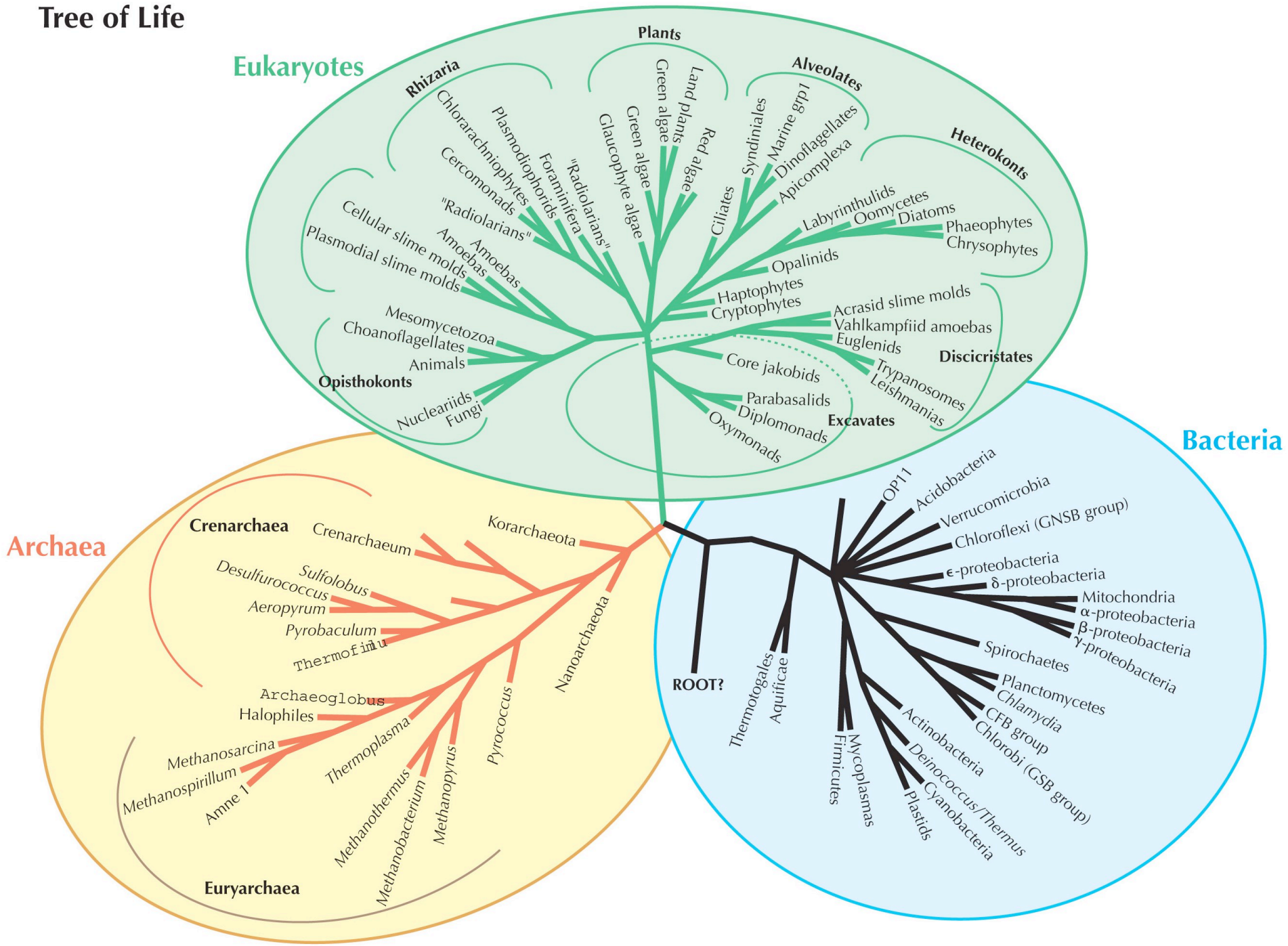


Life in the alimentary tract

- Most parasitized microhabitat.
 - Natural source of entry: through ingestion, although not all intestinal parasites enter this way.
 - Natural point of egress: with faeces
 - reduced efficacy of immune response
 - Rich in organic material
 - Blood vessels very close to surface.
 - Mucosal cells relatively unprotected.

Tree of Life



Intestinal Protists

- Excavates: *Chilomastix**, *Retortamonas*, *Giardia**, *Hexamita*, *Trichomonas*, *Tritrichomonas*, *Pentatrichomonas**, *Histomonas*, *Dientamoeba*.
- Chromalveolata (SAR): Opalinida. *Balantidium coli**.
- Amoebozoa: *Entamoeba**.

Intestinal parasites are specific to particular parts of the intestine and differ in how they use the host.

Trichomonas tenax

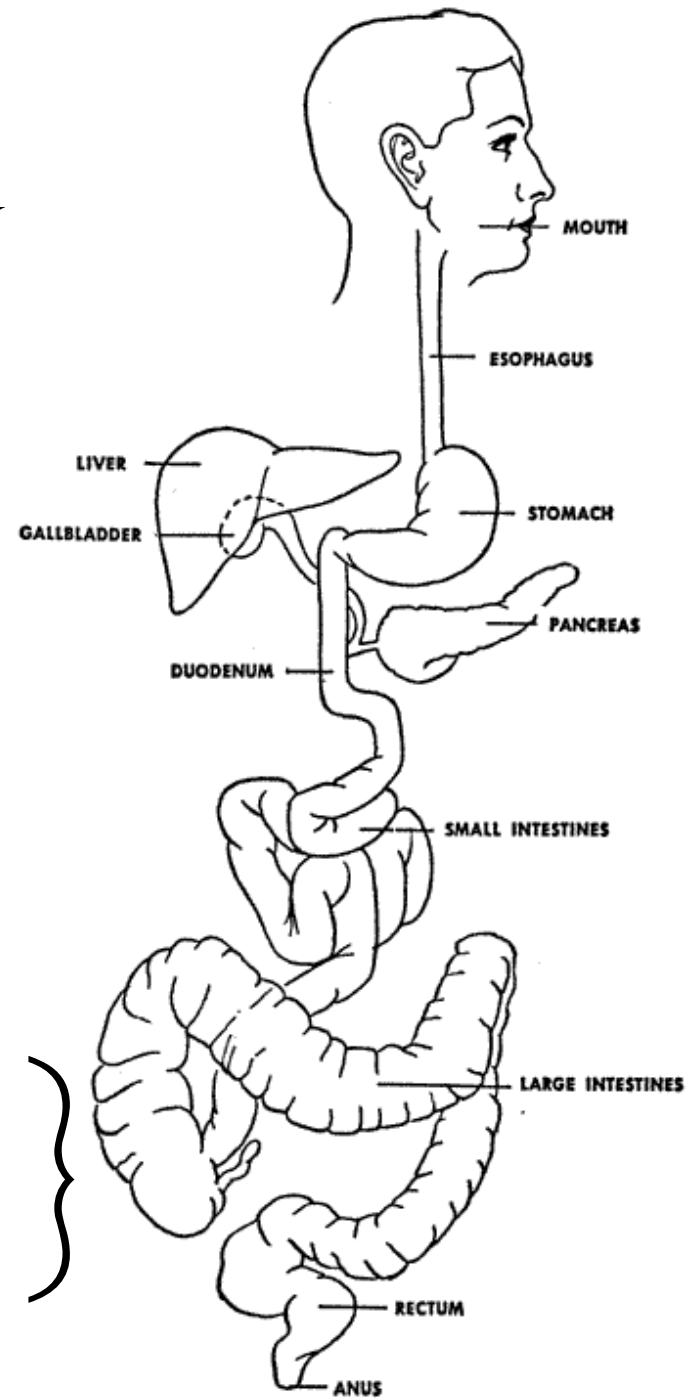
Giardia

Entamoeba

Dientamoeba

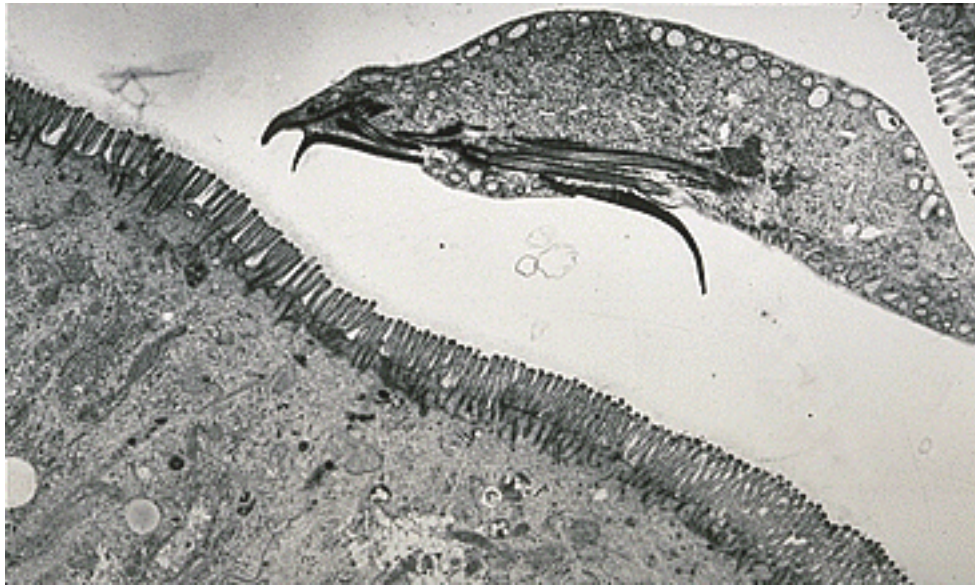
Pentatrichomonas

Chilomastix



Giardia intestinalis
= *G. duodenalis*, = *G. lamblia*

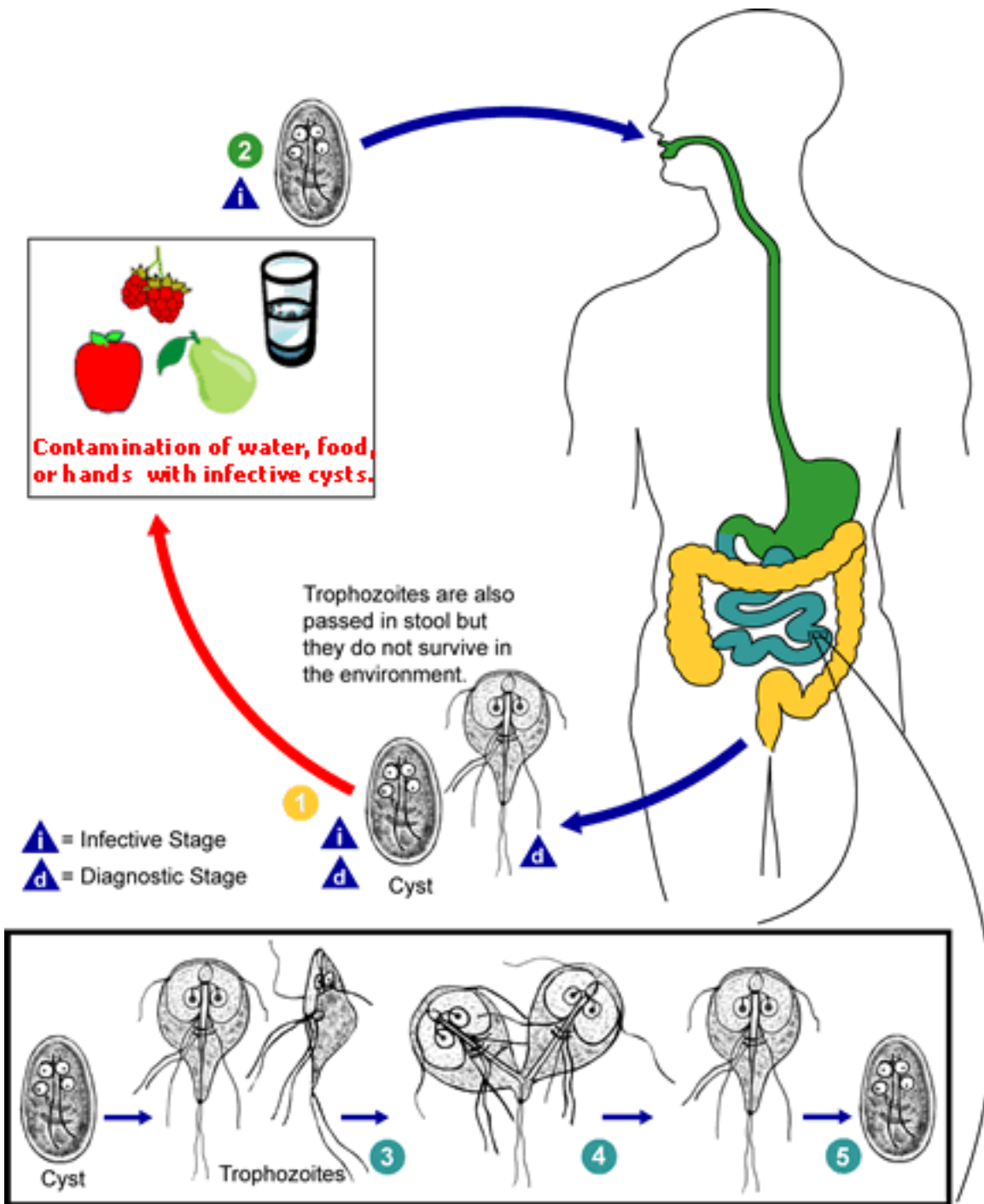
- Most common intestinal parasite of man.



Giardia background

- Phylum Retortamonadida; Order Diplomonadida.
- Usually basal position in Eukarya but evidence suggests secondary loss of endosymbiotic organelles
- Many (40+) nominal species in mammals and birds, but probably only a few are valid: broad host distributions

Giardia intestinalis



Trophozoite
Pear shaped with
adhesive disc; 2
nuclei; 4 pr flagella

Cyst
Oval; 4 nuclei;
flagellar primordia

High-speed microscopic imaging of flagella motility and swimming in *Giardia lamblia* trophozoites

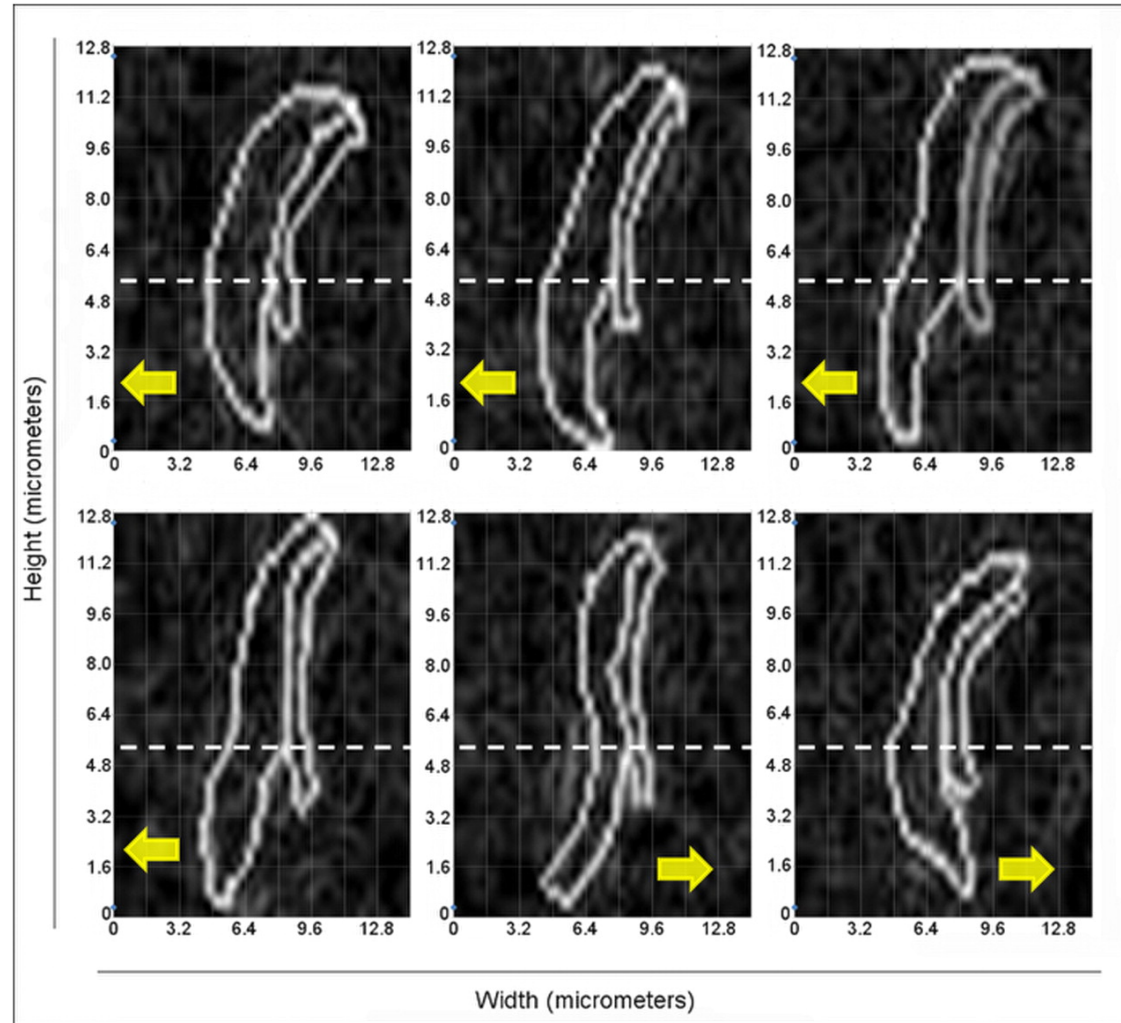
[Scott C. Lenaghan](#), [Corinne A. Davis](#), [William R. Henson](#), [Zhili Zhang](#), and [Mingjun Zhang](#)¹

PNAS August 23, 2011

vol. 108 no. 34

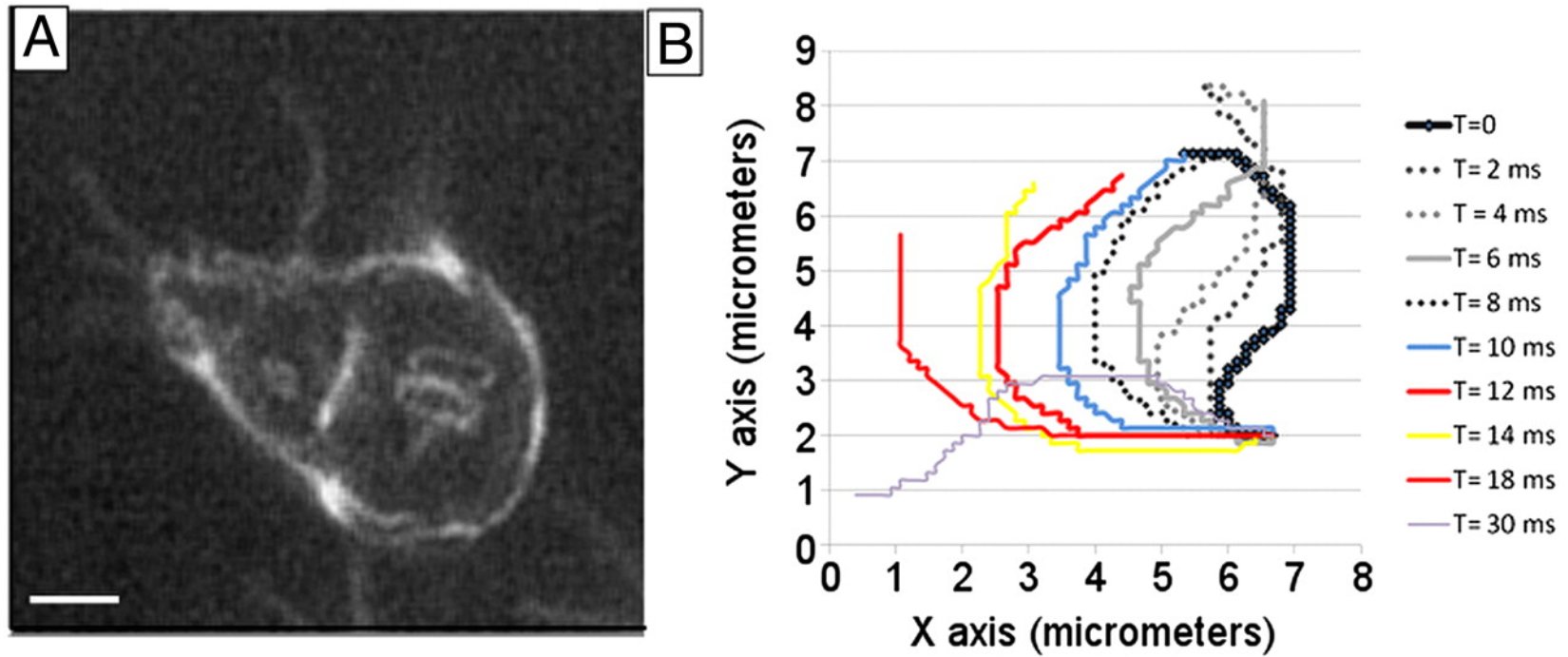
Giardia: posterolateral and anterior beat with power stroke. Caudal region (behind adhesive disc) undulates associated with internal flagellar beating. In free swimming the cell spirals forward. As they approach an object they go planar and circle before settling.

Time-lapse imaging of the beating of the caudal region.



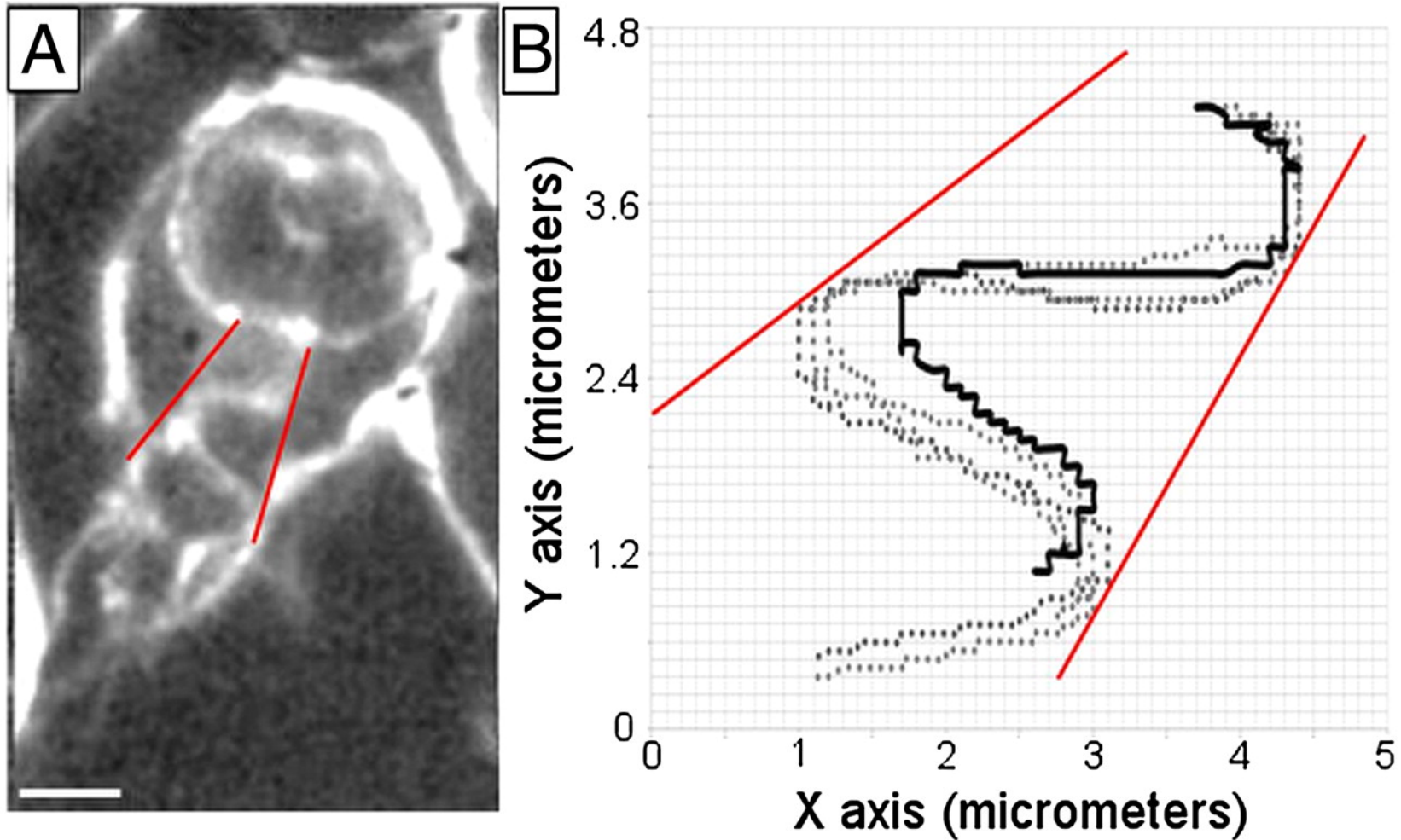
Scott C. Lenaghan et al. PNAS 2011;108:E550-E558

Beating pattern of the posterolateral flagella.



Scott C. Lenaghan et al. PNAS 2011;108:E550-E558

Beating pattern of the ventral flagella.



Scott C. Lenaghan et al. PNAS 2011;108:E550-E558

Giardia intestinalis

- Diagnosis: cysts in stool. PCR techniques in development.
- Treatment: metronidazole (Flagyl) or quinacrine

Antigenic variants

Outer surface dominated by small number of surface molecules which can shift during the course of infection.

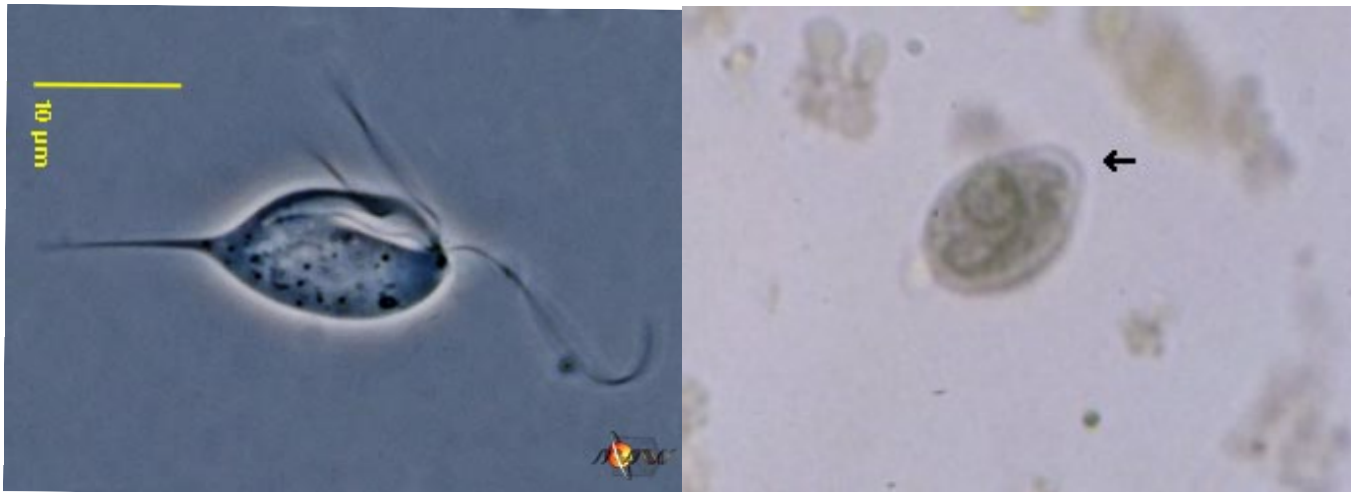
- 2 hypotheses: (1) variant surface antigens (VSA) are a defence against host immune system. (2) VSA allow parasite to survive in different intestinal environments.

Epidemiology Of Giardia

- *Giardia* occurs in a wide variety of hosts: - is this a single species with broad host specificity or is it a complex of species each with more narrow host restrictions?
- Most recent evidence points to relatively few species with broad host distribution.

Chilomastix mesnili,
Retortamonas intestinalis

- Intestinal parasites of humans
- Probably commensal, feeding on intestinal microflora but causing no harm.



Retortamonas intestinalis

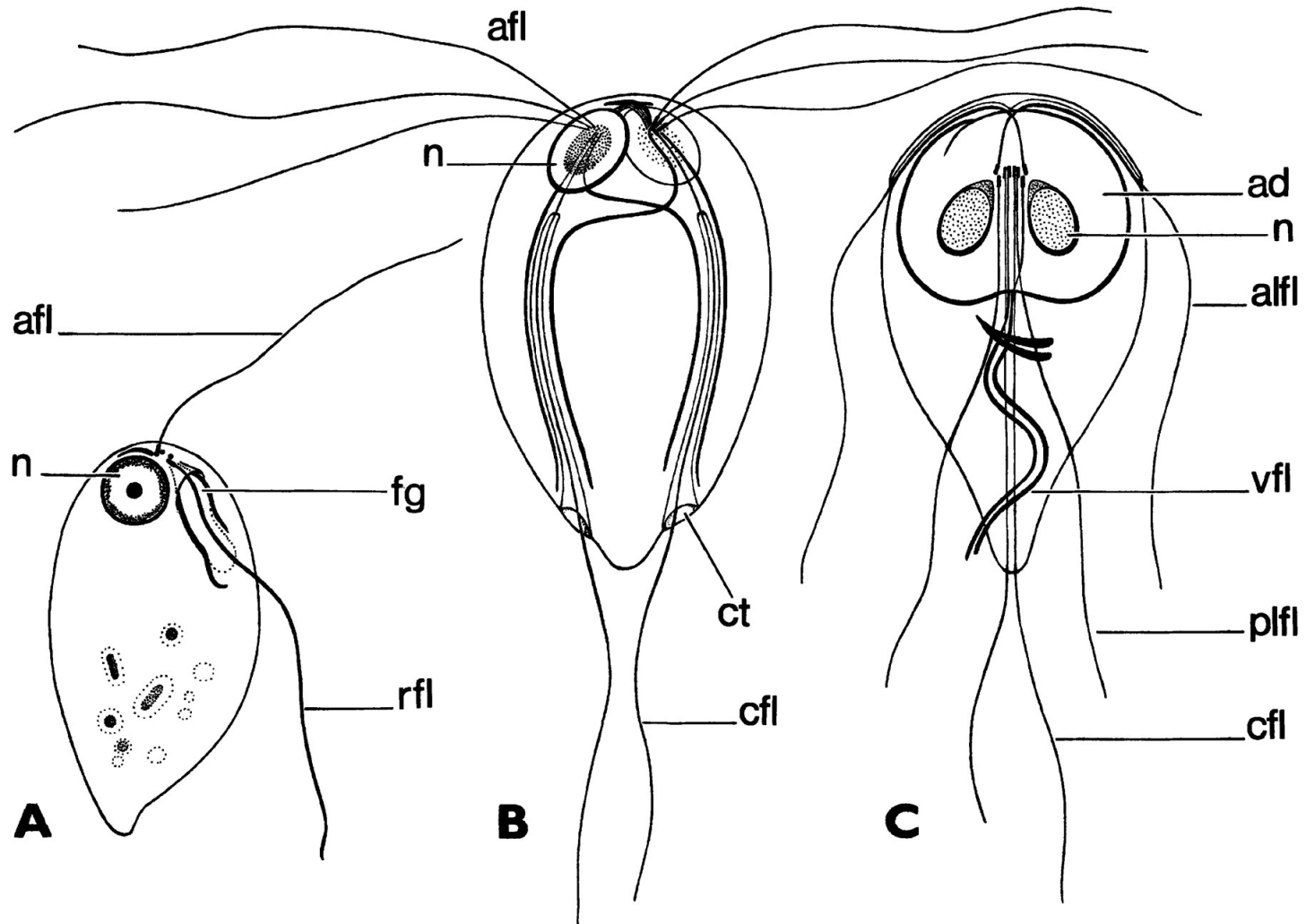
Tropics, SE Asia, Africa, S
America

Commensal

Others species in Insects and
Tetrapods

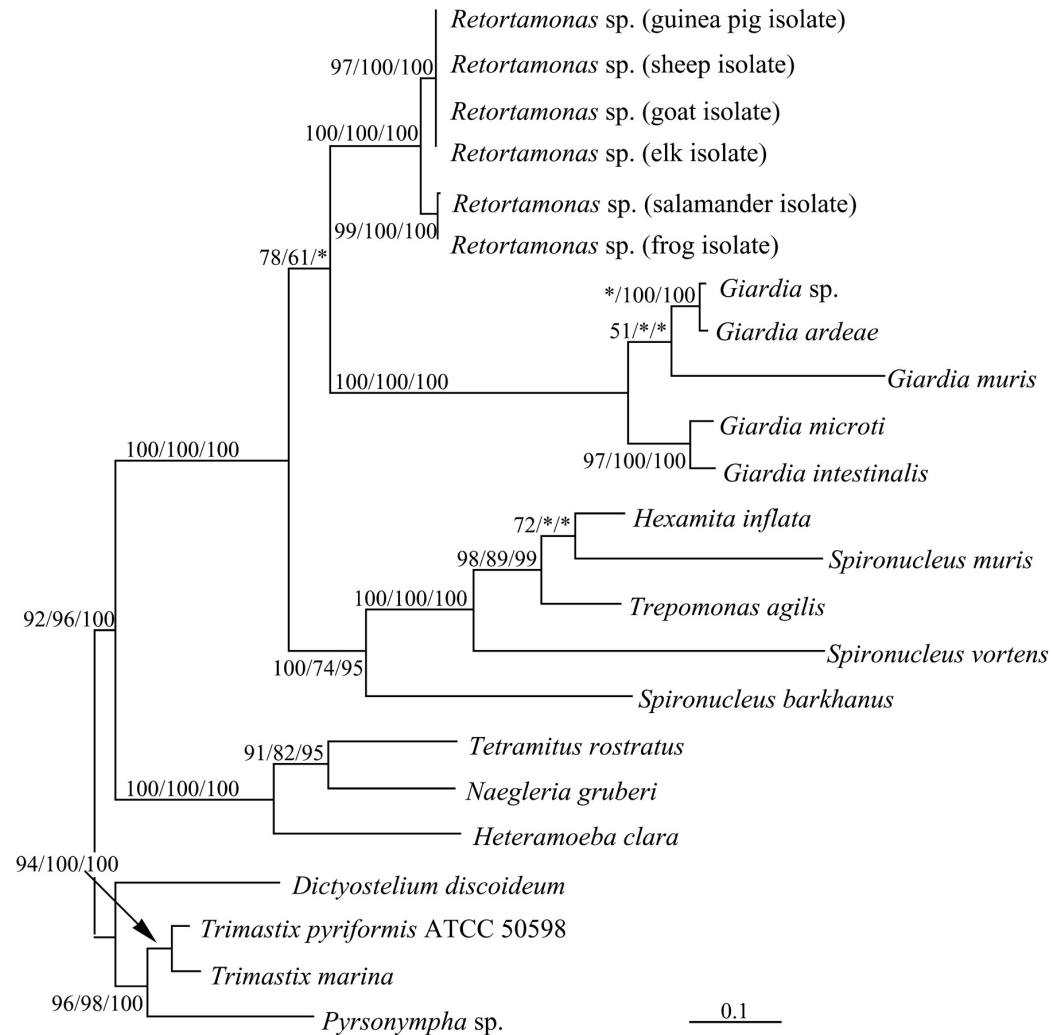


Fig. 3.—Schematic representations of (A) Retortamonas, (B) Hexamita, and (C) Giardia.



Jeffrey D. Silberman et al. Mol Biol Evol 2002;19:777-786

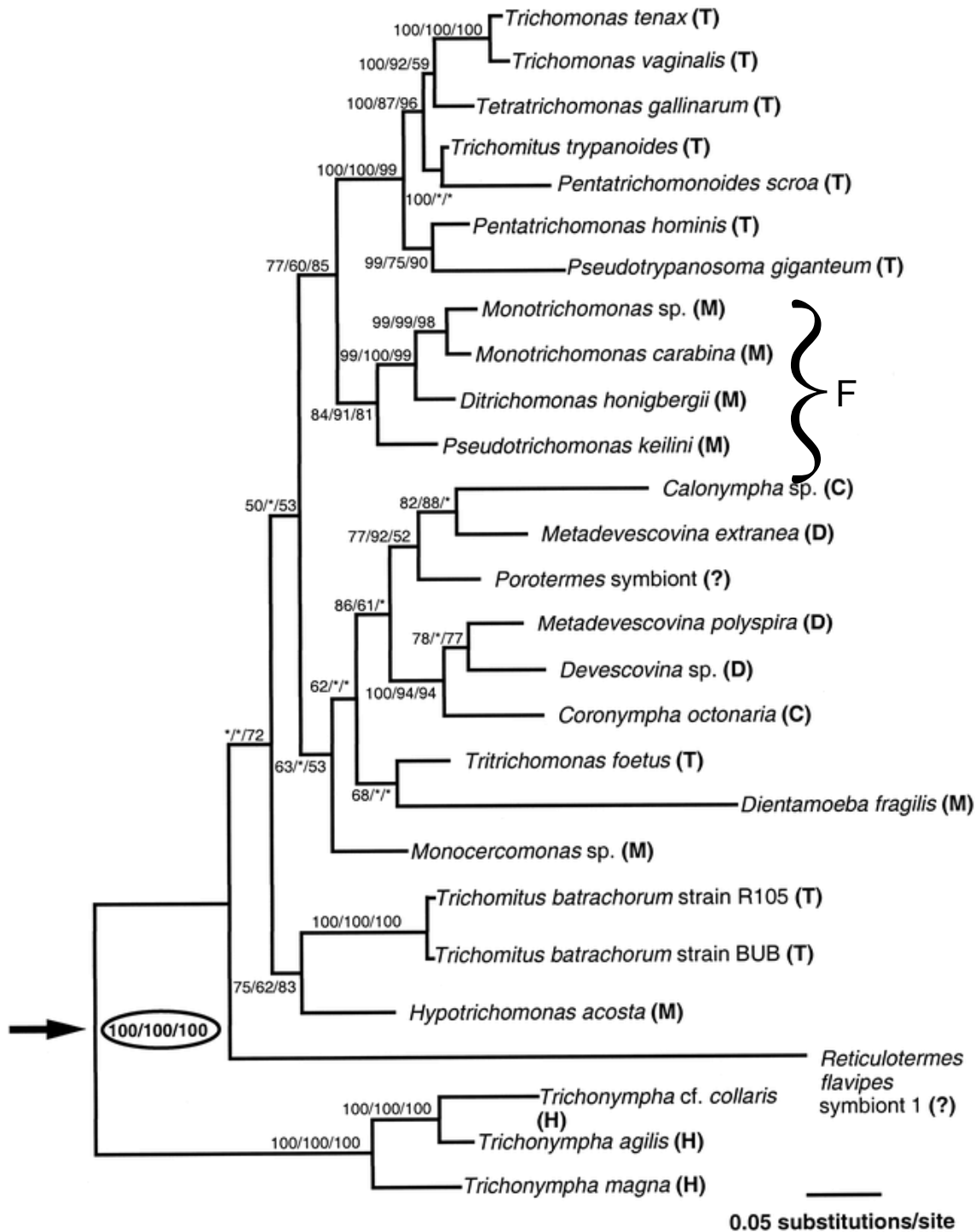
Fig. 2.—Phylogenetic relationships between retortamonads and diplomonads based on ssu rRNA sequences.



Jeffrey D. Silberman et al. *Mol Biol Evol* 2002;19:777-786

Trichomonadida

- Free living or in alimentary tract of arthropods and vertebrates.
- 3 species infect humans:
 - *Pentatrichomonas hominis* - intestine
 - *Trichomonas tenax* - mouth
 - *Trichomonas vaginalis* - vagina, urethra



This phylogeny, based on ribosomal small subunit sequence suggests some free living forms (F) in group may be secondarily derived.

Trichomonas vaginalis

- Infection in women of reproductive years: about 1/3 asymptomatic. Symptoms include vaginitis with green frothy discharge, pain while urinating. But easily confused with other non gonococcal STDs. Males often asymptomatic carriers.
- Diagnosis: organism in vaginal secretions; culture broths add sensitivity.



Other Parabasalea of note

- *Dientamoeba fragilis*: Human intestine, may cause diarrhea.
- *Trichomonas foetus*: Urogenital system of cattle. Leading cause of spontaneous abortion: production losses in beef/dairy herds.
- *Histomonas meleagridis*: part of a disease complex involving liver abscesses, diarrhea, droopiness and death. Transmitted by a nematode worm, *Heterakis gallinarum*

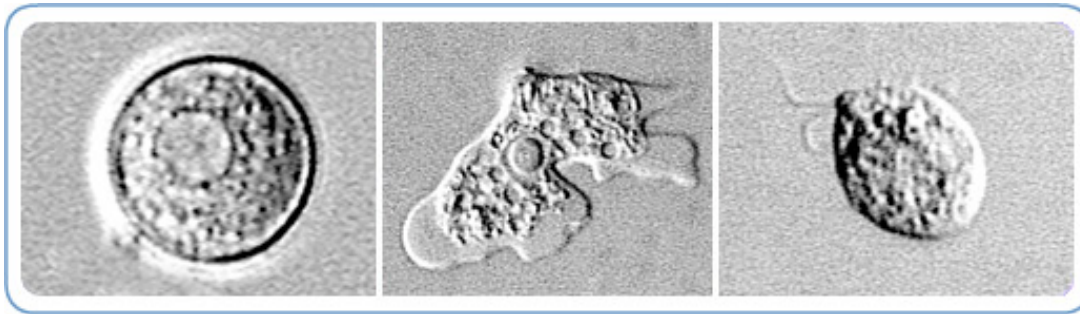
Figure 4. Hypothesized reconstruction of the Trichomonas-like infection of the oropharynx and mandible of MOR 980, commonly known as 'Peck's Rex' (Figure 2G).



Wolff EDS, Salisbury SW, Horner JR, Varricchio DJ (2009) Common Avian Infection Plagued the Tyrant Dinosaurs. PLoS ONE 4(9): e7288. doi:10.1371/journal.pone.0007288

<http://www.plosone.org/article/info:doi/10.1371/journal.pone.0007288>

Naegleria fowleri, free living, opportunistic pathogen



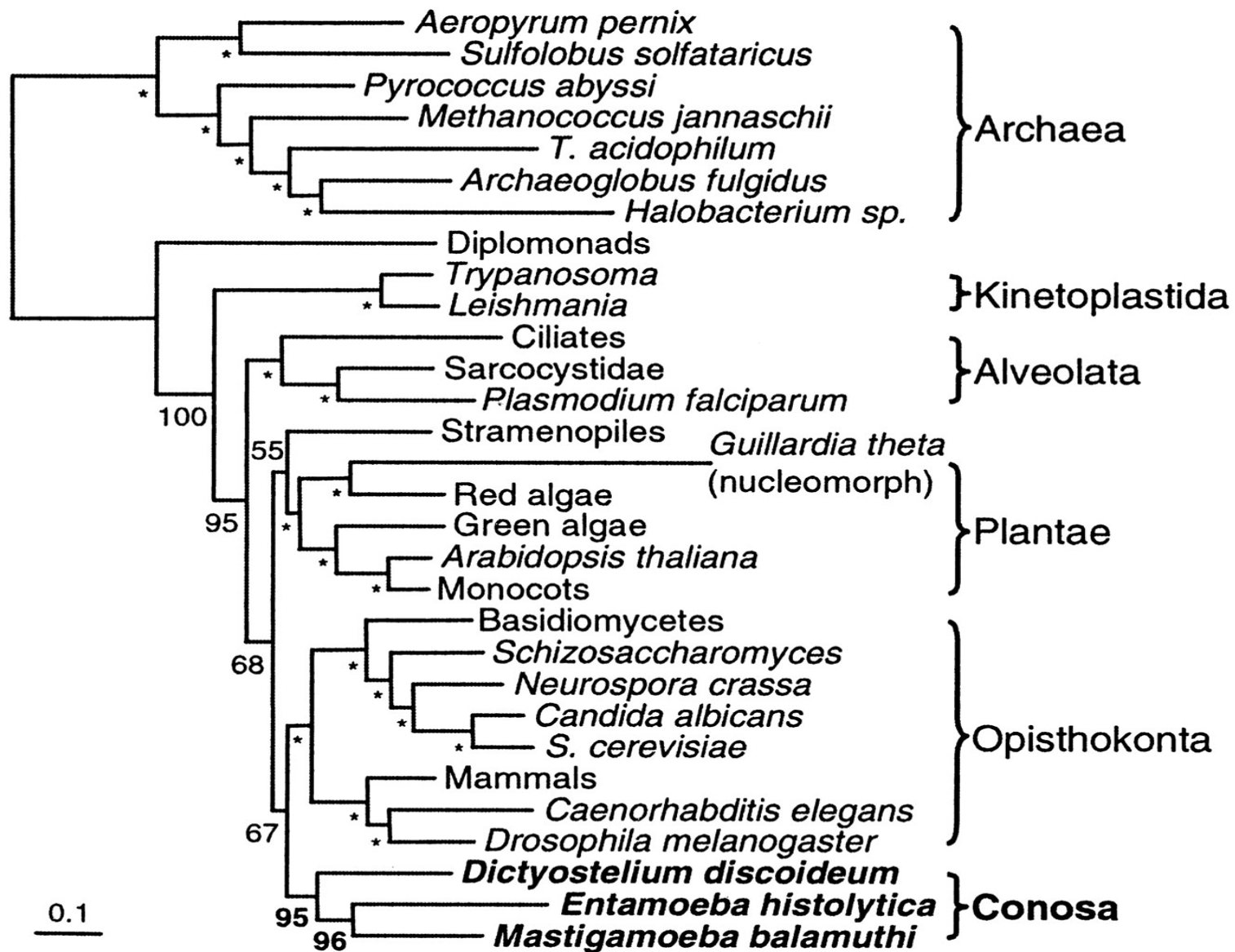
Excavate: Phylum Percolozoa

Entamoeba

- No mitochondria, once thought part of an ancient eukaryote lineage. Evidence suggests that mitochondrion has been lost secondarily. Amoebozoa sister group to Animals/Fungi

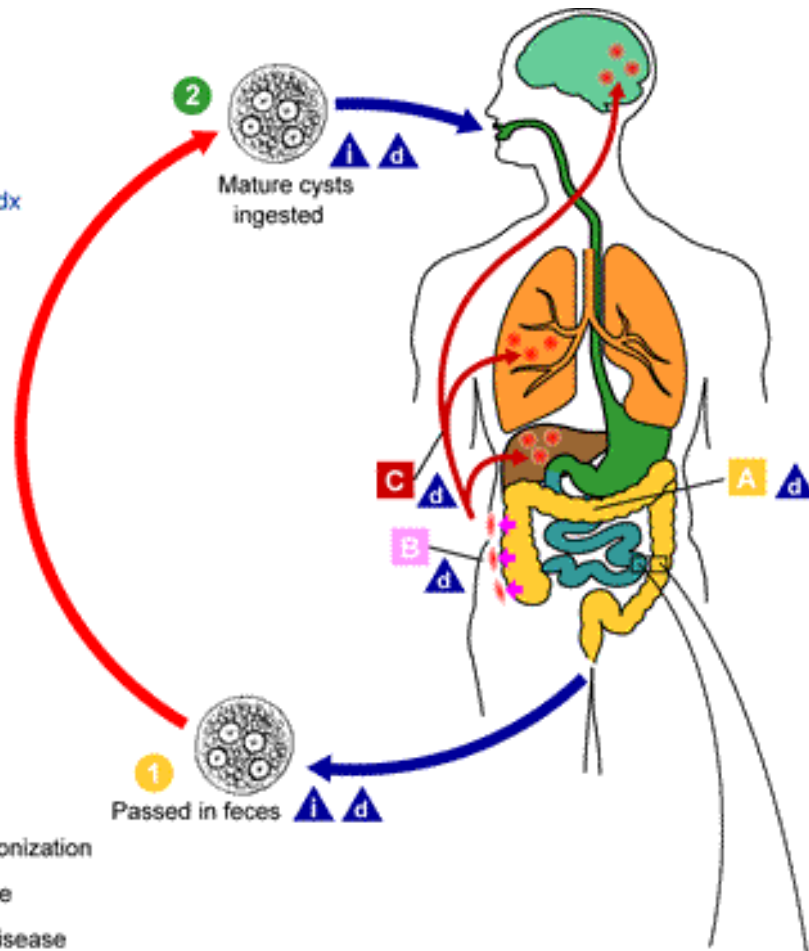


© Charles Prober, MD



Entamoebidae

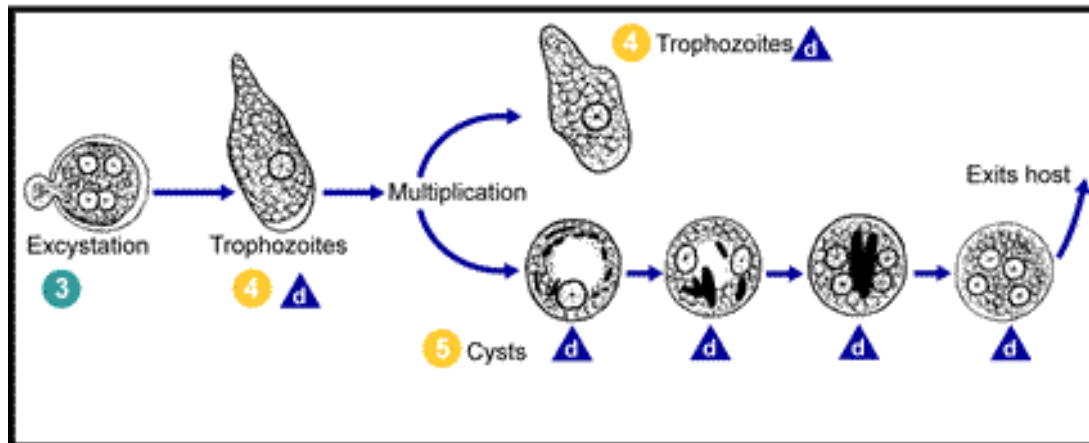
- Parasites (often commensal) of intestinal tract of arthropods and vertebrates.
- Human parasites: *E. histolytica*, *E. dispar*, *E. coli*.



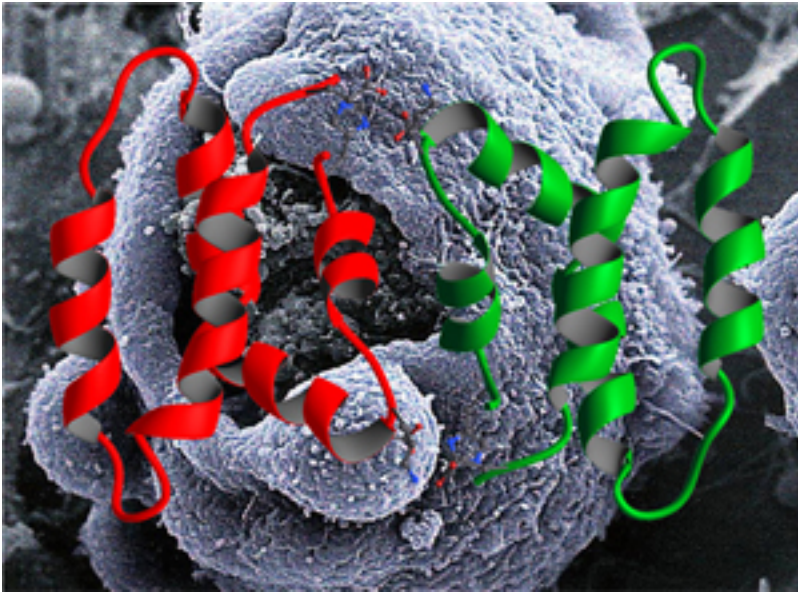
Entamoeba histolytica
 diagnosis: cysts in faeces

Treatment: Flagyl
 (metranidazole) or
 iodochlorhydroxy-
 quinoline.

Can be resistant to cure
 so careful follow-up
 needed.



pathogenesis



- Attachment to target cell involves lectin (Gal/GalNAc)
- Cysteine proteases implicated: regulate apoptosis in animal cells.
- Also involved is a protein, AP-A, which forms a dimeric structure, the amoebapore; inserted into target cell membrane, depolarizes and lyses cell.