

PARASITIC PROTOZOA

Edited by JULIUS P. KREIER

II

*Intestinal Flagellates, Histomonads,
Trichomonads, Amoeba, Opalinids,
and Ciliates*

Parasitic Protozoa

Volume II

*Intestinal Flagellates, Histomonads,
Trichomonads, Amoeba,
Opalinids, and Ciliates*

Edited by

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Preface

The parasitic protozoa are a large and diverse group. Many are of interest to physicians and veterinarians because they produce disease in man and his livestock. Others, which seldom produce disease, should be familiar to the practitioner of medicine and to the research scientist because they are present in the animal body and thus must be recognized to avoid a misdiagnosis, while still others, such as the intestinal and rumen protozoa, perform a useful function in the animal's economy, and their presence is an indication of health rather than disease.

I have included in these volumes protozoa parasitic in animals, such as fish and insects, which are not usually included in books on pathogenic protozoa. I did this because I believe veterinary medicine should concern itself with all species of animals, excepting man, whose care falls to the physician. From a more practical standpoint, I feel the inclusion of parasites of diverse species is appropriate in a book on protozoa of veterinary and medical interest because no matter how we set ourselves off from nature we remain a part of it, and thus we inevitably share parasites with the other species with which we live.

Because of the wide range of parasites and the volume of material available, no single author could hope to be qualified to write on all of them, thus I have chosen to have each chapter written by someone qualified in that area. This course of action, while it avoids the problems of the limitations of a single author, has problems of its own, the most serious being the variability in the author's styles and attitudes which produces unevenness in the treatment of the contributions. For this I accept responsibility as editor. For all that is good and useful in these volumes I thank the authors of the chapters and the staff of Academic Press who have aided in the production of these volumes. I also wish to thank the Army Malaria Project, whose support of my research has made it possible for me to continue my interest in protozoology.

Julius P. Kreier

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I. Introduction

Flagellates inhabiting the intestines of man and other animals are a heterogenous assemblage of organisms belonging to several orders of Zoomastigophorea. Retortamonadida, Diplomonadida, Oxymonadida, Proteromonadida and Cochlosomidae, a family of uncertain taxonomic position, are considered in this chapter. Families, genera, and important species are surveyed in Table I. Many of the intestinal flagellates belong to the order Trichomonadida and are discussed separately in Chapters 2, 3, and 4.

United in their ability to live and multiply anaerobically, intestinal flagellates differ in morphology, subcellular organization, and behavior. In the trophozoite stage all of them are equipped with flagella, fibrillar cytoskeletal components, nuclei, endoplasmic reticulum, and digestive vacuoles. Mitochondria and Golgi apparatus are absent in Retortamonadida, Diplomonadida, and Oxymonadida but are present in Proteromonadida. Their life cycles are simple and no sexual phenomena

have been observed. Trophozoites multiply typically by binary fission. In certain groups the multiplicative trophozoite stage alternates with a resting stage—the *cyst*. The cyst is enveloped by a resistant wall which is functional in transmission of the organism and its survival under unfavorable conditions.

Food is ingested by phagocytosis and pinocytosis, occurring either randomly over the protozoan surface or in specialized organelles called *cytostomes*. All intestinal flagellates seem to depend on associated flora for both nutrition and adjustment of proper physicochemical conditions. Virtually nothing is known of their metabolism, since they are rarely obtained in a condition suitable for biochemical experiments. Very few can be maintained in culture, and those which can be are usually maintained under agnotobiotic or poorly defined conditions.

A few species are pathogenic; all pathogenic species belong to the single order Diplomonadida. Pathogenicity was also ascribed to many other flagellates, whose abundant occurrence had been found coincident with disease. However, such reports are of little significance, since convincing experimental evidence is lacking. An increase in the protozoan population is often secondary to a pathological condition of another etiology, indicating merely that the intestinal biocenosis is out of balance. Perhaps some otherwise nonpathogenic flagellates may cause symptoms at the first encounter with an unusual but susceptible host until a host-parasite equilibrium is reached. Thus the great majority of flagellates are harmless commensals. However, even these deserve consideration both from the diagnostic standpoint and for their role as constituents of a normal intestinal biocenosis.

Intestinal flagellates are acquired by the host through contaminated food and water. The host is infected either by trophozoites or cysts or both, depending on the species of parasite. Establishment of an infection is influenced by the host's diet. In mammals, a carbohydrate diet is more favorable for the intestinal flagellates than a "carnivorous" one (Hegner, 1924; Tsuchiya, 1932; Schneider, 1961b). This apparently is an indirect effect resulting from changes in the intestinal flora induced by the diet. Populations of intestinal bacteria probably are the most important factor determining the growth and reproduction of intestinal flagellates in the host (Peterson, 1960).

In a manner similar to that of other intestinal parasites, flagellates show preference for particular regions of the intestine. Most species reside in "calm corners" of the digestive tract rich in intestinal flora, where digestive processes do not take place, or at least proceed gently, namely, in the cecum of mammals and birds and the cloacal ampulla of amphibians and reptiles. A few species prefer the upper parts of the small intestine

Table I
Survey of the Intestinal Flagellates of Vertebrates ^a

Taxonomic group	Genus	Hosts of the genus	Species parasitic to man	Pathogenic species	Affected host
Retortamonadida					
Retortamonadidae	<i>Retortamonas</i>	Man, monkeys, cattle, sheep, rabbit, rodents, amphibians, reptiles	<i>R. intestinalis</i>		
	<i>Chilomastix</i>	Man, monkeys, pig, horse, rabbit, rodents, poultry, amphibians, reptiles, fish	<i>C. mesnili</i>	(?) <i>C. mesnili</i>	Man
				(?) <i>C. gallinarum</i>	Quail
Diplomonadida					
Enteromonadina					
Enteromonadidae	<i>Enteromonas</i>	Man, monkeys, pig, rabbit, rodents, opossum, amphibians	<i>E. hominis</i>		
fam. nov.	<i>Trimitus</i>	Amphibians, reptiles, fish			
	<i>Caciomonas</i>	Guinea pig			
Diplomonadina					
Hexamitidae	<i>Hexamita</i>	Monkeys, rodents, amphibians, reptiles, fish		<i>H. salmonis</i>	Fish
				<i>H. parva</i>	Tortoise
				(<i>H. nelsoni</i>)	(Oyster)
				<i>S. meleagridis</i>	Turkey
				<i>S. columbae</i>	Pigeon
				<i>S. muris</i>	Laboratory rat and mouse
	<i>Sptronucleus</i>	Poultry, rodents, amphibians, fish		<i>S. elegans</i>	Fish

Giardiinae subfam. nov.	<i>Octomitus</i> <i>Giardia</i>	Rodents, amphibians Man, monkeys, cattle, goat, sheep, horse, dog, cat, rabbit, rodents, amphibians, reptiles	<i>G. intestinalis</i> (?) <i>G. bovis</i> (?) <i>G. caprae</i> (?) <i>G. cati</i> (?) <i>G. canis</i> (?) <i>G. duodenalis</i> (?) <i>G. chinchillae</i>	Man Cattle Sheep Cat Dog Rabbit Chinchilla
Oxymonadida				
Polymastigidae	<i>Monoceromonoides</i>	Cattle, goat, rodents, amphibians, reptiles		
Proteromonadida				
Proteromonadidae	<i>Proteromonas</i> <i>Karotomorpha</i>	Guinea pig, porcupine, amphibians, reptiles Amphibians		
Incertae sedis				
Cochlosomidae	<i>Cochlosoma</i>	Domestic and wild birds, bats	(?) <i>C. anatis</i>	Turkey

^aTrichomonadida is not included.