589
 Phyla Metamonada, Parabasala,
 Percolozoa and Euglenozoa 589
 Phylum Amoebozoa 589
 Phylum Sporozoa 589
 Phylum Ciliophora 589
 Kingdom Stramenopila (formerly Chromista) 589
 Phylum Bigyra 589
 Kingdom Fungi 589
 Phylum Microspora (Microsporidians) 589

82. Amoebae and *Naegleria fowleri* 591

Entamoeba histolytica 591
 Non-pathogenic amoebae 598
Entamoeba dispar 598
Entamoeba hartmanni 598
Entamoeba coli 598
Entamoeba polecki 598
Entamoeba gingivalis 599
Endolimax nana 599
Iodamoeba bütschlii 600
 Opportunistic protozoa 601
Naegleria fowleri 601
Acanthamoeba species 602
Balamuthia mandrillaris 604

83. Flagellates 608

Intestinal, oral and genital flagellates 608
Giardia lamblia (*G. duodenalis*; *G. intestindis*) 608
Trichomonas 611
Trichomonas tenax 611
Trichomonas hominis 611
Trichomonas vaginalis 611
Chilomastix mesnili 613
Enteromonas hominis 613

Retortamonas intestinalis 614
Dientamoeba fragilis 614
 Blood and tissue flagellates 615
Leishmania 615
 Old World leishmaniasis 616
Leishmania donovani 616
 Post kala-azar dermal leishmaniasis 619
Leishmania infantum 620
Leishmania tropica complex 620
Leishmania tropica 620
Leishmania major 621
Leishmania aethiopica 621
 New World leishmaniasis 621
Leishmania braziliensis complex and
Leishmania mexicana complex 621
Leishmania peruviana 622
Leishmania chagasi 622
 Trypanosomes 622
Trypanosoma brucei gambiense 623
Trypanosoma brucei rhodesiense 625
Trypanosoma cruzi 626
Trypanosoma rangeli 629

84. Sporozoa 634

Malaria parasites 634
Babesia 646
Toxoplasma gondii 647
Sarcocystis species 652
Cytoisopora (*Isospora*) *belli* 654
Cyclospora cayetanensis 656
Cryptosporidium parvum 657
Blastocystis species 660

85. *Balantidium coli* 665

86. Microsporidia 668

Section 10: Helminthology

87. Introduction to Helminths 673

88. Cestodes or Tapeworms 675

General characteristics of cestodes 675
 Classification of cestodes 676

Diphyllobothrium latum 677
Spirometra species 679
Taenia species 680
Taenia saginata and *Taenia solium* 681
Taenia asiatica 684

Taenia multiceps 684
Hymenolepis nana 685
Hymenolepis diminuta 686
Dipylidium caninum 688
Echinococcus granulosus 690
Echinococcus multilocularis 694
Echinococcus vogeli 695

89. Trematodes or Flukes 699

General characteristics 699
 Classification of trematodes 700
 Schistosomes or blood flukes 700
Schistosoma mekongi 704
Schistosoma intercalatum 704
Fasciola hepatica 704
Fasciola gigantica 707
Fasciolopsis buski 707
Clonorchis sinensis 709
Paragonimus westermani 711
 Trematodes of minor importance 713
Gastrodiscoides hominis 713
Watsonius watsoni 714
Opisthorchis felinus 714
Opisthorchis viverrini 714
Heterophyes heterophyes 714
Metagonimus yokogawai 715

90. Nematodes 719

General characteristics 719
 Modes of infection with nematode parasites 720
 Classification of nematodes 720
Trichinella spiralis 720
Trichuris trichiura 723
Strongyloides stercoralis 724
 Hookworms 728
Ancylostoma duodenale 728
Necator americanus 731
Ancylostoma braziliense 731
Ancylostoma ceylanicum 732
Ancylostoma caninum 732

Cutaneous larva migrans 732
Enterobius vermicularis 733
Ascaris lumbricoides 735
Ascaris suum 738
 Visceral larva migrans 739
Baylisascaris procyonis 739
 Filarial nematodes 739
Wuchereria bancrofti 740
 Occult filariasis 744
 Tropical pulmonary eosinophilia (TPE) 744
Brugia malayi 746
Brugia timori 746
Loa loa 747
Onchocerca volvulus 748
Mansonella streptocerca 749
Mansonella ozzardi 750
Mansonella perstans 750
Dirofilaria immitis 750
Dirofilaria immitis 750
 Other *Dirofilaria* species 751
 Other nematodes 751
Dracunculus medinensis 751
Angiostrongylus species 752
Angiostrongylus cantonensis 752
Angiostrongylus costaricensis 753
Gnathostoma species 754
Gnathostoma spinigerum 754
Gnathostoma hispidum 756
Gnathostoma doloresi 756
Gnathostoma nipponicum 756
Ternidens deminutus 756
Capillaria philippinensis 757
Capillaria hepatica 758
Capillaria aerophila 758
Anisakis simplex 758
Oesophagostomum species 759
Trichostrongylus species 759
Thelazia callipaeda 760
Diectophyma renale 760

Section 11: Applied Parasitology, Diagnostic Procedures and Overview

91. Parasitic Opportunistic Infections in AIDS Cases and Nosocomial Parasitic Infections 769

Parasitic opportunistic infections in AIDS cases 769
Toxoplasma gondii 769
Cryptosporidium parvum 769
Cytoisopora belli 770
Microsporidia 770
Entamoeba histolytica 770
Giardia lamblia 770
Cyclospora cayetanensis 770
Leishmania species 770
Strongyloides stercoralis 770
 Free-living protozoa 771
 Nosocomial parasitic infections 771
 Nosocomial gastrointestinal infections 771
 Nosocomial blood and tissue infections 771
 Nosocomial infections in the paediatric patients 771

92. Diagnostic Procedures 772

Examination of faeces 772
 Examination of urine 778
 Examination of sputum 778
 Examination of aspirates 778
 Examination of cerebrospinal fluid 778
 Examination of biopsy material 778
 Examination of blood 779
 Culture methods 782
 Serologic diagnosis 782
 Molecular biology 783
 Controlling microscopy 783

93. Medically Important Arthropods 785

Insects 786
 Mosquitoes 786
 Sandflies 787

Beetles	787	Parasites which can be cultured in the laboratory	800
Reduviid bugs	788	Skin tests	800
Fleas	788	Classification of nematodes	800
Lice	788	Nematodes which do not show systemic migration in man	800
Other biting flies	788	Types of microfilariae	801
Midges	788	Parasitic causes of travellers' diarrhoea	801
Arachnids	788	Concomitant immunity	801
Ticks	788	Life-long immunity	801
Other arthropods	788	Universal precautions	801
94. Quality Assurance in Parasitology	790	Most lethal of all helminthic infections of man	801
95. Ethics in Laboratory Medicine	793	Both male and female worms remain coiled together and it is difficult to separate them	801
96. Overview of Medical Parasitology	795	Various Protozoa	802
Habitat	975	Relative Sizes of Helminth Eggs	803
Morphology	996	Index	805
Portal of entry	996		
Source of infection	797		
Life cycle	797		
Obligate intracellular parasites	798		
Symptomatology	798		
Clinical samples	799		