Parasitic Diseases
Third Edition
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With a Foreword by Donald Krogstad

With 350 Illustrations Including
34 Parasite Life Cycle Drawings
and 4 Color Plates

Springer-Verlag
New York Berlin Heidelberg London Paris
Tokyo Hong Kong Barcelona Budapest
The illustration on the front cover is a differential interference contrast photomicrograph by Eric V. Gravé of the Nurse cell–parasite complex of *Trichinella spiralis*. The original photograph was awarded First Prize in the “Small World” competition (1976), sponsored by Nikon, Inc.
We dedicate this edition to the memory of Larry Carter and Jerry Stone, both Senior Medical Editors at Springer-Verlag, whose perseverance and dedication to this book ensured this third edition. Both shared our dream of producing a book which would not lose its relevance to the medical community.
Foreword

Worldwide, the numbers of people suffering and dying from parasitic diseases are overwhelming, with more than 100 million cases and 1 million deaths each year from malaria alone. Despite the magnitude of the problem and the importance of the parasites that cause opportunistic infections among persons with HIV/AIDS, medical schools in the United States, Canada, and other developed countries consistently reduce the amount of time spent on parasitic diseases in the curriculum. As a result most medical students receive limited information about these diseases, and are inadequately prepared to diagnose or treat them as physicians.

This problem is too large to be resolved within the time available for parasitology in the medical school curriculum; at most, students can be acquainted with the salient features of the medically important parasites. Likewise, the traditional isolation of parasitology from the rest of the curriculum (consistent with its exclusion from most microbiology texts) is another unresolved problem. In my opinion, this is why most physicians are unable to think about the differential diagnosis of parasitic diseases in the same way that they routinely balance the probabilities of malignancy, cardiovascular, renal, and pulmonary disease vs other infectious diseases. To resolve these problems, relevant paradigms from parasitology must be used in the teaching of cell biology, molecular biology, genetics, and immunology.

For example, cell biology offers a new level of understanding about the parasite life cycle. The specificity of host–parasite interactions is driven by receptor–ligand relationships fundamentally similar to those involved in the targeting of proteins to the cell surface or the lysosome, or the receptor-mediated entry of cholesterol. The impact of escape from the lysosome, inhibition of acidification, or resistance to killing by acidification (as demonstrated by *Trypanosoma cruzi*—the agent of Chagas’ disease—toxoplasma, and leishmania) provides insights relevant to all of cell biology. Similarly, molecular biology has shown how trypanosomes evade host defenses by changing their dominant (variant) surface glycoproteins, and now permits the cloning and expression of candidate vaccine antigens from parasites that are difficult or impossible to grow in vitro. Genetic factors affect the interaction between parasite and host in at least three ways: 1) by host selection—sickle cell hemoglobin, which prevents severe and complicated malaria, is the most powerful selective (evolutionary) factor known in humans; 2) by multiplicity of reproduction to allow for natural selection at each stage of the parasite life cycle; and 3) by constantly creating genetically novel parasites through crossing over during the meiotic reduction division. Immunology, which first characterized the eosinophilic and IgE responses to helminthic infection, is now providing insights into...
the role of cytokines in the pathogenesis of severe and complicated malaria. In each case, modern biology has provided not only basic insights, but also potential interventions: drugs that can be targeted to the lysosome or interfere with parasite-specific pathways, new candidate vaccine antigens, opportunities for immunization with monoecious organisms (which should have less genetic variability because fertilization occurs between genetically identical eggs and sperm from the same parent), and anti-disease strategies based on inhibiting the noxious effects of cytokines released as part of the normal immune response to parasitic infection.

In addition to the basic science paradigms outlined above, the implementation of parasitic disease control strategies in the developing world raises epidemiologic and socio-cultural issues broader than parasitology alone. When the numbers of people suffering from preventable and treatable diseases are vastly greater than the resources available to prevent and treat them, epidemiologic data provide an objective measure by which to define priorities—developed countries might note. Socio-economic and developmental issues are also major determinants of success (or failure) in disease control programs. To prevent malaria by using insecticide-impregnated bed nets, one must first understand the cultural factors governing acceptance and use of bed nets. To control onchocerciasis, one must understand the cultural impact of early signs such as onchocercal dermatitis which makes a young woman unmarriageable in many West African countries.

Having recognized that there are major obstacles in providing medical students with a comprehensive understanding of parasitology, how does this book help to resolve the problem? First, it is succinctly and clearly written, so that it will be easy to read under the time pressures that confront all medical students. Second, it is well-organized with clear headings and introductory sections for each major group of parasites, facilitating its use as a text and as a reference. Third, the authors have been careful to use medical relevance as a major criterion. Less relevant parasites are typically grouped at the ends of chapters, and identified as parasites of minor medical importance.

Finally, this text also has the potential for use in Diploma Courses in Clinical Tropical Medicine, which will be offered at a number of US and Canadian institutions beginning in the fall of 1995. The entomology section, which is more extensive than necessary for medical students, has sufficient information for the entomological aspects of those courses, and for many introductory courses in medical entomology.

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Preface

In this third edition, we welcome Dr. Peter Hotez, pediatrician and researcher, as author and colleague, replacing Dr. Michael Katz. We note with some sadness Dr. Katz's departure from our team, since it was his clear vision of infectious diseases, especially those caused by eukaryotic parasites, that led to the creation of our book back in 1980. We will also miss his comradery, piercing wit, bad puns (there is no other kind), and pithy humorous quotations from the likes of Groucho Marks, Woody Allen, George Bernard Shaw, Winston Churchill, and Oscar Wilde. While engaged in the highly interactive process of writing, Mike and I (DDD) cemented our friendship which has lasted to the present, untarnished by the sometimes stressful process of revision and re-writing. Now at the March of Dimes, he continues to share with us his many insights regarding the practice of infectious disease medicine; for this we are most fortunate. Dr. Hotez continues and strengthens the emphasis on and our concern for young people regarding these often neglected infections, and his fresh approach to the subject of clinical parasitic diseases will insure relevance to the medical community at large.

In this edition we have revised many chapters and have added descriptions of new organisms as the list of opportunistic agents that have found their way into the immunocompromised patient continues to lengthen. Microsporidial agents, *Cyclospora* sp., *Baylisascaris procyonis* and *Oesophagostomum bifurcum* are among the new entries. Chapters on *Trichinella spiralis*, *Strongyloides stercoralis*, the hookworms, the malarials and the leishmanias have been extensively rewritten. In addition, most of the referenced literature on clinical aspects is new (1990 to 1994). Several of the life cycles have been revised, especially the schistosomes which now includes the migration of the schistosomulum to the lungs prior to its journey to the liver. We have retained *Pneumocystis carinii*, even though it is now considered more fungal than protozoan in its biology.

Our audience is predominantly medical students and the practitioner; therefore we have striven to keep the reader abreast of the latest developments in diagnosis, treatment, and the mechanism of action of some of the newer chemotherapeutic agents. The importance of the history of discovery of each major eukaryotic pathogen has been retained since students and physicians, alike, have praised us for this aspect. We remain grateful to Drs. Kean, Mott, and Russell for their classic work; “Tropical Medicine and Parasitology. Classic Investigations”, Cornell University Press, 1978. Nearly all of our historical references are from this master work, and thus, regrettably, some are incomplete. A thorough search for the complete citation would involve a very large expenditure of time and effort, and we have elected to leave them as is.
We thank John Hawdon for generously sharing his computer skills which saved us heaps of time, and Miguel Gelpe for supplying us with stained slide material for the newest additions to the diagnostic atlas. We especially thank John Kara­pelou who continues to add new drawings and revisions of old ones to our book; without these it would be unattractive and less informative to students. Special thanks go to our wives: Ann Hotez and Joyce Gwadz; and children: Matthew, Emily, and Rachel Hotez; Marya, Mark, and Joel Gwadz; and Bradley and Bruce Despommier for their friendship and encouragement. Finally, we want to acknowledge all the students in our many classes who have gently pointed out inconsistencies, dropped arrows, misspelled words and clumsy sentences. We hope we have corrected most of these blemishes and blame only ourselves for new ones that may have arisen since the last edition.

Dickson Despommier
New York City
Contents

Foreword vii
    Donald Krogstad

Preface ix

I. Nematodes 1

1. Enterobius vermicularis (Linnaeus 1758) 2
2. Trichuris trichiura (Linnaeus 1771) 6
3. Ascaris lumbricoides (Linnaeus 1758) 11
4. Hookworms: Necator americanus (Stiles 1902) and Ancylostoma duodenale (Dubini 1843) 17
5. Strongyloides sp.: Strongyloides stercoralis (Bavay 1876) and Strongyloides fuelleborni (Von Linstow 1905) 25
6. Trichinella spiralis (Railliet 1896) 32
7. Lymphatic Filariae: Wuchereria bancrofti (Cobbold 1877) and Brugia malayi (Brug 1927) 40
8. Onchocerca volvulus (Leuckart 1893) 47
9. Loa loa (Cobbold 1864) 53
10. Dracunculus medinensis (Linnaeus 1758) 57
11. Aberrant Nematode Infections 61
12. Nematode Infections of Minor Medical Importance 71

II. Cestodes 75

13. Taenia saginata (Goeze 1782) 76
14. Taenia solium (Linnaeus 1758) 81
15. Diphyllobothrium latum (Linnaeus 1758) 84
16. Larval Tapeworms 89
17. Tapeworms of Minor Medical Importance 100

III. Trematodes 107

18. Schistosomes: Schistosoma mansoni (Sambon 1907), Schistosoma japonicum (Katsurada 1904), Schistosoma haematobium (Bilharz 1852) 108
19. Clonorchis sinensis (Loos 1907) 122
20. *Fasciola hepatica* (Linnaeus 1758) 126
21. *Paragonimus westermani* (Kerbert 1878) 130
22. Trematodes of Minor Medical Importance 135

IV. Protozoa 139
23. *Trichomonas vaginalis* (Donne 1836) 140
24. *Giardia lamblia* (Stiles 1915) 144
25. *Entamoeba histolytica* (Schaudinn 1903) 151
26. *Balantidium coli* (Malmsten 1857) 159
27. *Toxoplasma gondii* (Nicolle and Manceaux 1908) 162
28. *Cryptosporidium* sp. and *Cyclospora* sp. 169
29. Malaria: *Plasmodium falciparum* (Welch 1898),
    *Plasmodium vivax* (Grassi and Filetti 1889),
    *Plasmodium ovale* (Stephens 1922), *Plasmodium malariae* (Laveran 1881) 174
30. *Trypanosoma cruzi* (Chagas 1909) 190
31. African Trypanosomes: *Trypanosoma brucei gambiense* (Dutton 1902) and *Trypanosoma brucei rhodesiense* (Stephens and Fantham 1910) 196
32. *Leishmania tropica* (Wright 1903) and *Leishmania mexicana* (Biagi 1953) 203
33. *Leishmania braziliensis* (Vianna 1911) 209
34. *Leishmania donovani* (Ross 1903) 213
35. *Pneumocystis carinii* (Delanoe and Delanoe 1912) 219
36. Protozoans of Minor Medical Importance 224
37. Nonpathogenic Protozoa 230

V. Arthropods 235
38. Insects 236
39. Arachnids 268
40. Arthropods of Minor Medical Importance 283

Appendix I: Therapeutic Recommendations (Reprinted from The Medical Letter) 286
Appendix II: Procedures Suggested for Examining Clinical Specimens for Agents of Parasitic Diseases 299
Appendix III: Laboratory Diagnostic Methods 301
Appendix IV: Diagnostic Atlas of Nematodes, Cestodes, Trematodes, and Protozoa 307

Index 323