6TH EDITION

DIAGNOSTIC MEDICAL PARASITOLOGY

LYNNE SHORE GARCIA
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As with the first five editions, I dedicate this book to Marietta Voge, a truly rare individual who was widely recognized as one of the world’s leading parasitologists. During her years as a diagnostic and research parasitologist at the University of California, Los Angeles, she touched the lives of many students and staff in a very special way. She was always more than willing to share her expertise with all who asked and volunteered this help over the years whenever contacted. She was always willing to donate a considerable amount of her personal time as a volunteer for various medical projects throughout the world.

She was a very special individual to work with, always interested in the person as well as the problem at hand. Her areas of teaching extended far beyond science. Whatever subject she was interested in received her total enthusiasm and dedication, and she had an exceptional ability to deal with detailed work. Her sense of fairness and professional integrity were remarkable; these ideals were shared with all who came in contact with her.

Her contributions to the field of diagnostic parasitology were numerous and included many classes, seminars, papers, and textbooks. The importance of working with Dr. Voge is hard to put into words. She was unique in her ability to allow a student to grow, both scientifically and personally. She could guide without constraints, teach without formal lectures, counsel without being judgmental, challenge without being unrealistic, tease without being cruel, and always be supportive regardless of the situation. She expected much from her students and employees and yet always gave considerably more than she received.

Scientific information gained from our association with her was invaluable; however, her impact on our lives was considerably more than scientific. She was always available for consultations and just to talk. She left all of us with a sense of having personally matured as a result of knowing and working with her over the years. She is missed by all of us, and yet her contributions in terms of teaching, consultations, volunteer work, professionalism, and friendship will remain with us forever.

I would also like to dedicate the sixth edition of this book to the bench technologists, those of you who provide critical diagnostic information on a daily basis and contribute such valuable input for excellent patient care.
vi  Dedication

Academic training provides key information in the field, but those who perform routine work at the bench often contribute much more than simple diagnostic identifications. Congratulations and thanks to all of you.

Finally, I also dedicate this book to John Lawrence. He was an extraordinary individual, and without his original encouragement and assistance, the first edition of the book would never have been written.
Contents

Dedication v
Preface xi
Acknowledgments xv

PART I
Diagnostic Procedures 1

1 Philosophy and Approach to Diagnostic Parasitology 3

2 Collection, Preservation, and Shipment of Fecal Specimens 6

    Safety 6
    Fresh-specimen collection 7
        Collection of the specimen 7
        Number of specimens to be collected (standard recommendation) 7
        Number of specimens to be collected (pros and cons of various options) 8
        Collection times 9
        Specimen type, specimen stability, and need for preservation 9
    Preservation of specimens 12
        Preservatives 12
        Use of fixatives 20
    Shipment of diagnostic specimens, biological products, etiologic agents, or infectious substances 21

3 Macroscopic and Microscopic Examination of Fecal Specimens 26

    Macroscopic Examination 26
    Microscopic Examination (Ova and Parasite Examination) 27
        Direct wet smear 27
        Concentration (sedimentation and flotation) 32
        Permanent stained smear 41

    Specialized Stains for Coccidia (Cryptosporidium, Cyclospora, and Cyclospora Species) and the Microsporidia 60
        Modified Kinyoun’s acid-fast stain (cold method) 60
        Modified Ziehl-Neelsen acid-fast stain (hot method) 63
        Carbol fuchsin negative stain for Cryptosporidium (from W. L. Current) 66
        Rapid safranin method for Cryptosporidium 66
        Rapid safranin method for Cyclospora, using a microwave oven 66
        Auramine O stain for coccidia (from Thomas Hånscheid) 67
        Modified trichrome stain for the microsporidia (Weber—green) 68
        Modified trichrome stain for the microsporidia (Ryan—blue) 70
        Modified trichrome stain for the microsporidia (Kokoskin—hot method) 72
        Acid-fast trichrome stain for Cryptosporidium and the microsporidia 72

4 Additional Techniques for Stool Examination 77

    Culture of larval-stage nematodes 77
        Harada-Mori filter paper strip culture 78
        Filter paper/slant culture technique (petri dish) 79
        Charcoal culture 80
        Baermann technique 81
        Agar plate culture for Strongyloides stercoralis 83

    Egg studies 87
        Estimation of worm burdens and Kato-Katz thick film 87
        Hatching of schistosome eggs 89

    Search for tapeworm scolex 91

    India ink injection procedure for tapeworm proglottids 92

    Qualitative test for fecal fat 94

    Quantitation of reducing substances (Clinitest) 95

vii
Contents

5 Examination of Other Specimens from
the Intestinal Tract and the
Urogenital System 98

Examination for pinworm 98
Cellulose tape preparations 99
Anal swabs 99
Sigmoidoscopy material 100
  Direct saline mount 101
  Permanent stained slide 101
Duodenal contents 102
  Duodenal drainage 102
  Duodenal capsule technique (Entero-Test) 103
Urogenital specimens 103
  Trichomoniasis 103
  Filariasis 105
  Schistosomiasis 105

6 Sputum, Aspirates, and Biopsy Material 107

Expectorated sputum 107
Induced sputum 109
Aspirates 116
  Lungs and liver 116
  Lymph nodes, spleen, liver, bone marrow, spinal fluid, eyes, and nasopharynx 118
  Cutaneous ulcer 120
Biopsy material 120
  Skin 124
  Lymph nodes 124
  Muscle 125
  Rectum and bladder 126

7 Procedures for Detecting Blood Parasites 129

Preparation of thick and thin blood films 129
  Thick blood films 130
  Thin blood films 131
  Combination thick and thin blood films
    (on the same slide) 132
  Combination thick and thin blood films
    (can be stained as either) 132
  Buffy coat blood films 134
Staining blood films 135
  Giemsa stain 136
  Wright’s stain 137
  General notes on staining procedures 140
Proper examination of thin and thick blood films 140
  Thin blood films 140
  Thick blood films 141
  Determination of parasitemia 141
Diagnosis of malaria: review of alternatives to
  conventional microscopy 142
    QBC microhematocrit centrifugation method 145
    ParaSight F test 146
    NOW malaria test 147
Flow anti-pLDH Plasmodium monoclonal antibodies 148
Molecular testing 149
Automated blood cell analyzers 150
Diagnosis of leishmaniasis: review of alternatives to
  conventional microscopy 150
  ICT for detection of anti-rK-39 antibodies 150
Concentration procedures 151
  Cyto centrifugation technique 151
  Knott concentration procedure 151
  Membrane filtration technique 151
  Gradient centrifugation technique 152
  Triple-centrifugation method for trypanosomes 152
Special stain for microfilarial sheath 152
  Delafield’s hematoxylin 152

8 Parasite Recovery: Culture Methods, Animal
Inoculation, and Xenodiagnosis 156

Culture methods 156
  Intestinal protozoa 157
  Pathogenic free-living amebae 162
  Blastocystis spp. (Blastocystis hominis) 167
  Pathogenic flagellates 168
  Flagellates of blood and tissue 172
  Toxoplasma gondii 176
  Plasmodium and Babesia spp. 177
  Cryptosporidium spp. 178
  Microsporidia 178
Animal inoculation 178
  Leishmania spp. 180
  Trypanosoma spp. 180
  Toxoplasma gondii 180
Xenodiagnosis 181

9 Fixation and Special Preparation of Fecal
Parasite Specimens and Arthropods 183

Fixation of parasite specimens and arthropods 183
  Protozoa 185
  Solutions to induce relaxation in adult helminths 185
  Nematodes 186
  Trematodes 187
  Cestodes 187
  Helminth eggs and larvae 188
  Arthropods 188
Mounting and staining of parasite specimens for
  examination 189
  Nematodes 189
  Trematodes 189
  Cestodes 191
Mounting of arthropods for examination 191
  Mites 192
  Fleas and lice 192
  Ticks 193
  Miscellaneous arthropods 193
10 Artifacts That Can Be Confused with Parasitic Organisms 195

Protozoa 195
  Amebae 195
  Flagellates 198
  Ciliates 198
Coccidia and microsporidia 198
  Cryptosporidium spp. and Cyclospora cayetanensis 198
  Cystoisospora belli 198
  Microsporidia 199
Blood and body fluids 200
  Malaria parasites and Babesia spp. 200
  Leishmaniae and trypanosomes 200
  Microfilariae 201
  Body fluids: ciliated epithelial cells 202
Helminths 203
  Adult worms and larvae 203
  Eggs 204
Human cells 204
  Polymorphonuclear leukocytes 205
  Eosinophils 206
  Macrophages 207
  Lymphocytes 207
  Red blood cells 207
  Charcot-Leyden crystals 208
Nonhuman elements seen in feces (yeast cells) 209
Insect larvae 209
Spurious infections 209
Delusory parasitosis (delusional infestation) 210

11 Equipment, Supplies, Safety, and Quality System Recommendations for a Diagnostic Parasitology Laboratory: Factors Influencing Future Laboratory Practice 212

Equipment 212
  Microscope 212
  Centrifuge 216
  Fume hood 217
  Biological safety cabinet 217
  Refrigerator-freezer 218
Supplies 218
  Glassware 218
  Miscellaneous supplies 218
  ATCC quality control organisms 219
Safety: personnel and physical facilities 219
  General precautions 219
  Handwashing 220
  Personal protective equipment
    (OSHA 2001 blood borne) 221
  Handling specimens 221
  Processing specimens 221
  Spills 222

Disposal of contaminated materials 224
Standard precautions 224
Hepatitis exposure protocol 227
Dangerous properties of industrial materials 227
Current OSHA regulations for the use of formaldehyde 228
Latex allergy 229

Quality systems 229
  Extent of services 229
  Proficiency testing 230
  In-house quality control 233
  Patient outcome measures 236
  Continuous quality improvement, total quality management, or 10-step and FOCUS-PDCA for performance improvement activities 237
  CLIA ’88 inspection process 238
New quality guidelines 239
  ISO guidelines 240
  CLSI (NCCLS) model 240
Factors influencing future laboratory practice 241
  Managed care 241
  Financial considerations 242
  Current regulations 242
  Decentralized testing 243
  Laboratory services 244
  Technological trends 244
  Clinical decision support 245
  Personnel issues 245
  Changing demographics 245
  Emerging diseases 246
  Bioterrorism 246

12 Medical Parasitology: Case Histories 249

Protozoal infections 249
  Case 1 249
  Case 2 251
  Case 3 252
  Case 4 255
  Case 5 256
  Case 6 258
  Case 7 260
Helminth infections 262
  Case 8 262
  Case 9 263
  Case 10 266
  Case 11 267
  Case 12 269
  Case 13 271
  Case 14 273
Blood parasite infections 274
  Case 15 274
  Case 16 278
  Case 17 280
PART II
Clinically Important Human Parasites  297

13 Intestinal Nematodes  299
   Ascaris lumbricoides  300
   Enterobius vermicularis  308
   Trichuris trichiura  311
   Capillaria philippinensis  314
   Hookworms (Ancylostoma duodenale, Necator americanus, and Ancylostoma ceylanicum)  316
   Trichostrongylus spp.  321
   Strongyloides spp.  322

14 Tissue Nematodes  336
   Trichinella spp.  336
   Baylisascaris procyonis  346
   Lagochilascaris minor  352
   Toxocara canis and T. cattii (visceral larva migrans and ocular larva migrans)  353
   Ancylostoma braziliense and A. caninum (cutaneous larva migrans)  358
   Human eosinophilic enteritis  359
   Dracunculus medinensis  360
   Angiostrongylus (Parasangilliasis) cantonensis (cerebral angiostrongyliasis)  362
   Angiostrongylus (Parasangilliasis) costaricensis (abdominal angiostrongyliasis)  365
   Gnathostoma spinigerum  366
   Gnathostoma doloresi, G. nipponicum, G. hispidum, and G. binucleatum  368
   Anisakis simplex, A. physetis, Pseudoterranova decipiens, Contracaecum osculatum, Hysterobothrium aduncum, and Porrocaecum reticulatum (larval nematodes acquired from saltwater fish)  370
   Capillaria hepatica  373
   Thelazia spp.  373

15 Filarial Nematodes  377
   Basic Life Cycle  380
   The Endosymbiont  380
   Human Pathogens  380
   Wuchereria bancrofti  381
   Brugia malayi  391
   Brugia timori  392
   Zoonotic Brugia infections (American brugian filariasis)  393
   Tropical pulmonary eosinophilia  394
   Loa loa  394
   Mansonella ozzardi  397
   Mansonella perstans  398
   Mansonella streptocerca  399
   Onchocerca volvulus  400
   Dirofilaria Dirofilaria and Dirofilaria Nochtielli spp.  409

16 Intestinal Cestodes  418
   Diphyllobothrium latum  418
   Taenia solium  425
   Taenia saginata  435
   Taenia asiatica (Asian Taenia or Taenia saginata asiatica)  437
   Hymenolepis (Rodentolepis) nana  439
   Hymenolepis diminuta  441
   Dipylidium caninum  443

17 Tissue Cestodes: Larval Forms  447
   Echinococcus granulosus (cystic hydatid disease)  447
   Echinococcus multilocularis (alveolar disease, hydatid disease)  458
   Echinococcus vogeli (Polyzystic Hydatid Disease) and Echinococcus oligarthrus (Uncystic Hydatid Disease): Neotropical Echinococcosis  463
   Taenia (Multiceps) spp. (Taenia multiceps, Taenia serialis) (coenurosis)  465
   Spirometra mansonoides and Diphyllobothrium spp. (sparganosis)  467

18 Intestinal Trematodes  474
   Fasciolopsis buski  475
   Echinostoma ilocanum  479
   Heterophyes heterophyes  481
   Metagonimus yokogaei  482
   Gastrodiscoides hominis  484

19 Liver and Lung Trematodes  487
   Liver Flukes  487
   Clonorchis sinensis  487
   Opisthorchis viverrini  494
   Opisthorchis felineus  497
   Fasciola hepatica  499
   Fasciola gigantica  502
   Less Common Liver Flukes  504
   Dicrocoelium dendriticum, Dicrocoelium hospes, and Eurytrema pancreaticum  504
   Lung Flukes  506
   Paragonimus westermani  506
   Paragonimus kellicotti  512

20 Blood Trematodes: Schistosomes  516
   Schistosoma mansoni  517
   Schistosoma japonicum  530
   Schistosoma mekongi  536
Contents

21 Intestinal Protozoa: Amebas 552
Entamoeba histolytica 552
Entamoeba dispar 567
Entamoeba moshkovskii 568
Entamoeba bangladashi 569
Entamoeba hartmanni 570
Entamoeba coli 571
Entamoeba polecki 572
Entamoeba gingivalis 572
Endolimax nana 574
Iodamoeba bütschlii 575
Blastocystis spp. 576

22 Intestinal Protozoa: Flagellates and Ciliates 584
Giardia lamblia (G. duodenalis, G. intestinalis) 584
Dientamoeba fragilis 598
Pentatrichomonas hominis (Trichomonas hominis) 602
Trichomonas tenax 603
Chilomastix mesnili 604
Enteromonas hominis 604
Retortamonas intestinalis 605
Balantidium coli 605

23 Intestinal Protozoa (Coccidia), Microsporidia, and Algae 612
Coccidia 612
Cryptosporidium spp. 612
Cyclospora cayetanensis 630
Cystoisospora (Isospora) belli 637
Sarcocystis spp. 643
Microsporidia 648
Algae (Prototheca) 662

24 Free-Living Amebae 667
Naegleria fowleri 669
Acanthamoeba spp. 677
Balamuthia mandrillaris 687
Sappinia (diploidea) pedata 690

25 Protozoa from Other Body Sites 694
Trichomonas vaginalis 694
Toxoplasma gondii 704

26 Malaria and Babesiosis 719
Malaria 719
Babesiosis 763

27 Leishmaniasis 778
Cutaneous Leishmaniasis: General Comments 779
Old World (Eastern) Leishmaniasis: Cutaneous Leishmaniasis 780
New World (Western) Leishmaniasis: Cutaneous Leishmaniasis 788
Visceral Leishmaniasis: General Comments 796
Old World (Eastern) Leishmaniasis: Visceral Leishmaniasis 796
New World (Western) Leishmaniasis: Visceral Leishmaniasis 803

28 Trypanosomiasis 810
African trypanosomiasis 811
Trypanosoma brucei gambiense 811
Trypanosoma brucei rhodesiense 822
American trypanosomiasis 826
Trypanosoma cruzi 826
Trypanosoma rangeli 839

29 Unusual Parasitic Infections 845
Aquatic protist 845
Rhinosporidium seeberi 845
Protozoa 848
Lophomonas blattarum 848
Dictyostelium polycephalum 850
Myxozoan parasites 850
Trypanosoma evansi, Trypanosoma lewisi 851
Nematodes (the roundworms) 852
Ancylostoma ceylanicum 852
Halicephalobus gingivalis 853
Oesophagostomum spp. 853
Eustrongylides spp. 855
Mermis nigrescens 856
Dioctophyma renale 856
Teredinus deminutus 858
Mammomonogamus laryngeus (Syngamus laryngeus) 859
Ascaris suum 860
Gongylonema pulchrum 861
Haycocknema perplexum 861
Cestodes 862
Diplogonoporus spp. 862
Bertiella studeri 862
Inermicapsifer madagascariensis 863
Raillietina celebensis 863
Mesocestoides spp. 864
Taenia crassiceps 865
Trematodes 866
Alaria americana 866
Plagiorchis spp. 868
Neodiplostomum seoulense 868
Spelotrema breviceca 869
Brachyaima sp. 869
Neophyetus (Troglotrema) salmifcola 870
Stellantchasmus falcatus 871
Phaneropsolus spinicirrus, Phaneropsolus bonnei, and Prosthemadonium molenkempi 871
Contents

Haplorchis taichui  872
Gymnophalloides seoi  872
Metorchis conjunctus (North American liver fluke)  873
Schistosoma mattheei  874
Philophthalmus lacrinosus  875
Achilarbainia spp.  875
Penstomids  875
Armillifer spp., Linguatula serrata, and Sebekia spp.  875
Acanthocephalans  876
Macracanthorhynchus hirudinaceus and Moniliformis moniliformis  876

30 Parasitic Infections in the Compromised Host  883
Entamoeba histolytica  885
Free-living amebae  895
Blastocystis spp.  903
Giardia lamblia  903
Toxoplasma gondii  905
Cryptosporidium spp.  907
Cyclospora cayetanensis  910
Cystoisospora (Isospora) belli  912
Sarcocystis spp.  913
Microsporidia  914
Leishmania spp.  918
Strongyloides stercoralis  923
Plasmodium spp.  926
Babesia spp.  927
American trypanosomiasis  929
Crusted scabies  930

31 Health Care-Associated and Laboratory-
Acquired Infections  935
Health Care-Associated (Nosocomial) infections  935
Gastrointestinal infections  936
Cryptosporidium spp.  936
Giardia lamblia  939
Entamoeba histolytica  940
Microsporidia  941
Cystoisospora (Isospora) belli  941
Hymenolepis nana  942
Taenia solium  942
Blood and tissue infections  942
Plasmodium spp.  942
Babesia spp.  943
Trypanosoma brucei gambiense and T. brucei rhodesiense  943
Trypanosoma cruzi  943
Leishmania donovani  944
Toxoplasma gondii  944
Infections with ectoparasites  945
Pediculus spp. and Phthirus pubis  945
Sarcoptes scabiei  945
Myiasis  945
Infections in the pediatric patient  946
Cryptosporidium spp.  946
Giardia lamblia  946
Pediculus humanus capitis  946
Sarcoptes scabiei  946
Infections in the compromised patient  946
Intestinal protozoa  948
Free-living amebae  948
Plasmodium spp.  948
Trypanosoma brucei gambiense and T. brucei rhodesiense  948
Trypanosoma cruzi  950
Leishmania spp.  950
Toxoplasma gondii  951
Specimen handling  951
Summary  951

32 Immunology of Parasitic Infections  954
Amebiasis  960
Giardiasis  964
Toxoplasmosis  966
African trypanosomiasis  968
American trypanosomiasis  970
Malaria  973
Helminth infections  978
Summary  981

33 Antibody and Antigen Detection in Parasitic Infections  986
Protozoal infections  993
Amebiasis  993
Babesiosis  995
Chagas' disease  996
Cryptosporidiosis  997
Cyclosporiasis  997
Giardiasis  997
Leishmaniasis  998
Malaria  999
Toxoplasmosis  1001
Trichomoniasis  1004
Helminth infections  1004
Cysticercosis  1004
Hydatid disease  1005
Fascioliasis  1007
Filariasis  1007
Paragonimiasis  1009
Schistosomiasis  1010
Strongyloidiasis  1011
Toxocariasis  1012
Trichinosis  1013
Intradermal tests  1014
Casoni test  1014
Montenegro test  1014
Summary  1014
34 Histologic Identification of Parasites 1019

Protozoa 1020
   Amebae 1020
   Flagellates 1024
   Ciliates 1024
   Coccidia 1025
   Microsporidia 1027

Helminths 1029
   Nematodes 1029
   Cestodes 1039
   Trematodes 1045

Blood Parasites 1052
   Malaria 1052
   Leishmania 1053
   Trypanosomes 1055
   Filaria 1056

35 Medically Important Arthropods 1077

Arthropods and their relationship to disease 1077
   Biological vectors of microorganisms 1077
   Bites and envenomation 1078
   Tissue invasion 1081
   Entomophobia and delusional infestation (parasitosis) 1082

Class Insecta (insects) 1083
   Order Diptera (flies, mosquitoes, and midges) 1083
   Myiiasis 1090
   Order Hemiptera (true bugs) 1098
   Order Coleoptera (beetles) 1100
   Order Siphonaptera (Fleas) (Ctenocephalides spp., Xenopsylla cheopis, Pulex irritans [Human Flea], Tunga penetrans, Nosopsyllus fasciatus, Echidnophaga gallinacea, and “Sand Fleas”) 1102
   Order Anoplura (sucking lice) 1104
   Order Mallophaga (biting and chewing lice) 1106
   Order Hymenoptera (bees, wasps, and ants) 1106
   Order Blattaria (cockroaches) 1108

Class Arachnida (ticks, mites, spiders, and scorpions) 1109
   Subclass Acari (ticks, mites, and chiggers) 1109
   Subclass Araneae (spiders) 1118
   Subclass Scorpiones (scorpions) 1122

Other arthropods 1122
   Class Chilopoda (centipedes) 1122
   Class Diplopoda (millipedes) 1123
   Class Crustacea (copepods, crabs, crayfish, etc.) 1123

Control of arthropods of medical importance 1123
   Physical control 1124
   Biological control 1124
   Chemical control 1124

36 Treatment of Parasitic Infections 1134

Albendazole (Albenza) (Amedra) 1134
Amphotericin B (AmBisome) (Gilead) 1135
Amphotericin B (Fungizone) (X-Gen) 1153
Artemether (Artenam) (Arenco, Belgium) 1154
Atovaquone (Mepron) (GlaxoSmithKline) 1154
Atovaquone-Proguanil (Malarone) (GlaxoSmithKline) 1155
Benznidazole (Rochagan) (Roche, Brazil) 1155
Bithionol (Bitin) (CDC) 1156
Chloroquine Phosphate (Aralen) (Sanofi, Others) 1156
Crotamiton (Eurax) (Ranbaxy) 1156
Dapsone (Jacobs) 1157
Diethylcarbamazine Citrate USP (Hetrazan) (CDC) 1157
Diloxanide Furoate (Furamide, Entamide) (Boots, England) 1157
Eflornithine (Difluoromethylornithine, Ornidy1) (Sanofi) (CDC) 1158
Fumagillin (Fumidil-B) 1158
Furazolidone (Furoxone) 1158
Iodoquinol/Diiodohydroxyquin (Yodoxin) (Glennwood, Others) 1158
Ivermectin (Stromectol, Sklice) (Merck, Sanofi) 1159
Lumefantrine/Artemether (Coartem, Riamet) (Novartis) 1160
Malathion (Ovide) (Taro Pharmaceuticals) 1160
Mebendazole (Generics) 1160
Mefloquine Hydrochloride (Generics) 1161
Mesoropsrol (Mel-B) (CDC) 1162
Metronidazole (Flagyl, IV Flagyl) (Searle/Pfizer, Baxter) 1162
Miltefosine (Impavid, Miltex) (Paladin, Canada) (CDC) 1163
Niclosamide (Yomesan, Niclocide) (Bayer, Germany) 1163
Nifurtimox (Lampit) (Bayer HealthCare) (CDC) 1163
Nitazoxanide (Alinia) (Romark) 1164
Paromomycin (Generics) (Sun Pharma) 1164
Pentamidine Isethionate (Pentam 300, Nebupent) (APP Pharmaceuticals) 1165
Permethrin (Nix [Insight Pharmaceuticals], Elimite [Premier Pharma]) 1166
Polyhexamethylene Biguanide (Baquacil) (Zeneca) 1166
Praziquantel (Biltricide) (Bayer) 1166
Primaquine Phosphate (Sanofi-Aventis) 1167
Propamidine Isethionate (Brolene) (Aventis, Canada) 1167
Pyrantel Pamoate (Pin-X, Reese's Pinworm Medicine) (Quartz Specialty Pharmaceuticals, Reese) 1168
Pyrethrins with Piperonyl Butoxide (Rid) (Bayer, Others) 1168
Pyrimethamine (Daraprim) (Amedra) 1168
Quinidine Gluconate (Generics) 1169
Quinoline Sulfate or Quinine Dihydrochloride (Many Manufacturers) 1169
Spiramycin (Rovamyicine) (Sanofi-Aventis) 1169
Stibogluconate Sodium (Pentostam, Solustibosan) (GlaxoSmithKline) (CDC) 1170
Suramin Sodium (Germanin) (Bayer, Germany) (CDC) 1170
**Contents**

Thiabendazole (Mintezol) (Merck) 1170

Tinidazole (Tindamax) (Mission Pharmaceuticals) 1171

Triclabendazole (Egaten) (Novartis) 1172

**APPENDIXES 1175**

**APPENDIX 1 Information Tables 1176**

A1.1 Classification of human parasites 1176

A1.2 Distribution of selected parasitic infections in the Americas 1179

A1.3 Distribution of selected parasitic infections in Europe 1179

A1.4 Distribution of selected parasitic infections in Africa 1180

A1.5 Distribution of selected parasitic infections in Asia 1180

A1.6 Distribution of selected parasitic infections in Oceania 1181

A1.7 Cosmopolitan distribution of common parasitic infections (North America, Mexico, Central America, South America, Europe, Africa, Asia, and Oceania) 1181

A1.8 Body sites and specimen collection 1182

A1.9 Body sites and possible parasites recovered (trophozoites, cysts, oocysts, spores, adults, larvae, eggs, amastigotes, and trypomastigotes) 1183

A1.10 Body site, specimen and procedures, recommended methods, relevant parasites, and comments 1184

A1.11 Examination of tissue and body fluids 1189

A1.12 Key characteristics of protozoa of the intestinal tract and urogenital system 1191

A1.13 Key characteristics of tissue protozoa 1194

A1.14 Key characteristics of helminths 1196

A1.15 Key characteristics of most common parasites found in blood 1198

A1.16 Diagnostic laboratory report information that should be relayed to the physician 1200

A1.17 Pros and cons of stool specimen collection and testing options 1201

A1.18 Approaches to stool parasitology: test ordering 1203

A1.19 Pros and cons of ova and parasite examination options 1204

A1.20 Laboratory test reports: optional comments 1206

A1.21 Estimated prevalence of parasitic diseases worldwide 1207

**APPENDIX 2 Flowcharts and Staining Tables for Diagnostic Procedures 1208**

Flowcharts

A2.1 Procedure for processing fresh stool for the ova and parasite examination by using the traditional two-vial collection kit 1210

A2.2 Procedure for processing preserved stool for the ova and parasite examination by using sodium acetate-acetic acid-formalin (SAF)-preserved stool 1211

A2.3 Use of various fixatives and their recommended stains: fecal specimens preserved using polyvinyl alcohol (PVA) 1212

A2.4 Use of various fixatives and their recommended stains: fecal specimens preserved in the Universal Fixative, TOTAL-FIX 1213

**Tables**

A2.1 Steps in the trichrome staining procedure (mercuric chloride-based PVA-preserved stool specimens) 1214

A2.2 Steps in the trichrome staining procedure (non-mercuric chloride-based PVA-preserved stool specimens) 1215

A2.3 Steps in the iron hematoxylin staining procedure (mercuric chloride-based PVA-preserved stool specimens) (Spencer-Monroe method) 1216

A2.4 Steps in the iron hematoxylin staining procedure (mercuric chloride-based PVA-preserved stool specimens) (Tompkins-Miller method) 1217

A2.5 Steps in the iron hematoxylin staining procedure (incorporating the carbol fuchsin step) 1218

A2.6 Steps in the trichrome staining procedure (Universal Fixative [no mercury, no formalin, no PVA]) 1219

A2.7 Oil-mounted permanent stained smears (no Permount is used) 1220

A2.8 Tips on stool processing and staining 1221

**APPENDIX 3 Common Problems in Parasite Identification 1222**

**Figures**

A3.1–A3.25 Paired drawings of “look alikes” 1222

A3.26 Relative sizes of helminth eggs 1233

**Tables**

A3.1 Entamoeba spp. trophozoites versus macrophages 1223

A3.2 Entamoeba spp. cysts versus polymorphonuclear leukocytes (PMNs) 1224

A3.3 Entamoeba bistolytica versus Entamoeba coli precysts and cysts 1226

A3.4 Endolimax nana versus Dientamoeba fragilis 1227

A3.5 Adult nematodes and/or larvae found in stool specimens: size comparisons 1234

**APPENDIX 4 Quality Control Recording Sheets 1235**

A4.1 Diagnostic parasitology quality control (QC) (reagents) 1236
A4.2 Diagnostic parasitology quality control (QC) (reagents)—example for multiple reagents 1237
A4.3 Diagnostic parasitology quality control (QC) (culture)—example of a worksheet 1238
A4.4 Equipment maintenance 1239

APPENDIX 5 Commercial Supplies and Suppliers 1241

Tables
A5.1 Sources of commercial reagents and supplies 1242
A5.2 Addresses of suppliers listed in Table A5.1 1245
A5.3 Sources of available reagents for immunodetection of parasitic organisms or antigens 1246
A5.4 Addresses of suppliers listed in Table A5.3 1248
A5.5 Commercial suppliers of diagnostic parasitology products 1249
A5.6 Sources of additional teaching materials, including case histories 1252

A5.7 Sources of parasitologic specimens 1253

APPENDIX 6 Reference Sources 1254

APPENDIX 7 “Late-Breaking” Published Information 1257

APPENDIX 8 Molecular Panels for Parasitology 1278

APPENDIX 9 FAQs 1284


GLOSSARY 1307

Index 1321
During the past few years, the field of diagnostic medical parasitology has seen dramatic changes, including newly recognized parasites, emerging pathogens in new geographic areas, bioterrorism considerations and requirements, alternative techniques required by new regulatory requirements, reevaluation of diagnostic test options and ordering algorithms, continuing changes in the laboratory test menus, implementation of testing based on molecular techniques, reporting formats and report comments, coding and billing requirements, managed-care relevancy, increased need for consultation and educational initiatives for clients, and an overall increased awareness of parasitic infections from a worldwide perspective. We have seen organisms like the microsporidia change from the status of “unusual parasitic infection” to being widely recognized as among the most important infections in both immunocompetent and compromised patients. With confirmation of the fifth human malaria, *Plasmodium knowlesi*, this field has expanded dramatically. More sensitive diagnostic methods for organism detection in stool specimens are now commercially available for *Entamoeba histolytica*, *Entamoeba histolytica*/*E. dispar*, *Giardia lamblia*, Cryptosporidium spp., and *Trichomonas vaginalis*. Reagents are actively being developed for other organisms such as *Dientamoeba fragilis*, *Blastocystis* spp., and the microsporidia. We have seen *Cyclospora cayetanensis* coccidia become well recognized as the cause of diarrhea in immunocompetent and immunocompromised humans. We continue to see new disease presentations in compromised patients; a good example is granulomatous amebic encephalitis caused by *Acanthamoeba* spp., *Sappinia diploidea*, and *Balamuthia mandrillaris*. With the expansion of transplantation options, many parasites are potential threats to patients who are undergoing immunosuppression, and these must be considered within the context of this patient group. Transfusion transmission of potential parasitic pathogens continues to be problematic. Transfusion in general is becoming more widely recognized as a source of infection, and donors are also more likely to come from many parasite-endemic areas of the world. It is also important to recognize the many neglected parasitic infections seen within the United States; indeed, the world continues to shrink in terms of infectious diseases.

With expanding regulatory requirements related to the disposal of chemicals, laboratories are continuing to review the use of mercury compounds as specimen fixatives and learning to become familiar with organism morphology when using substitute compounds. Permanent staining of fecal smears confirms
that none of the substitute fixatives provide results of the same quality found with the use of mercuric chloride-based fixatives. However, the key issue is whether the intestinal parasites can be identified using these alternative fixatives, not how “perfect” they look. Many fixative options are now available, including single-vial collection systems, some of which are coupled with their own stains. Requirements also mandate that any laboratory using formalin must have formalin vapor monitored as both an 8-hour time-weighted average and 15-minute readings. Most laboratories are now familiar with the regulations on protection of health care workers from blood and other body fluids and have implemented specific changes that are no longer optional. Although laboratories were already using many of the safety recommendations, these regulations delineate in detail what must be done and documented. Regulatory information based on new shipping requirements is also included.

On the basis of excellent suggestions and comments, I have made the following changes in this new edition: (i) the chapter on case histories has been expanded and contains a large number of parasite medical case histories (case history, study questions, correct answer and discussion, and illustrative material); (ii) some of the life cycles have been redrawn, and new life cycles have been added; (iii) algorithms have been expanded; (iv) new tables and figures have been added throughout the book; (v) additional drawings and photographs have been added; (vi) extensive color images have replaced the black and white images; (vii) extensive updated text information is included, all of which was taken from a comprehensive literature review of all aspects of diagnostic medical parasitology; (viii) additional examples of unusual parasitic infections are included; (ix) the chapter on arthropods has been expanded and includes additional photographs and drawings and expanded text; (x) the chapter on the immunology of parasitic infections has been enlarged, and updated information on both antigen and antibody detection methods continues to be included in this edition; (xi) the chapter on histological identification of parasites has been dramatically expanded with diagrams of various parasites and their visual presentations in tissue sections, with greatly enhanced legends for all images; (xii) diagnostic methods using newer immunoassay and “dipstick” technology are included; and (xiii) the chapter on quality control has been expanded to include information on instrumentation and equipment, safety regulations, quality control and quality systems information, continuous quality improvement, and managed-care considerations. The appendixes have been expanded to contain more information on artifacts; expanded lists and photographs of products and commercial suppliers; algorithms for ordering specific tests that complement the ova and parasite examination; flowcharts for processing stool specimens; quality control recording sheets for use in the laboratory; and general references and relevant web sites. One of the most important expanded areas of the sixth edition is found in Appendix 7, which contains information that has been published within months prior to the final printing of this edition. This “late-breaking” synopsis of very recent publications can assist the reader in having access to the latest information available. I encourage you to review this section as you read various chapters throughout the book. A more comprehensive discussion of molecular methods has also been added to the sixth edition and can be found in Appendix 8. Appendix 9 contains comprehensive information on the most frequently asked questions for all aspects of human parasitology, and Appendix 10 contains information related to CPT coding for testing options for diagnostic parasitology.

The approach to the sixth edition of the book has been revised to present the diagnostic methods first, then the didactic discussion of parasitic infections.
as the second component of the book. This change was made to ensure that the most recent and relevant material would be updated right before editing. My objective is to provide the user with clear, concise, well-organized, clinically relevant, cost-effective, and practical quality procedures for use in the clinical laboratory setting. To use and fully understand these methods for the parasites discussed, it is imperative that the user also understand information related to life cycle, morphology, clinical disease, pathogenesis, diagnosis, treatment, epidemiology, and prevention. My intent is to provide a comprehensive discussion of both aspects of the field of diagnostic medical parasitology: first, relevant diagnostic methods designed to detect and identify the organisms present, and second, a comprehensive discussion of the individual parasites. I believe that the book fulfills these objectives and provides readers, whether they are laboratorians, physicians, or other health care professionals, with not only comprehensive, but very practical information.

It is also important for readers to understand that there are many diagnostic test options available to the clinical laboratory; not every laboratory will approach the diagnosis of parasitic infections in the same way. The key to quality and clinically relevant diagnostic work is a thorough understanding of the pros and cons of each option and how various options may or may not be relevant for one’s particular geographic area, laboratory size and range of expertise, client base, number and type of patients seen, personnel expertise and availability, equipment availability, educational initiatives, and communication options, just to name a few variables. However, it is also important to understand the regulations and technical recommendations that govern and guide this type of laboratory work; many of these guidelines are related to coding and reimbursement, proficiency testing, and overall clinical relevance.

The use of product names is not intended to endorse specific products or to exclude substitute products. Also, because of possible advances and changes in the therapy of parasitic infections, independent verification of drugs and drug dosages is always recommended. The diagnostic procedures are intended for laboratory use only by qualified and experienced individuals or by the personnel under their direct supervision. Every effort has been made to ensure accuracy; however, ASM Press and I encourage you to submit to us any suggestions, comments, and information on errors found.
Acknowledgments

Peter Schantz, Frederick L. Schuster, James Seidel, Nicholas Serafy, J. A. Shadduck, Harsha Sheorey, Irwin Sherman, Robyn Shimizu, Balbir Singh, James Smith, Rosemary Soave, Frank J. Sorvillo, S. L. Stanley, Jr., John Steele, Deborah Stenzel, Damian Stark, Linda Sterzenbach, Charles Sterling, James J. Sullivan, Alex Sulzer, Kevin S. W. Tan, Egbert Tannich, Herbert Tanowitz, Mehmet Tanyuksel, William Trager, Peter Traynor, Antonio R. L. Teixeira, Sam Telford, William Trager, Allan R. Truant, Jerrold Turner, Saul Tzipori, Jacqueline A. Upcroft, Peter Upcroft, Tom van Gool, Eric Vanderslice, Jacob Verweij, Govinda Visvesvara, Marietta Voge, Susanne Wahlquist, Kenneth Walls, Rainer Weber, Wilfred Weinstein, Louis Weiss, P. P. Wilkins, John Williams, John Wilson, Marianna Wilson, Jeffrey J. Windsor, Washington Winn, Martin Wolfe, Donna Wolk, Johnson Wong, Lihua Xiao, Nigel Yeates, Judy Yost, Wenbao Zhang, Charles and Wiladene Zierdt, and many others whom I may have failed to mention specifically. If the information contained in this edition provides help to those in the field of microbiology, I will have succeeded in passing on this composite knowledge to the next generation of students and teachers.

Special thanks go to Sharon Belkin for her additional illustrations for this edition. I also thank Ronald Neafie from the Armed Forces Institute of Pathology for providing many photographs to illustrate several areas of the book, particularly the information on histological identification of parasites, and Herman Zaiman for providing slides that he has prepared and/or edited from many contributors worldwide. Very special thanks go to the group at the Centers for Disease Control and Prevention for the use of many of their clinical parasitology images; these images are invaluable to the microbiology community and include images contributed to CDC by many others, as well.

I would like to thank members of the editorial staff of ASM Press, especially Ellie Tupper; they are outstanding professionals and made my job not only challenging but fun.

Above all, my very special thanks go to my late husband, John, for his love and support for the many projects that I have been involved in over the years. I could never have undertaken these challenges without his help and understanding, a true partnership.