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Markell and Voge's
**Medical
Parasitology**

10th South-East Asian Edition

David T. John | William A. Petri, Jr.

Adapting Editor

Gregorio L. Martin I



RESTRICTED SOUTH-EAST ASIAN EDITION

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10th South-East Asian edition

Markell and Voge's Medical Parasitology

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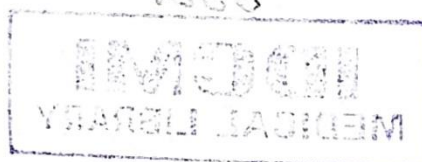
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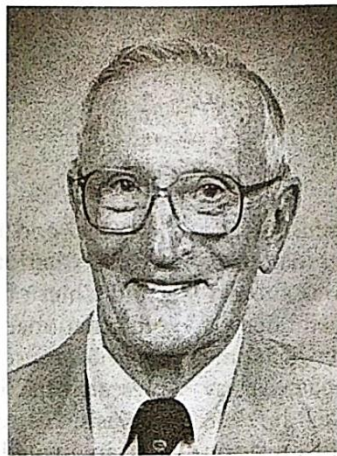
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Edward K. Markell, 1918-1998



Marietta Voge, 1918-1984

Preface

The first edition of *Markell and Voge's Medical Parasitology* was published 48 years ago in 1958 under the title of *Diagnostic Medical Parasitology*. The name was abbreviated to *Medical Parasitology* with the second edition and remained as such until the eighth edition, at which time the current title was adopted. Marietta Voge passed away in 1984 at the age of 66 and Edward Markell in 1998 at the age of 80. The present edition is the first revision that one or both of them have not been involved with.

By way of historical note, Dr. Markell received his PhD in zoology from the University of California, Berkeley in 1942 and his MD from Stanford University in 1951. Dr. Voge received her PhD also from the University of California, Berkeley in 1950. They were both assistant professors at the University of California, Los Angeles, School of Medicine when they published the first edition of *Medical Parasitology*.

I became co-author with the sixth edition and Al Krotoski with the eighth edition. Dr. Krotoski and I both received our introduction to the field of parasitology through the first edition of *Medical Parasitology*. Dr. Krotoski retired from active professional work in 1995 and has decided not to participate in further editions of the book. My collaboration with Al Krotoski has been most enjoyable and productive and it was with regret that I accepted his decision to withdraw from authorship.

With the ninth edition, I am indeed fortunate to have William Petri become co-author. Dr. Petri earned

his MD and PhD degrees from the University of Virginia, Charlottesville, where currently he is Professor and Chief of the Division of Infectious Diseases and International Health. Dr. Petri is a past president of the *American Society of Tropical Medicine and Hygiene* and his research has been with *Entamoeba histolytica* and amebiasis. His research has taken him around the world as an invited lecturer to Australia, Japan, Thailand, Bangladesh, India, Turkey, Israel, France, Germany, Argentina, Mexico, Canada, and throughout the United States.

Ed Markell was born in Brooklyn, New York, but he had a knack for recruiting "non-natives" to work with him on the book. Marietta Voge was born in Yugoslavia, Al Krotoski in Latvia, and I was born in Nigeria. Bill Petri was born in Washington, DC, so we have come full circle. A good sign, I believe.

This book is intended primarily for the medical student and the physician, but it is equally useful to the medical technologist and others who are concerned with the laboratory identification of the parasites of humans. All the chapters have been thoroughly updated and give current information on the life cycles of the human parasites and on the epidemiology, immunology, diagnosis, and treatment of the diseases they cause.

David T. John, MSPH, PhD

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Introduction to Medical Parasitology and Basic Terminologies

SHEILA GRACE ALARILLA-MARTIN

Parasitic infections represent more than 50% of those listed in the WHO list of neglected tropical diseases. Research shows that helminths and protozoans are among the common agents of infections that affect ASEAN countries that include these ten member states: Brunei Darussalam, Cambodia, Indonesia, Lao People's Democratic Republic (PDR), Malaysia, Myanmar, the Philippines, Singapore, Thailand, and Vietnam. These NTDs draw attentions among health clusters primarily because of their public health impact especially in many marginalized areas. NTDs and poverty are interconnected ideas that should be given utmost attention by health workers and policy making bodies of the government. Extensive efforts were already made at the community level however despite the several control measures that were instituted the problems still exist and continually affecting one's productivity.

Studying the basic concepts of parasitology will enlighten us to the issues arising from existence of parasites and their effects to the general population. More so, understanding the biology of the parasites and their unique interaction with their host will provide clear evidence about their life cycle. Laboratory tests are relevant for parasite diagnosis and require skills for proper processing and recognition. Misidentification of the parasite may lead to serious consequence thereby affecting correct diagnosis.

The primary purpose of this book is to serve as a guide both to the clinical diagnosis and treatment and to the laboratory diagnosis of the protozoan and helminthic diseases of medical importance, and to a lesser extent to the arthropods in relation to disease. While it is intended primarily for medical students and physicians, it is hoped that this book will prove equally useful to medical technologists and all others concerned with laboratory identification of the animal parasites of humans. The success of the cooperative diagnostic efforts of the physician and laboratory technologist depends on a mutual appreciation of their several problems. In

the chapters dealing with technical methods, the problems of technologists are discussed; physicians will be better able to utilize laboratory services if they understand them. The manner in which parasitic organisms are acquired and how they produce disease in humans are perhaps of no direct importance to technologists. Yet a basic understanding of these matters should not only make technologists' work more interesting but enable them to do it better and more efficiently.

- Parasites, parasitism, and host relations
 - Many terms have been devised to describe the relationships that exist between different kinds of plants and animals at the fundamental food-seeking or food-supplying level.
 - Organism may at different times exhibit different nutritional habits or at a given time obtain its nutriment in more than one way.
 - Fundamentally, there are two ways in which an animal may obtain food at the expense of other animals.

Predation: It may attack another living animal, consuming part or all of its body for nourishment. The *attacker* is the *predator*, and the *victim* is called the *prey*. In predator-prey relationship, the prey is usually killed because it is eaten by the predator.

Scavenging: An animal deriving its nutrition from already dead animals, either devouring those dead of natural causes or taking the leavings of a predator. Animals that subsist in this manner are known as *scavengers*.

- Some animals are pure predators, others pure scavengers, but many predators are not averse an occasional bit of scavenging.
- Some animals always seek their food by their own efforts or in association with others of their own species.
- This is the most conspicuous and perhaps the most common way in which animals go about obtaining food.

Signs and Symptoms of Parasitic Disease

It must be emphasized that the following defined terms are not intended as a complete differential diagnosis of any of the symptoms discussed. Limitations of space do not permit even mention of the various nonparasitic causes of many of these conditions.

ABDOMINAL PAIN

Abdominal pain refers to increased spasmodic contraction of abdominal muscle characterized by amoebic colitis, with tenesmus if ulcerations involve the rectal area. It is observed in symptomatic infections that is usually associated with diarrhea accompanied by infrequent, high-pitched bowel sounds.

In giardiasis, the pain is usually mild but may occasionally be severe; it is usually crampy and may be accompanied by steatorrhea and a full-blown malabsorption syndrome. On the other hand, pain is seldom present in intestinal worm infections.

Intestinal or biliary obstruction (the former primarily occurs in smaller children) can be the result of ascariasis, with signs and symptoms that mimic obstruction of these passages from any other cause. *Strongyloides stercoralis*, invading the mucosal wall, may cause a severe duodenitis or jejunitis, with symptoms suggestive of duodenal ulcer disease. Anisakid larvae, penetrating the wall of the stomach or small bowel, may give rise to symptoms suggestive of gastric or duodenal ulcer or appendicitis. *Angiostrongylus costaricensis* most frequently invades the bowel wall in the region of the appendix, with pain in the right iliac fossa. Moderate to heavy eosinophilia generally accompanies these invasive worm infections.

ABSCESS, AMOEBIC

Amoebic invasion of the liver is characterized by tenderness and enlargement of that organ, progressive malaise, an irregularly spiking fever with night sweats, leukocytosis, elevation and fixation of the right diaphragm (often seen on presenting chest radiograph), and sometimes development of a right lower lobe pneumonitis. With abscess formation, pain becomes more intense

and may be referred to the tip of the right (less commonly the left) scapula (Martínez-Palomo, et al., 2017).

Amoebic Liver Abscess (ALA) is the most common manifestation of extraintestinal infection caused by *Entamoeba histolytica* – an invasive form of amoebiasis.

ABSCESS, FILARIAL

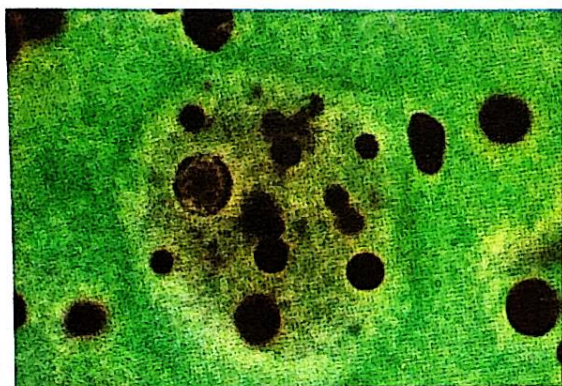
Abscesses may develop spontaneously or appear shortly after antifilarial treatment is begun. They occur along the course of lymphatics or at lymph nodes and may be distinguished from pyogenic abscesses by the fact that they are generally sterile when first opened and that fragments of the adult worms may be found in the abscess drainage. Filarial abscesses are even more common in *Brugia* infections than in those caused by *Wuchereria*.

ANEMIA

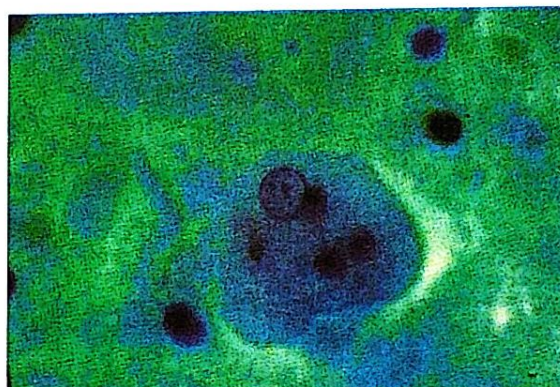
Anemia is characterized by reduced red blood cell counts, hemoglobin, and hematocrit. It is frequently associated with malaria, hookworm, and broad fish tapeworm infections, it may be observed in babesiosis, kala-azar, trypanosomiasis, schistosomiasis, fasciolopsiasis, and trichuriasis.

In *P. falciparum* malaria the red blood cell count may fall to 2.5 to 4.0 million per mm³ in cases of average severity, and fewer than 1.0 million per mm³ in severe infections. Anemia is usually not severe in *P. vivax* malaria and is still less pronounced in quartan infections. **Iron deficiency anemia** is the leading form of anemia and is commonly associated with hookworm infections. The characteristic *microcytic hypochromic anemia of hookworm* infection is the result of blood loss and is thus proportional to the severity of infection, although adequate dietary intake of iron may prevent its development in light or moderate infections. The small amount of blood ingested per *Trichuris* worm makes anemia rare except in massive infections. Persons heavily and chronically infected with *Dibothriocephalus latus* (formerly *Diphyllobothrium latum*) may develop **megaloblastic**

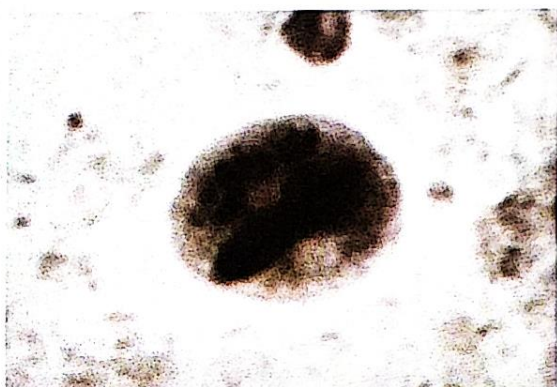
Atlas of Medically Important Parasites



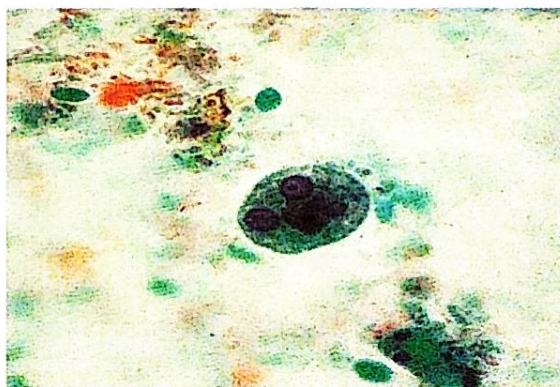
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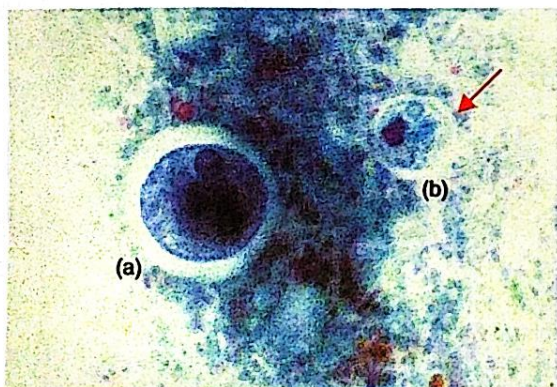
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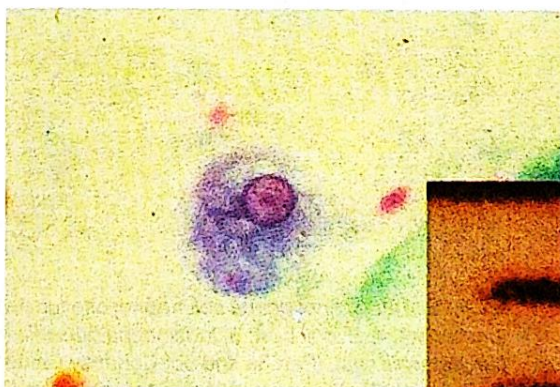
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6

PLATE I 1, 2, *Entamoeba histolytica* trophozoites; 3, 4, *E. histolytica* cysts; 5, *E. histolytica* (5a without arrow) and *E. hartmanni* (5b with arrow) cysts; 6, *E. hartmanni* trophozoite. (All color photographs are enlarged to emphasize internal structures)