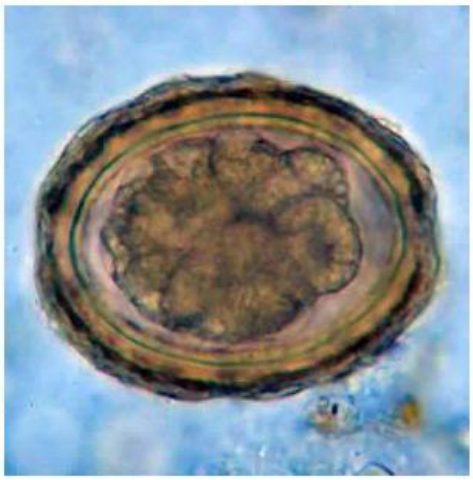
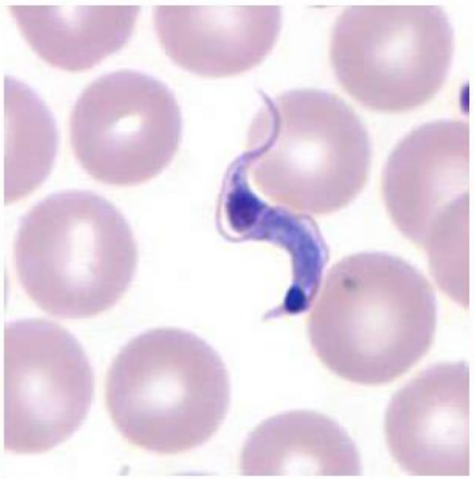
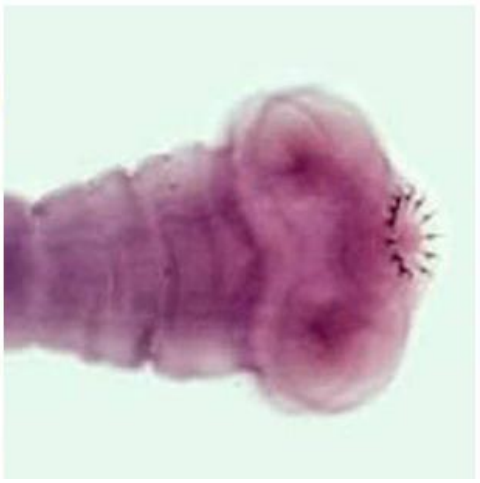
COLOUR ATLAS OF PARASITOLOGY (Part II)

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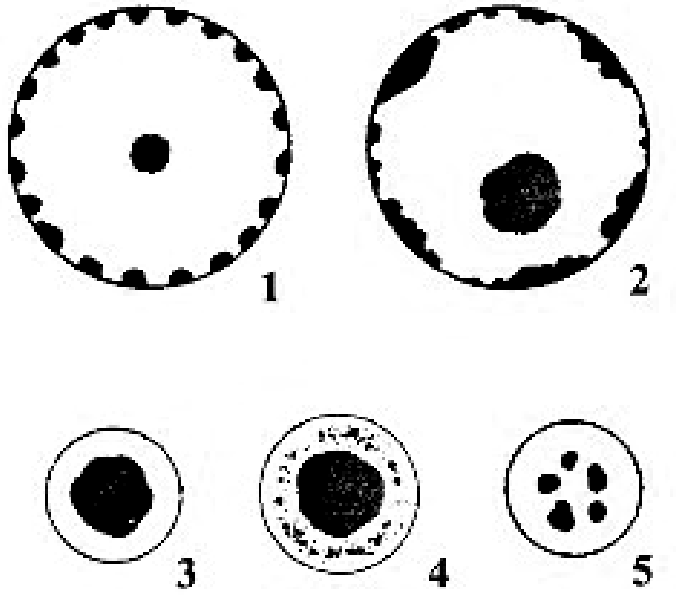
MOHD NAJWAN MOHD NASIR
Faculty of Medicine & Health Sciences
Universiti Sultan Zainal Abidin
2011

Content

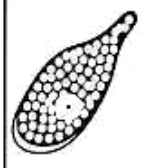
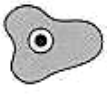
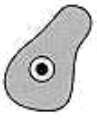
CHAPTER 1

INTESTINAL & TISSUE PROTOZOA (AMOEBA)

Major Classifications of Non-Pathogenic Amoebas



1) ***Entamoeba histolytica***
2) ***Entamoeba coli***
3) ***Endolimax nana***
4) ***Iodamoeba bütschlii***
5) ***Dientamoeba fragilis*** (a flagellate)

	Amebae					
	Entamoeba histolytica	*Entamoeba hartmanni*	*Entamoeba coli*	*Entamoeba polecki**	*Endolimax nana*	*Iodamoeba bütschlii*
Trophozoite						
Cyst						

**Rare, probably of animal origin*

Sarcomastigophora
The Amoebae and Flagellates
1.1 *Entamoeba histolytica*

Fig 1.1 (a)

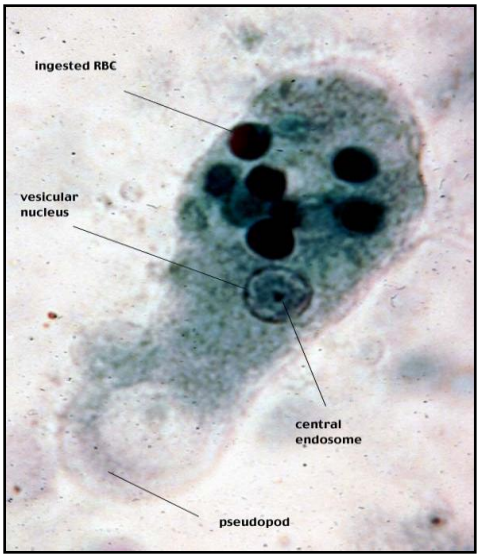


Fig 1.1 (b)

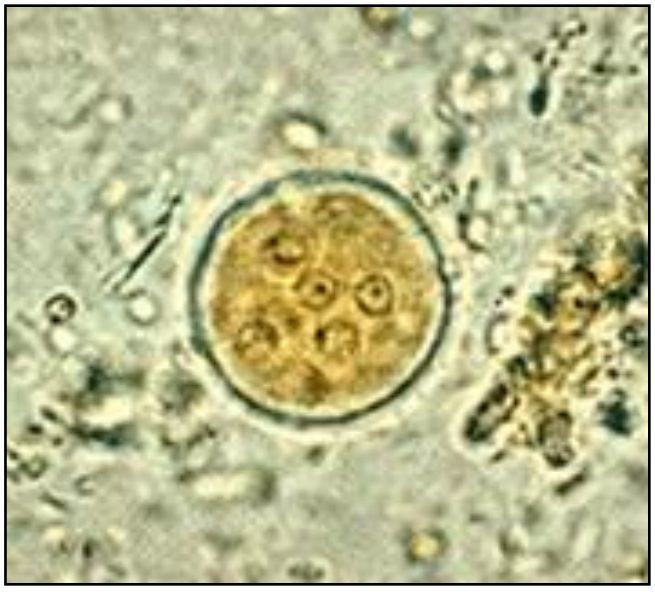


Fig 1.1 (c)

1.1 (a) *Entamoeba histolytica* ~ Cyst (Wet preparation)

1.1 (b) *Entamoeba histolytica* ~ Trophozoite (Wet preparation)

1.1 (c) *Entamoeba histolytica* ~ Cyst (Iodine stain)

1.2 *Entamoeba hartmanni*

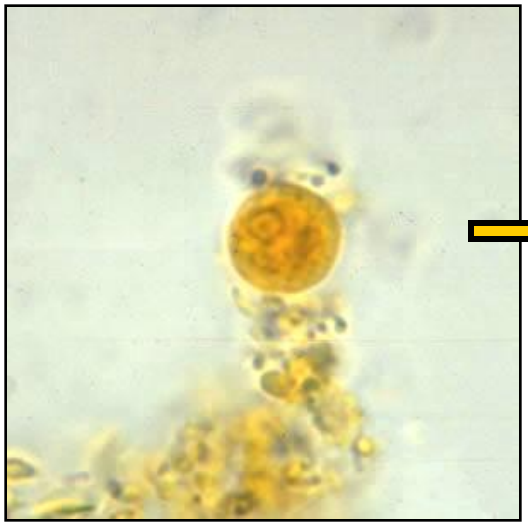


Fig. 1.2 (a)

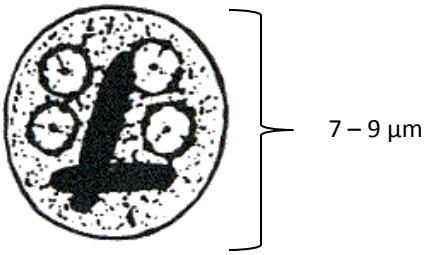


Fig. 1.2 (b)

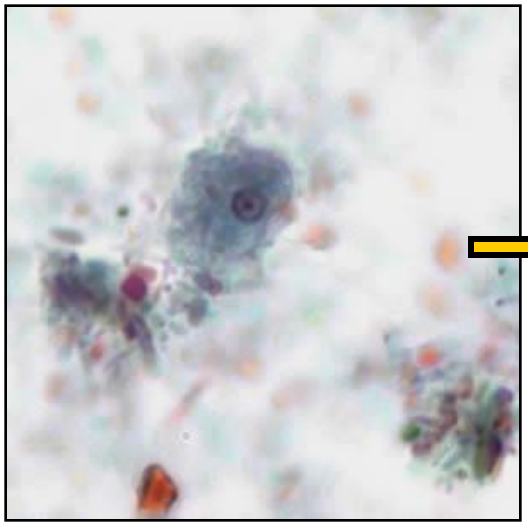


Fig. 1.2 (c)

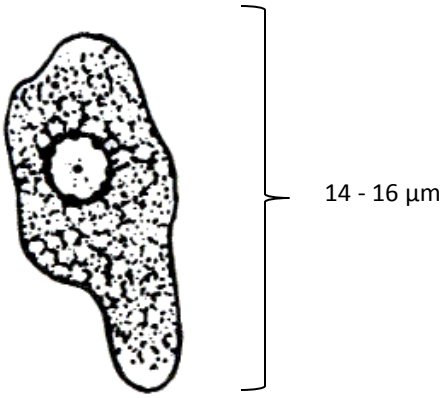


Fig. 1.2 (d)

1.2 (a) *Entamoeba hartmanni* ~ cyst (Iodine stain)
1.2 (b) *Entamoeba hartmanni* ~ cyst with dark stained chromatin bodies
1.2 (c) *Entamoeba hartmanni* ~ Trophozoite (Trichrome staining)
1.2 (d) *Entamoeba hartmanni* ~ Trophozoite

1.3 *Entamoeba coli*

Fig 1.3 (a)

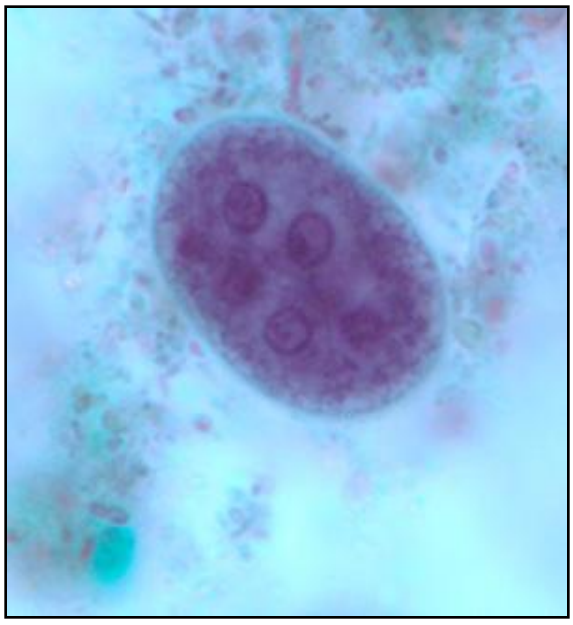


Fig. 1.3 (b)

Fig. 1.3 (c)

1.3 (a) *Entamoeba coli* ~ Cyst (Iodine staining)
Note the number of nuclei - 5 clearly visible in this focal plane compared to only 4 in *E. histolytica*.
1.3 (b) *Entamoeba coli* ~ Cyst (Trichrome staining)
1.3 (c) *Entamoeba coli* ~ Trophozoite
Note the eccentric endosome in the nucleus

1.4 *Iodamoeba buetschlii*

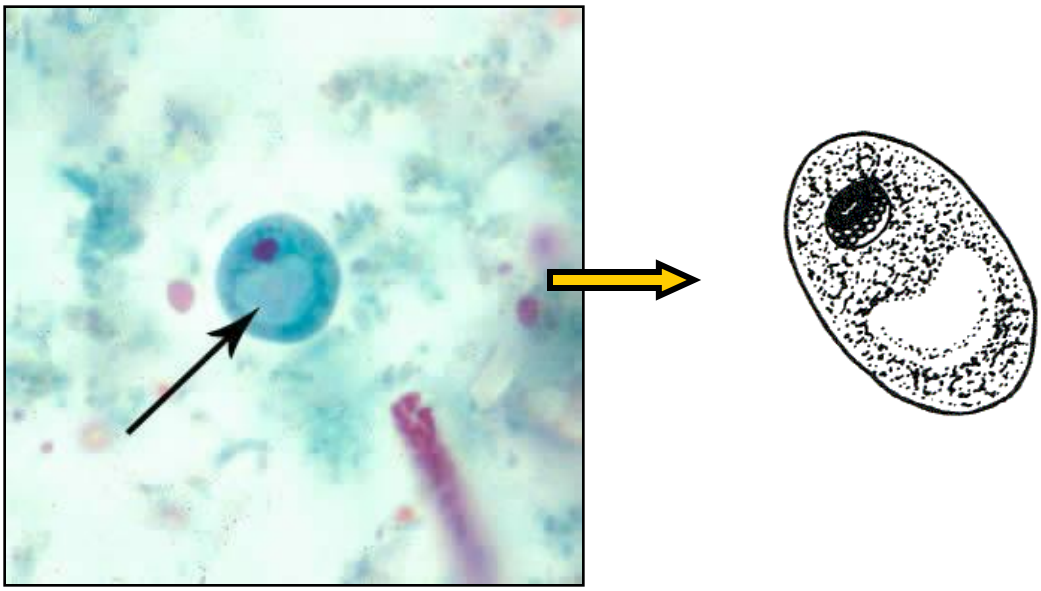


Fig. 1.4 (a) *Iodamoeba buetschlii* ~ Cyst (Trichrome staining)
Note the condensed dark chromatin and large vacoule; typical characteristic for I.buetschlii.

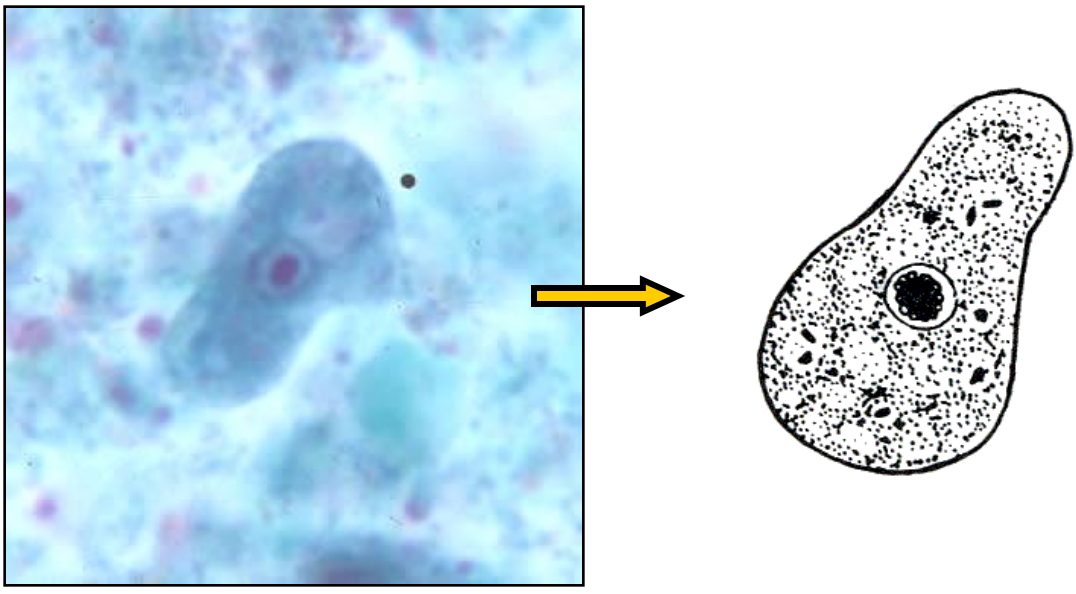


Fig. 1.4 (b) *Iodamoeba buetschlii* ~ Trophozoite (Trichrome)

1.5 *Endolimax nana*

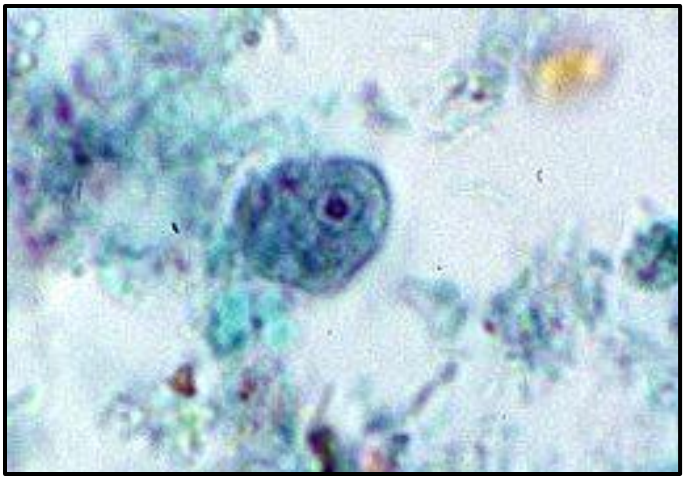


Fig. 1.5 (a)

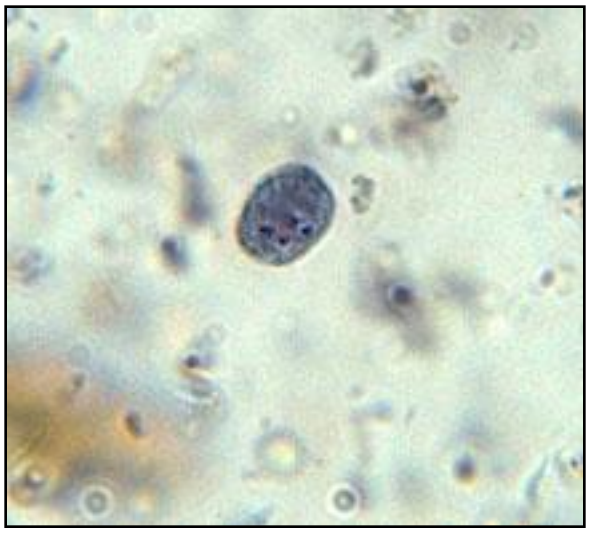


Fig. 1.5 (b)

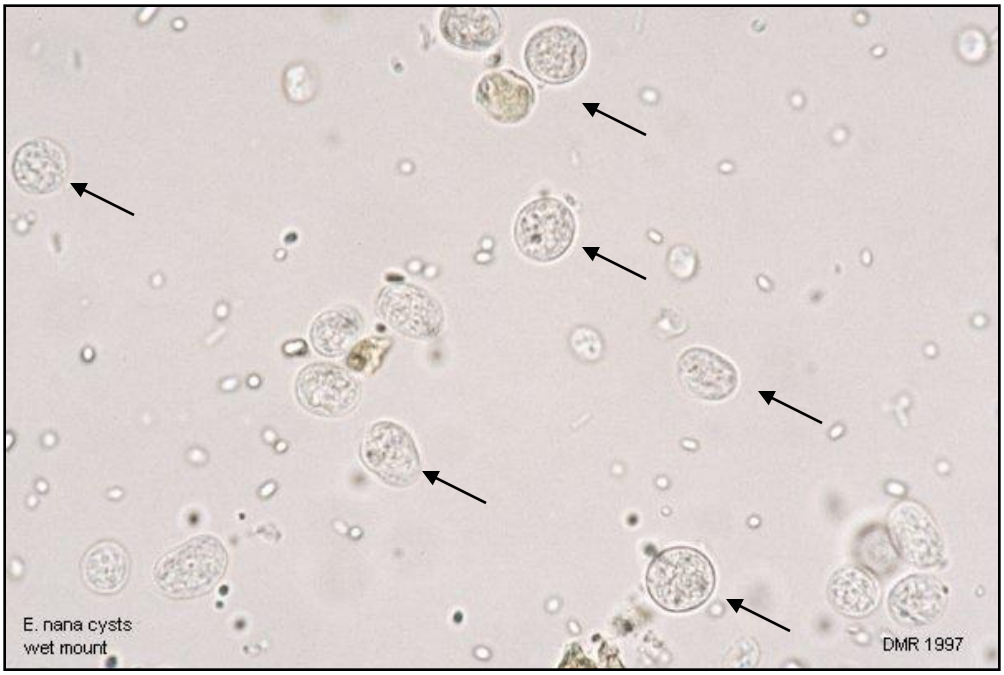
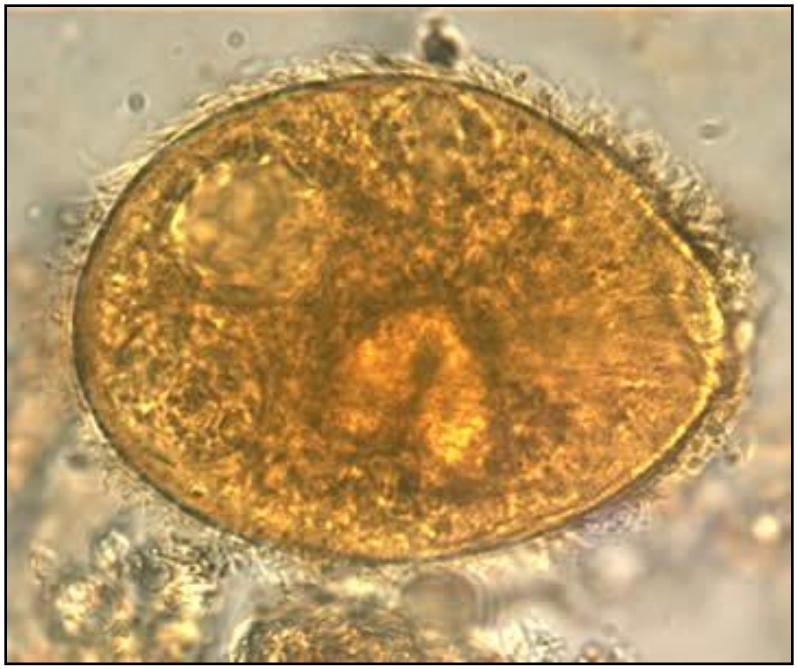


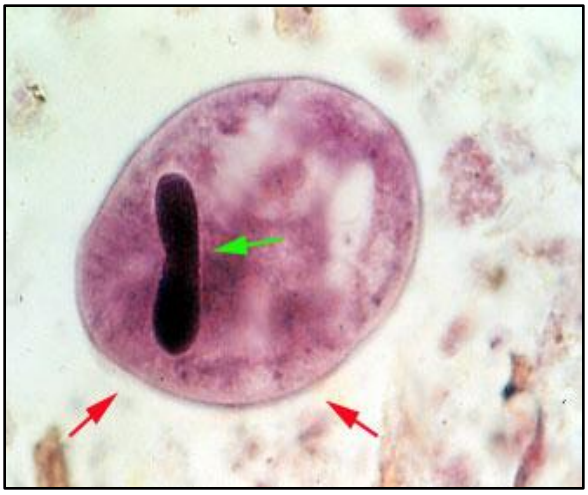
Fig. 1.5 (c)

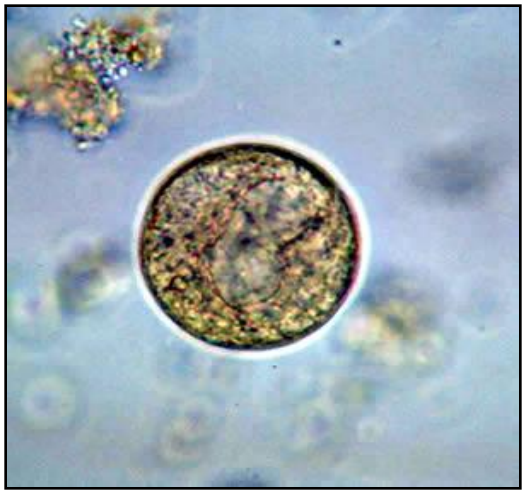
Fig. 1.5 (a) Endolimax nana trophozoite: Note the large endsome and thin layer of pigment around the nucleus.
Fig. 1.5 (b) Endolimax nana cyst: Contains 4 nuclei (3 seen in this focal plane) with large endosomes.
Fig. 1.5 (c) Endolimax nana cyst: Wet mount preparation (arrows)

Ciliophora ~ The Ciliates

1.6 *Balantidium coli*



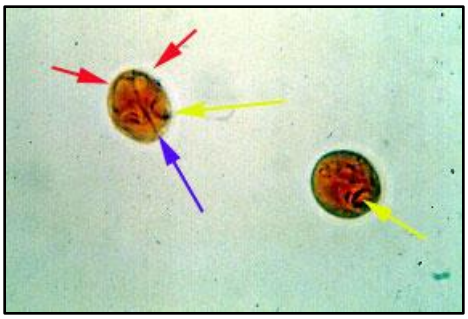


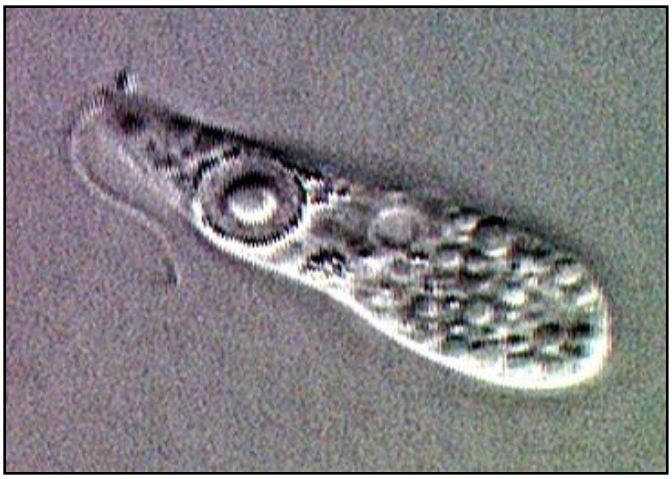


Balantidium coli ~ Trophozoite

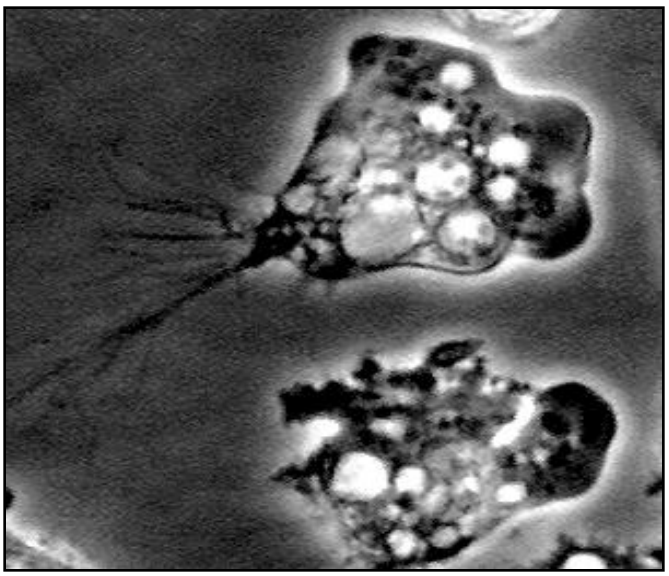
The red arrows indicate the cilia and the green arrow is pointing at the macronucleus.

1.7 *Naegleria fowleri*





Ameboflagellate trophozoite of *N. fowleri*

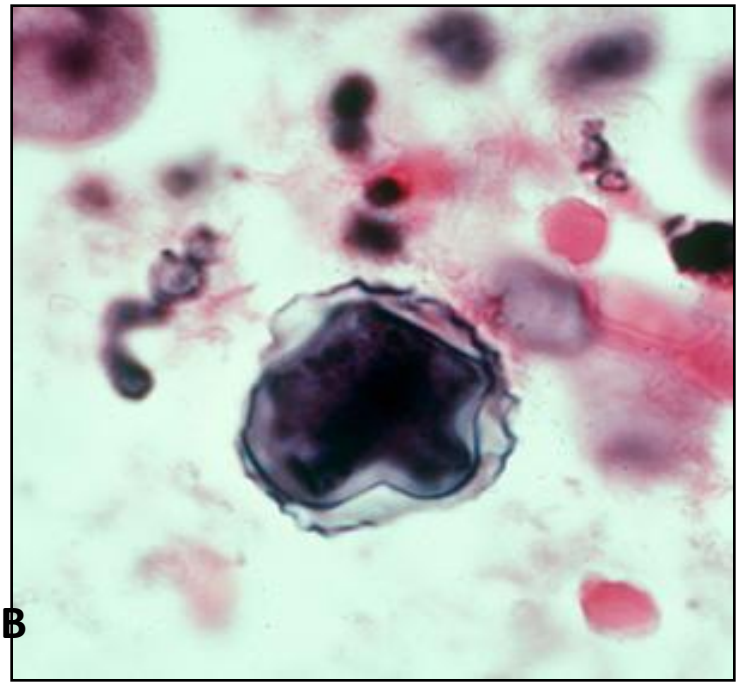


Trophozoites of *N. fowleri* in culture
(shows many vacuoles)

Cysts (about 12 µm): low power (left) and high power (right)
red arrow = nucleus; blue arrow = remains of the flagella;
yellow arrows = median bodies

Giardia sp. trophozoite

1.8 *Acanthamoeba spp.*

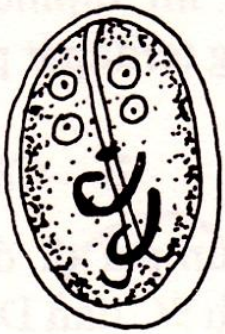


A:Cysts of *Acanthamoeba* sp. in culture
B: Cysts of Acanthamoeba sp. in tissue (H&E)

CHAPTER 2

INTESTINAL & TISSUE PROTOZOA (FLAGELLATES)

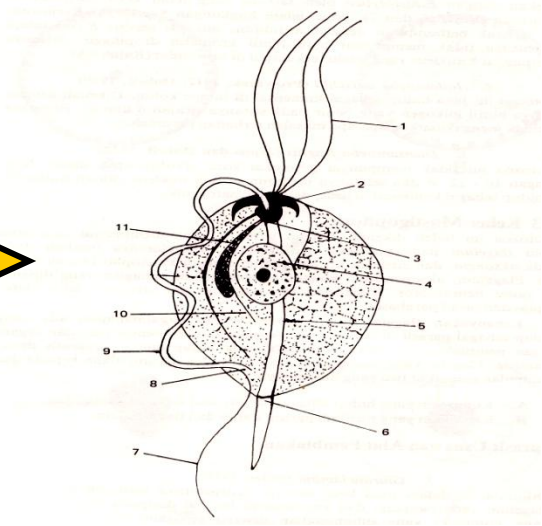
2.1 *Giardia lamblia (G. Intestinalis)*

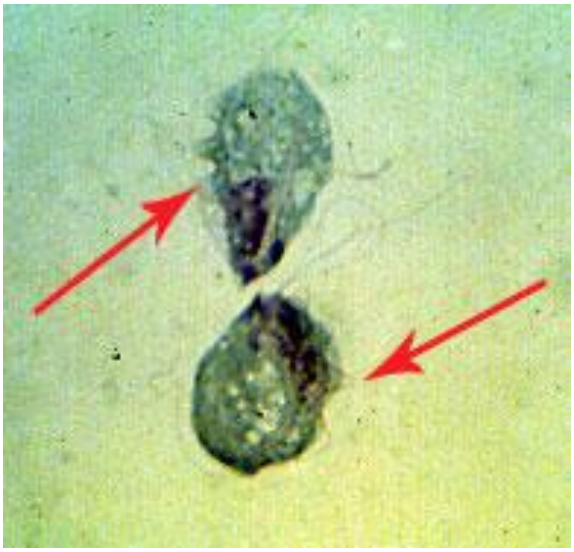


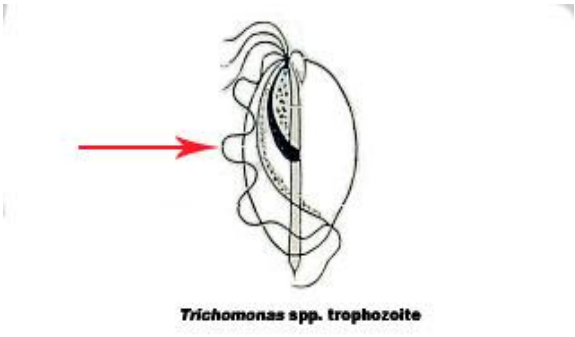
Giardia lamblia ~ Cyst

Giardia lamblia ~ Trophozoites

2.2 Trichomonas vaginalis





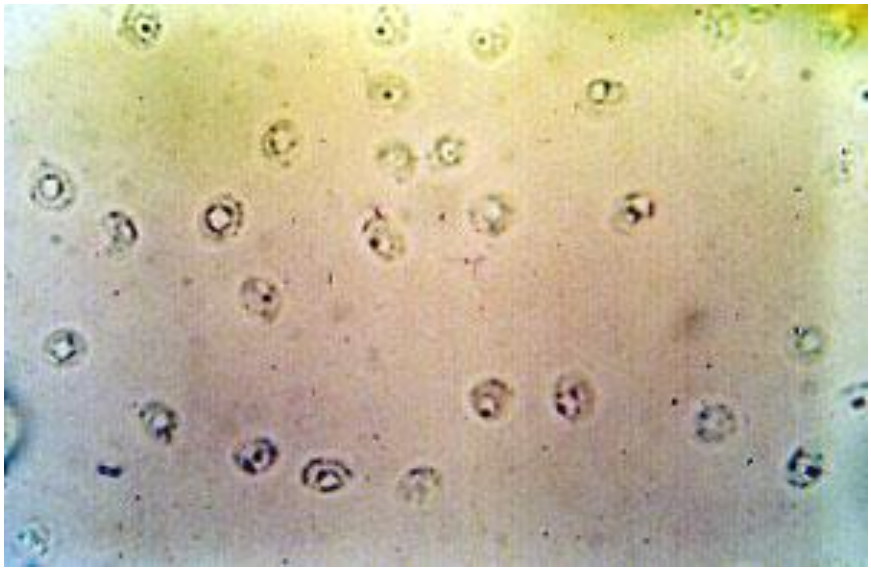


Trichomonas vaginalis ~ Trophozoites

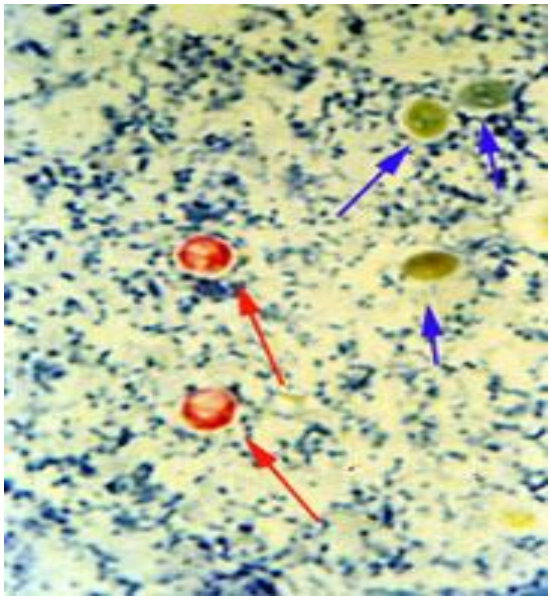
CHAPTER 3

INTESTINAL & TISSUE PROTOZOA (APIKOMPLEKSA)

3.1 Cryptosporodium spp.

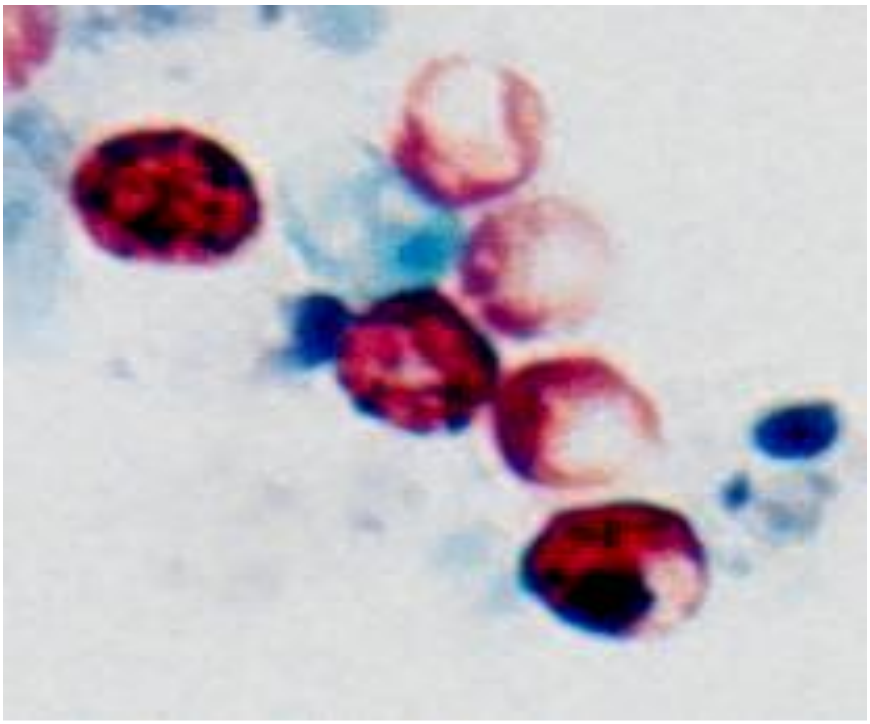


Cryptosporidium spp ~ oocyst
These oocysts measure about 4 to 5 µm in diameter.



This fecal smear was stained by a cold Kinyoun acid-fast technique. *Cryptosporidium* oocysts stain red (i.e. are acid fast), whereas yeast stains blue or green. This staining technique is normally used for Mycobacterium, but it also has great utility in confirming cryptosporidiosis.

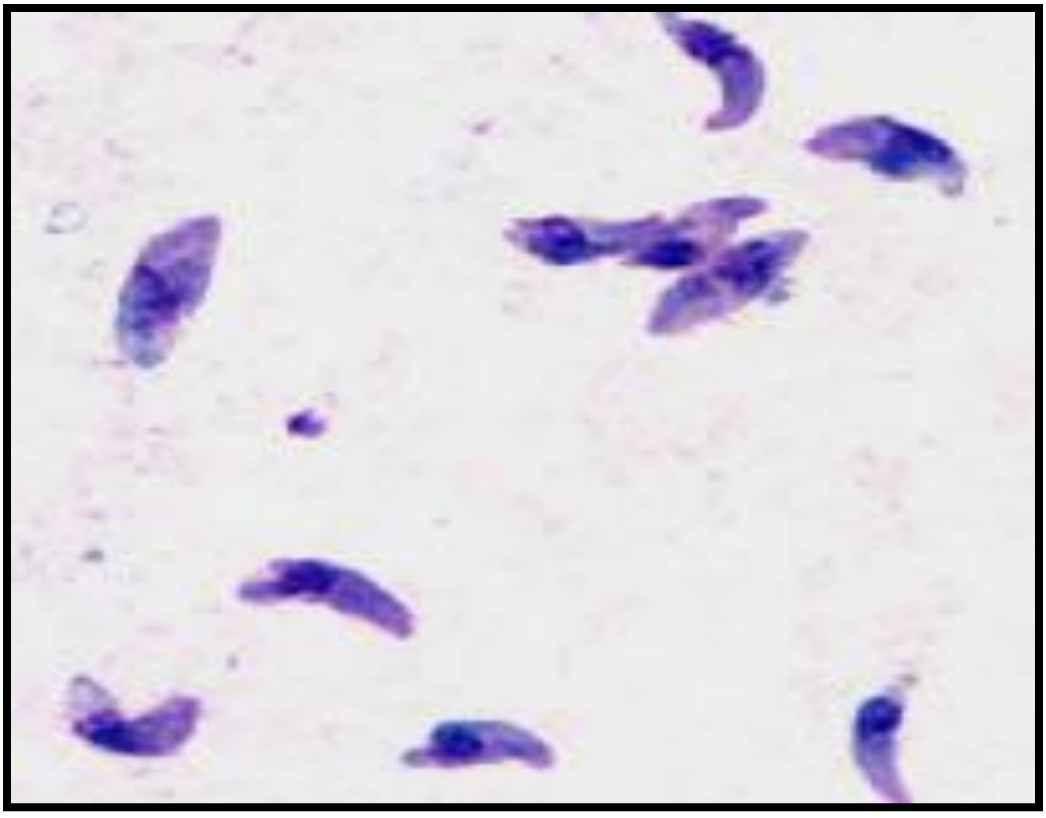
Cryptosporidium spp in gastrointestinal tract



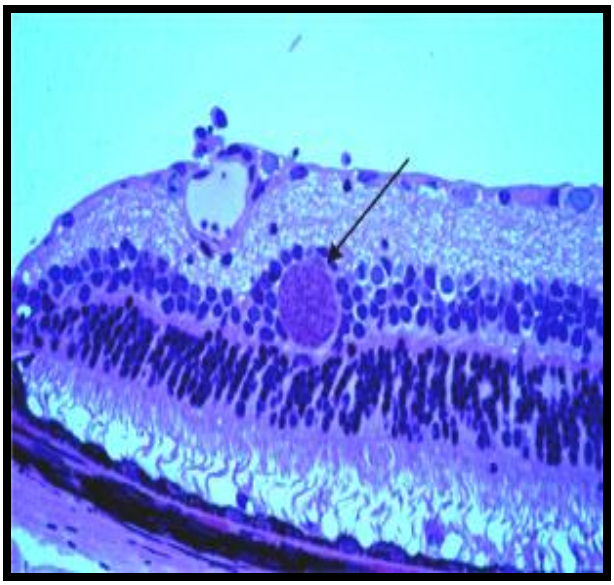
Cryptosporidium spp in tissue.

3.2 Toxoplasma gondii

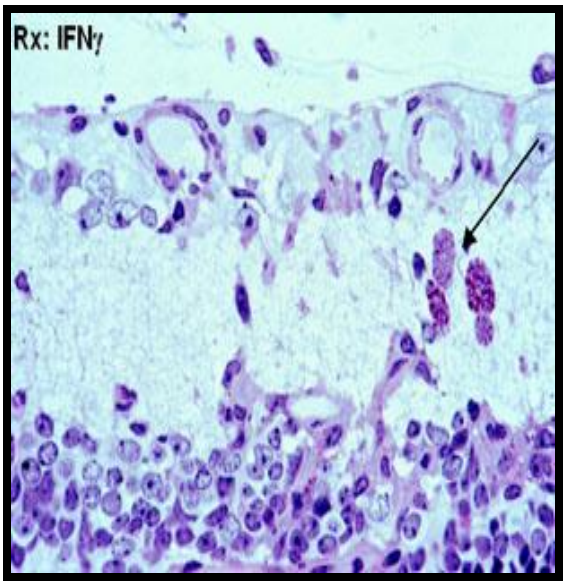
Toxoplasma gondii ~ oocyst



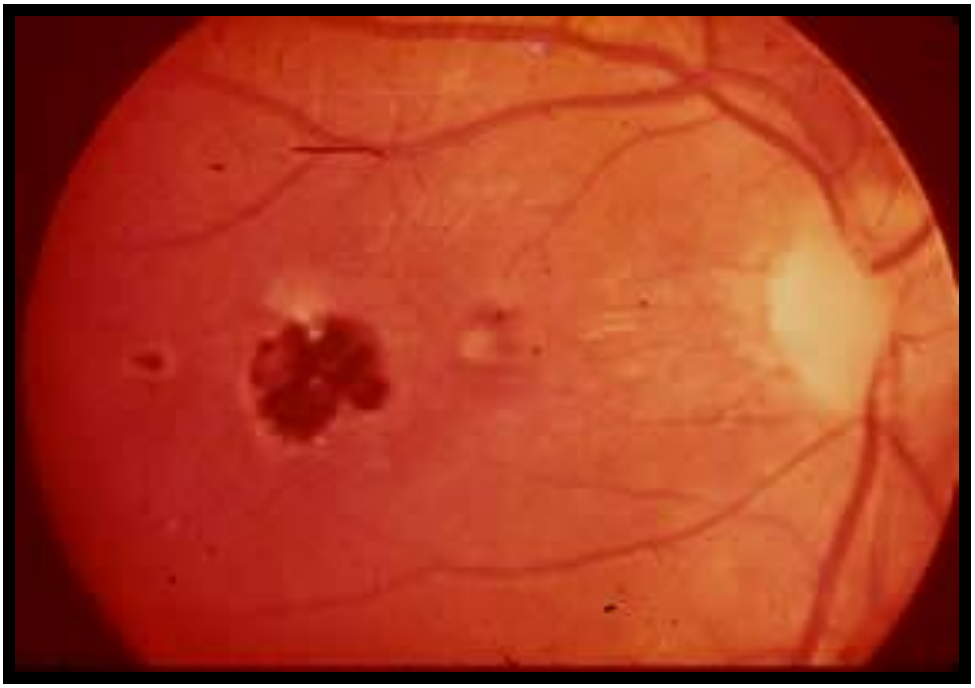
Toxoplasma gondii ~ tachyzoites



Toxoplasma cyst in the retina (arrow).



More cysts in the retina of a mouse (arrow).

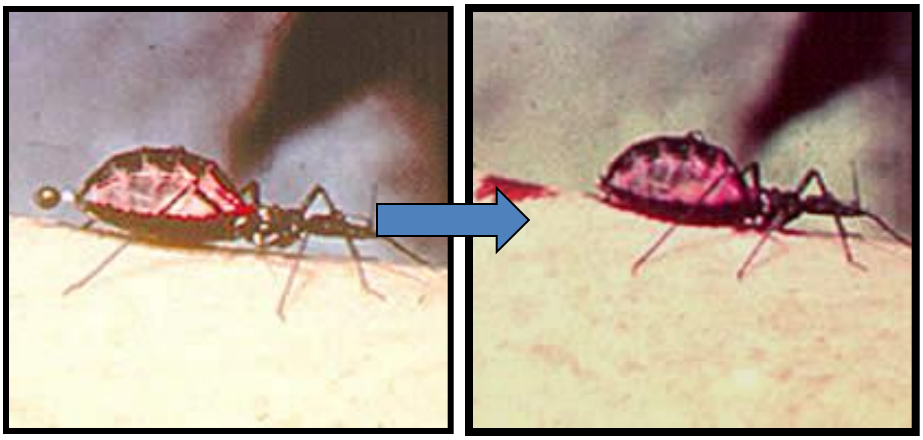


Ocular toxoplasmosis

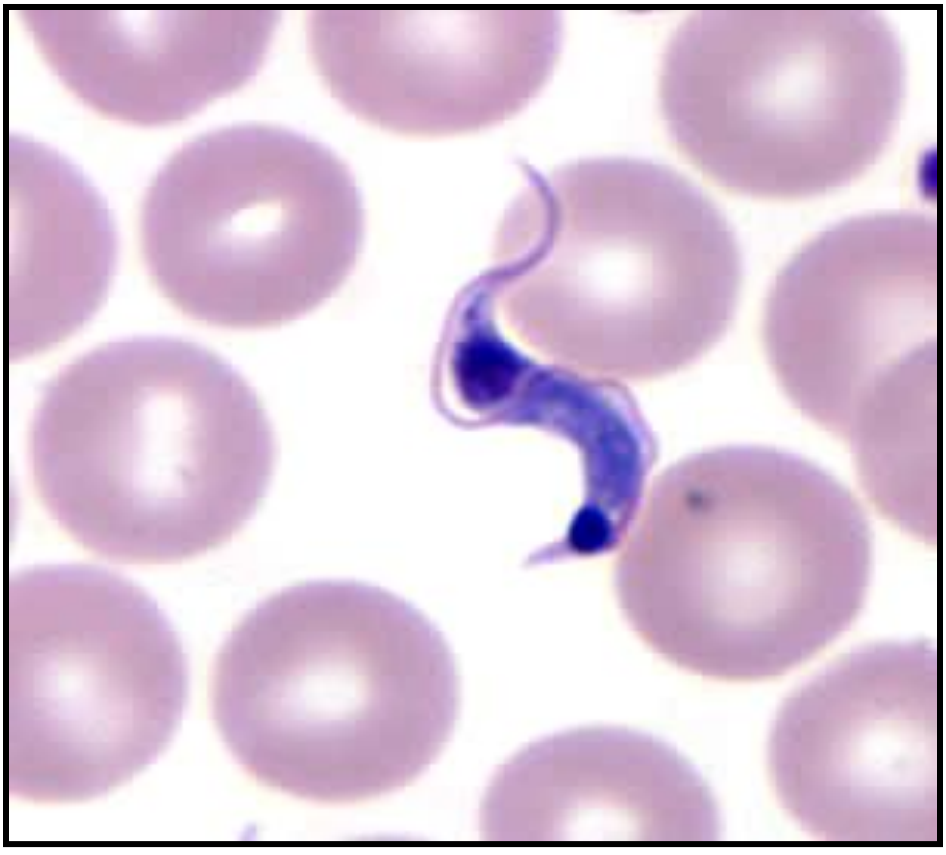
CHAPTER 4

HAEMOFLAGELLATES
(TRYPANOSOMA & LEISHMANIA)

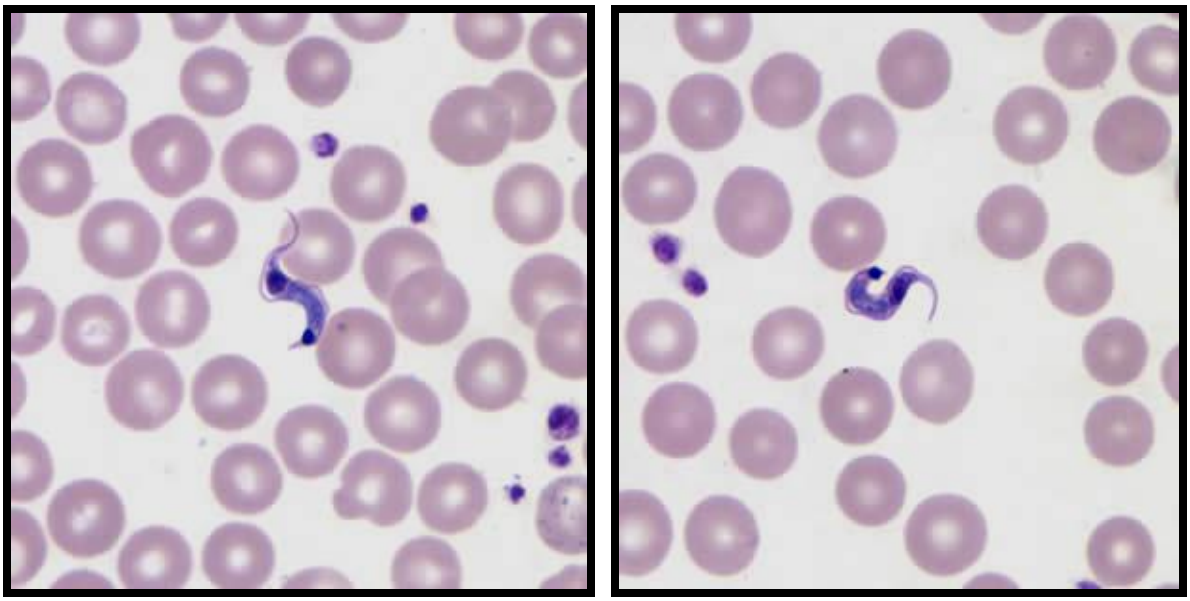
4.1 Trypanosoma cruzi



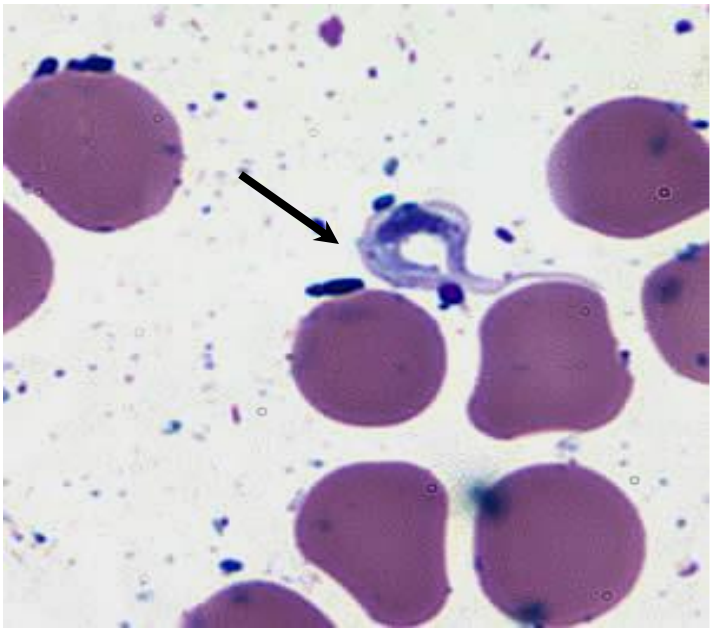
Triatomine bug



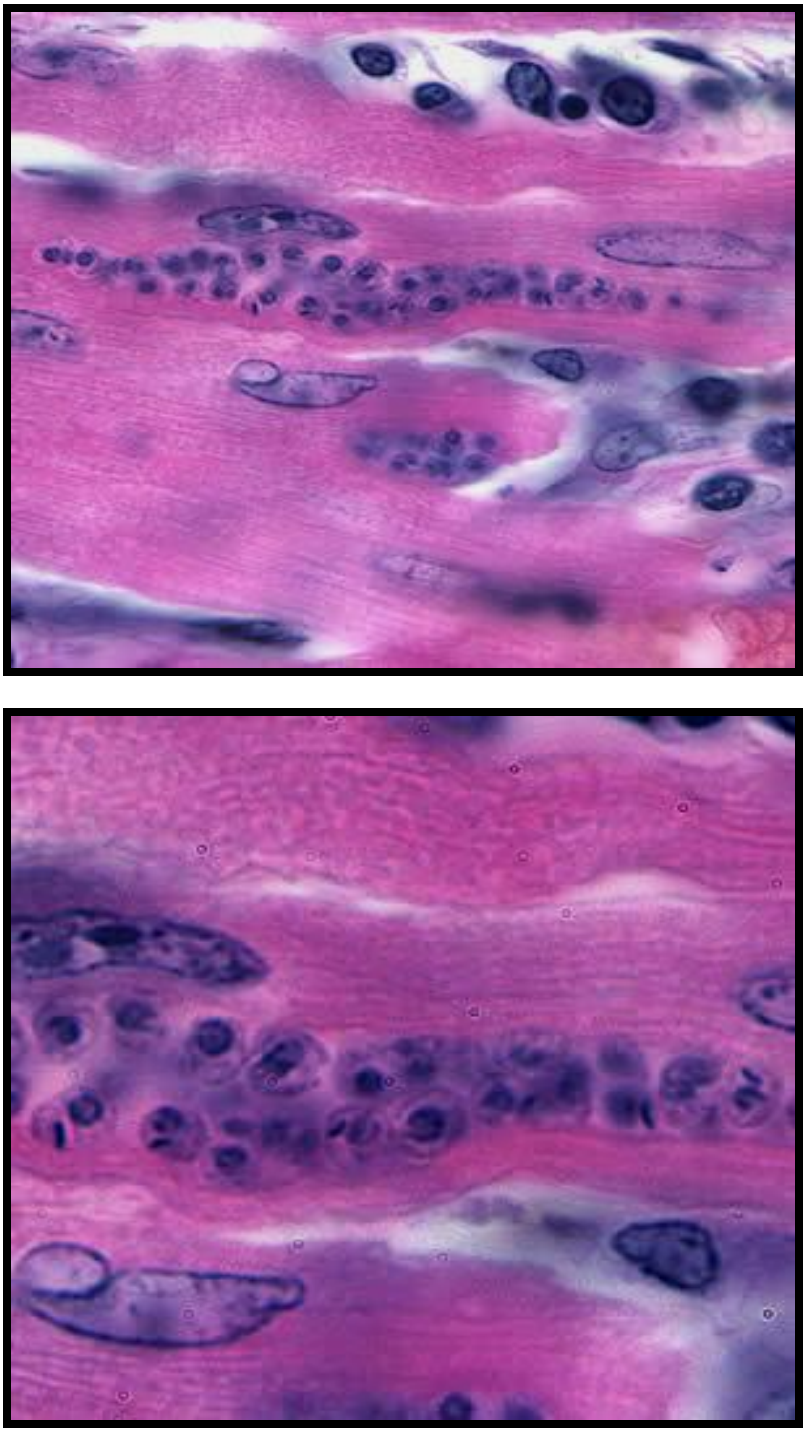
Trypanosoma cruzi in blood film



Trypanosoma cruzi in blood film



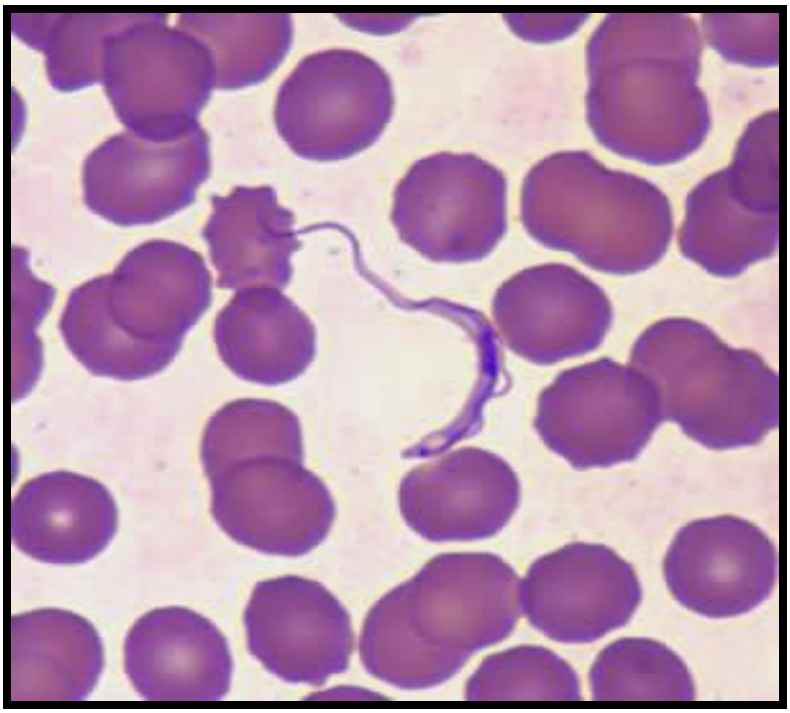
Trypanosoma cruzi in csf.



Amastigotes in heart tissues

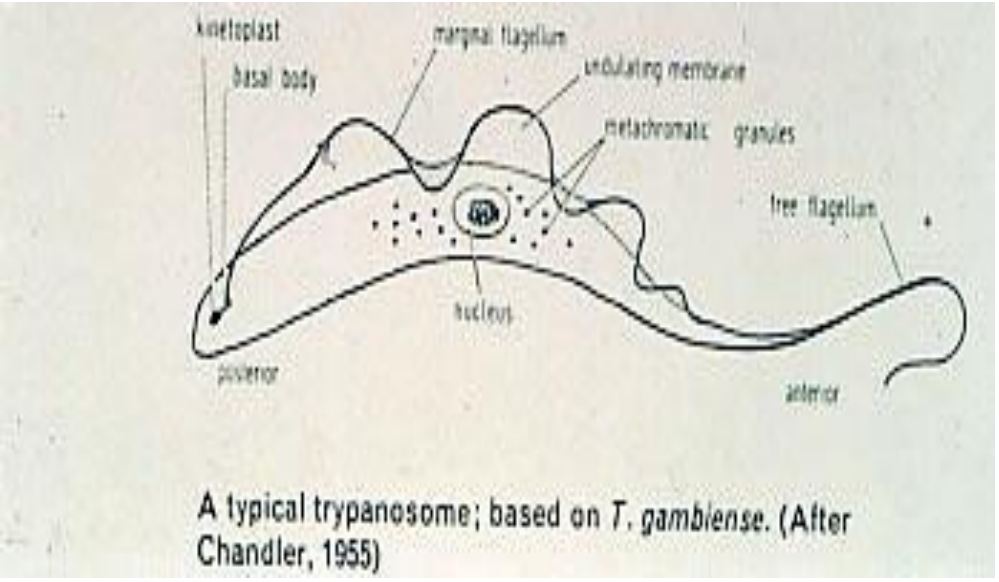
4.2 Trypanosoma brucei

Tsetse fly



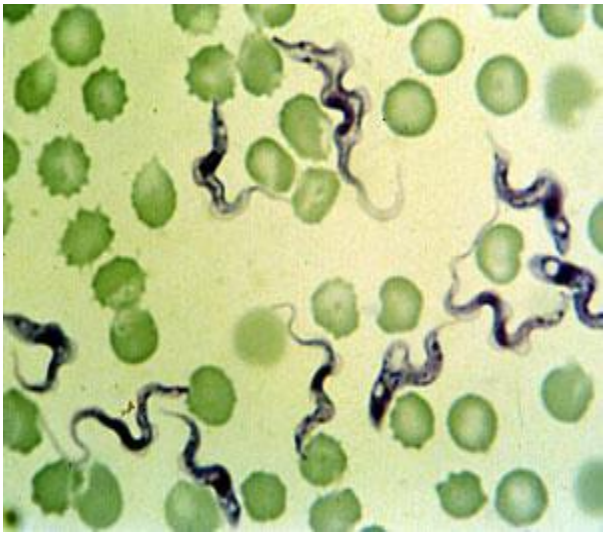
Trypanosoma brucei sp. in thin blood smears stained with Wright-Giemsa

Trypanosoma brucei gambiense



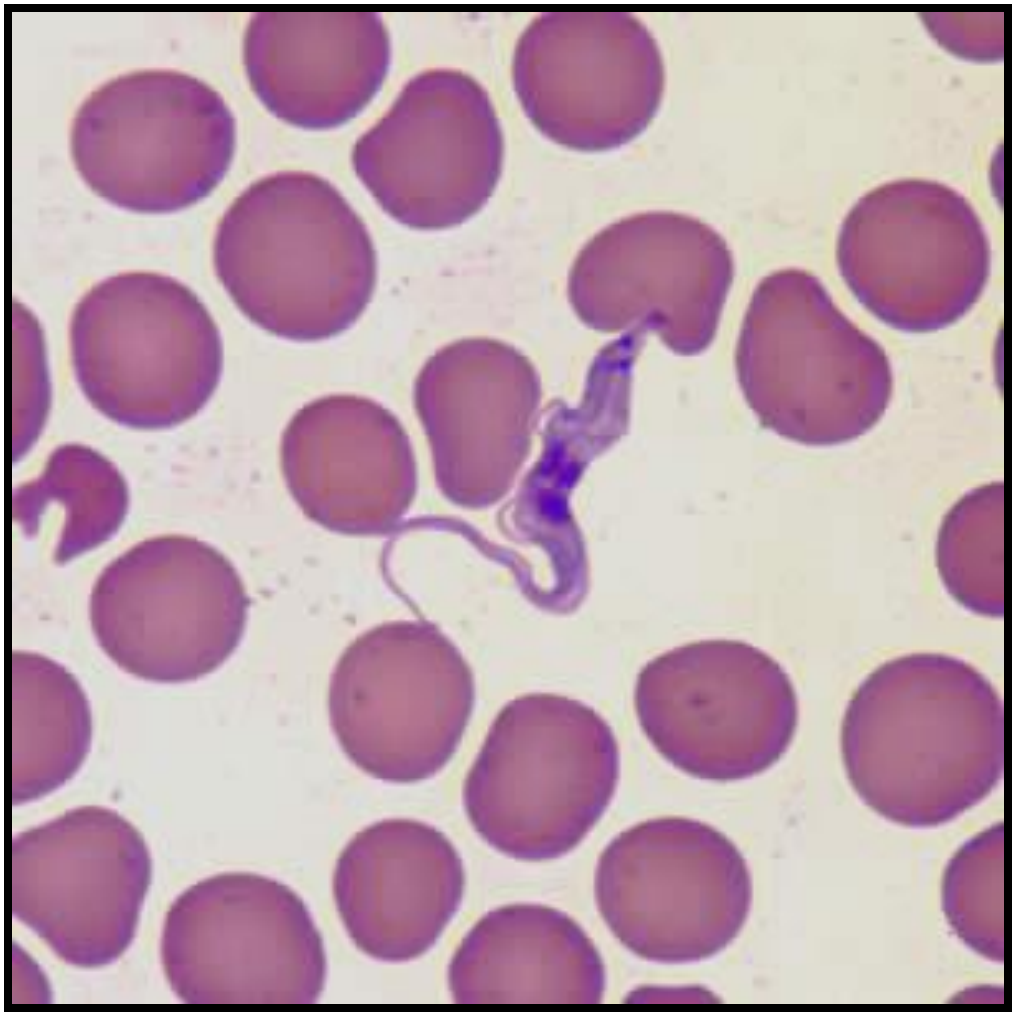
A typical trypanosome; based on *T. gambiense*. (After Chandler, 1955)

Diagram of the trypomastigote form of *Trypanosoma gambiense.*
Note the undulating membrane and the single free flagellum.



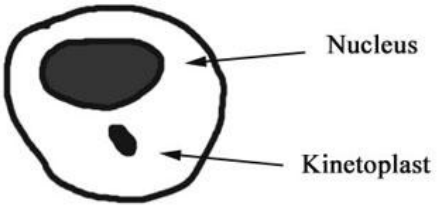
The trypomastigote form of *Trypanosoma gambiense* in a blood smear.

The trypomastigote form of *Trypanosoma equiperdum* in a blood smear.
This parasite causes a venereal disease ("Dourine") in horses and donkeys.

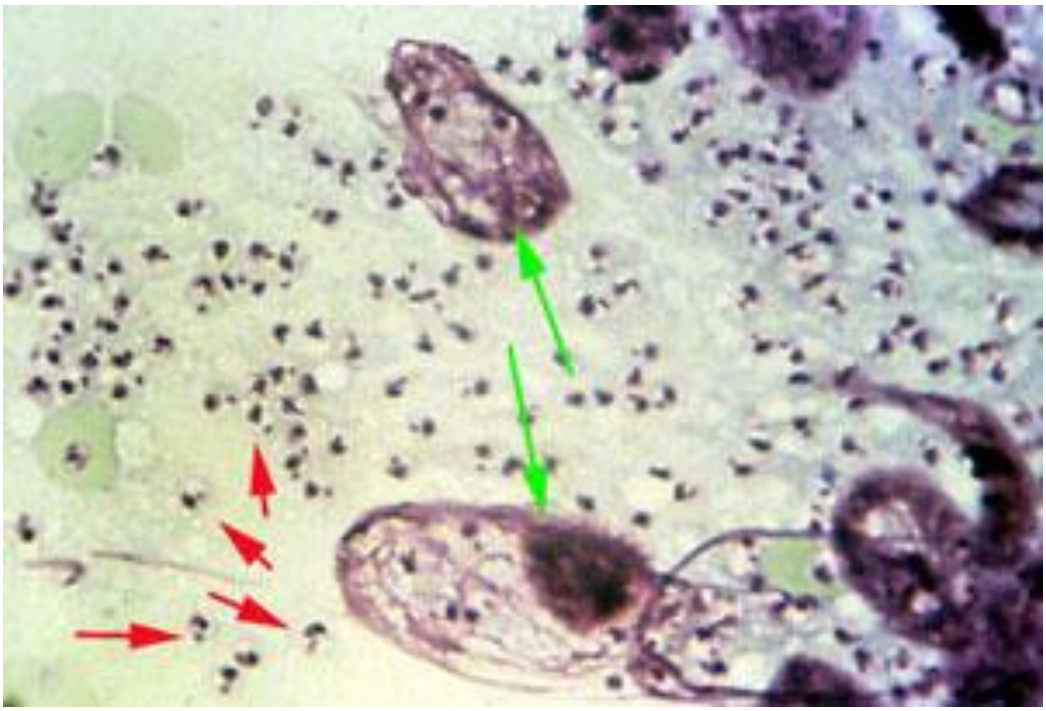


Trypanosoma brucei sp. in a thin blood smear stained with Giemsa. The trypomastigote is beginning to divide; dividing forms are seen in African trypanosomes, but not in American trypanosomes

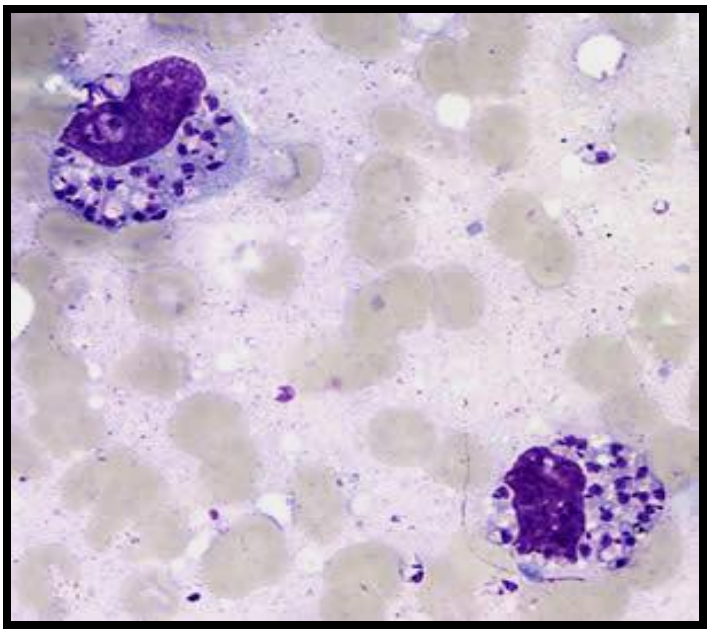
4.3 Leishmania spp.



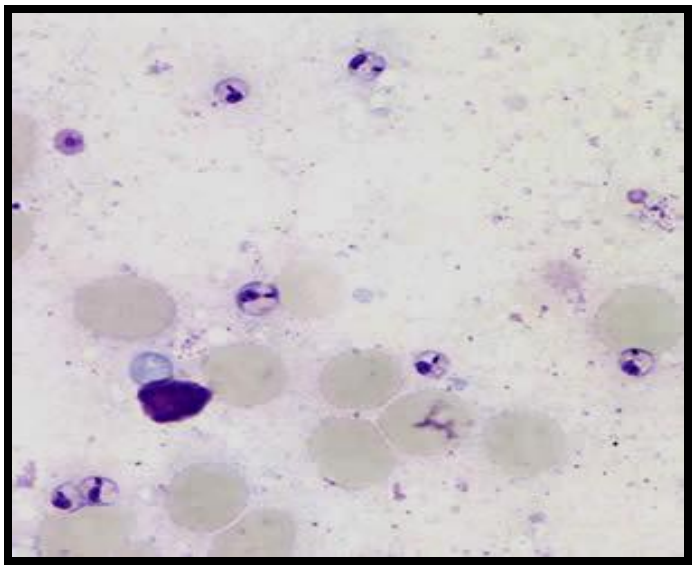
Drawing of a L. donovani amastigote



L. donovani tissue smear of the spleen of an infected rodent. The red arrows point to some of the amastigotes which have broken out of the splenic macrophages when the smear was made. The green arrows point to the remains of the nuclei of the host macrophages. Note the kinetoplast and nucleus within each amastigote.

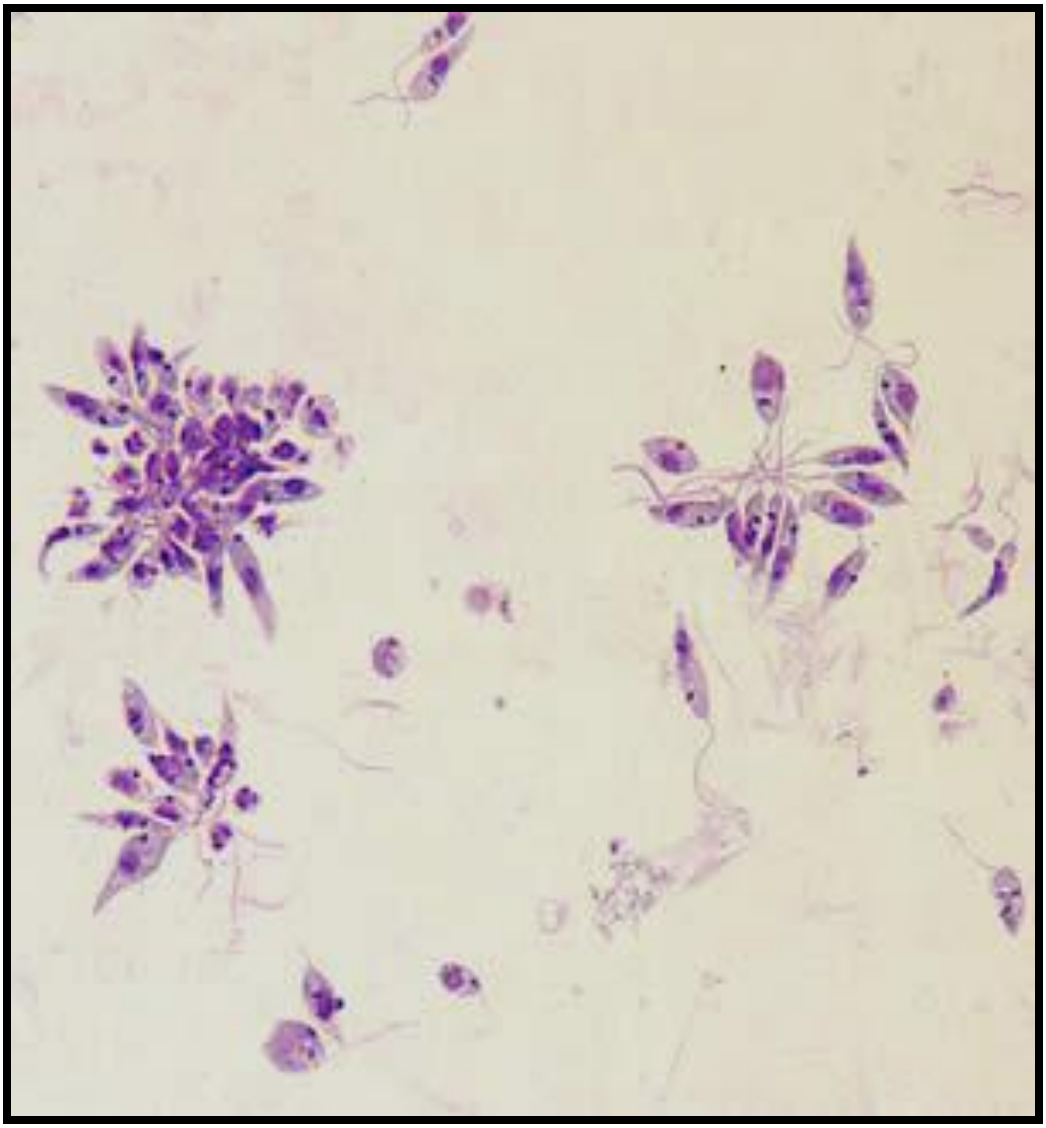


BEFORE
(an intact macrophage is practically filled with amastigotes)



AFTER
(amastigotes are being freed from a rupturing macrophage)

Leishmania spp. amastigotes; touch-prep stained with Giemsa

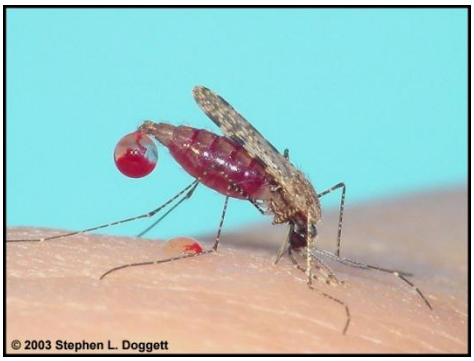


Leishmania spp. promastigotes from culture

CHAPTER 5

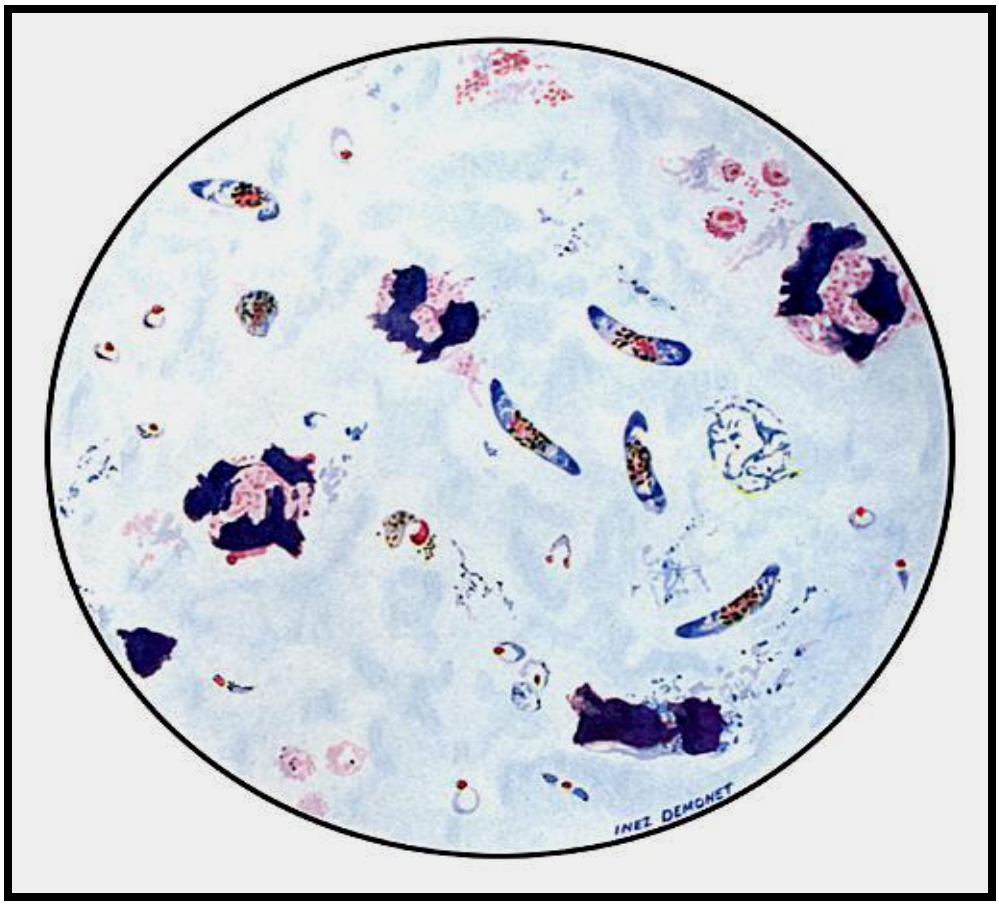
MALARIA

5.1 *Plasmodium falciparum*



Anopheles annulipes

The female *Anopheles annulipes* feeding. The clear droplet is excreted soon after the initiation of blood feeding, to maximise blood intake.



Thick blood smear

THIN BLOOD SMEARS

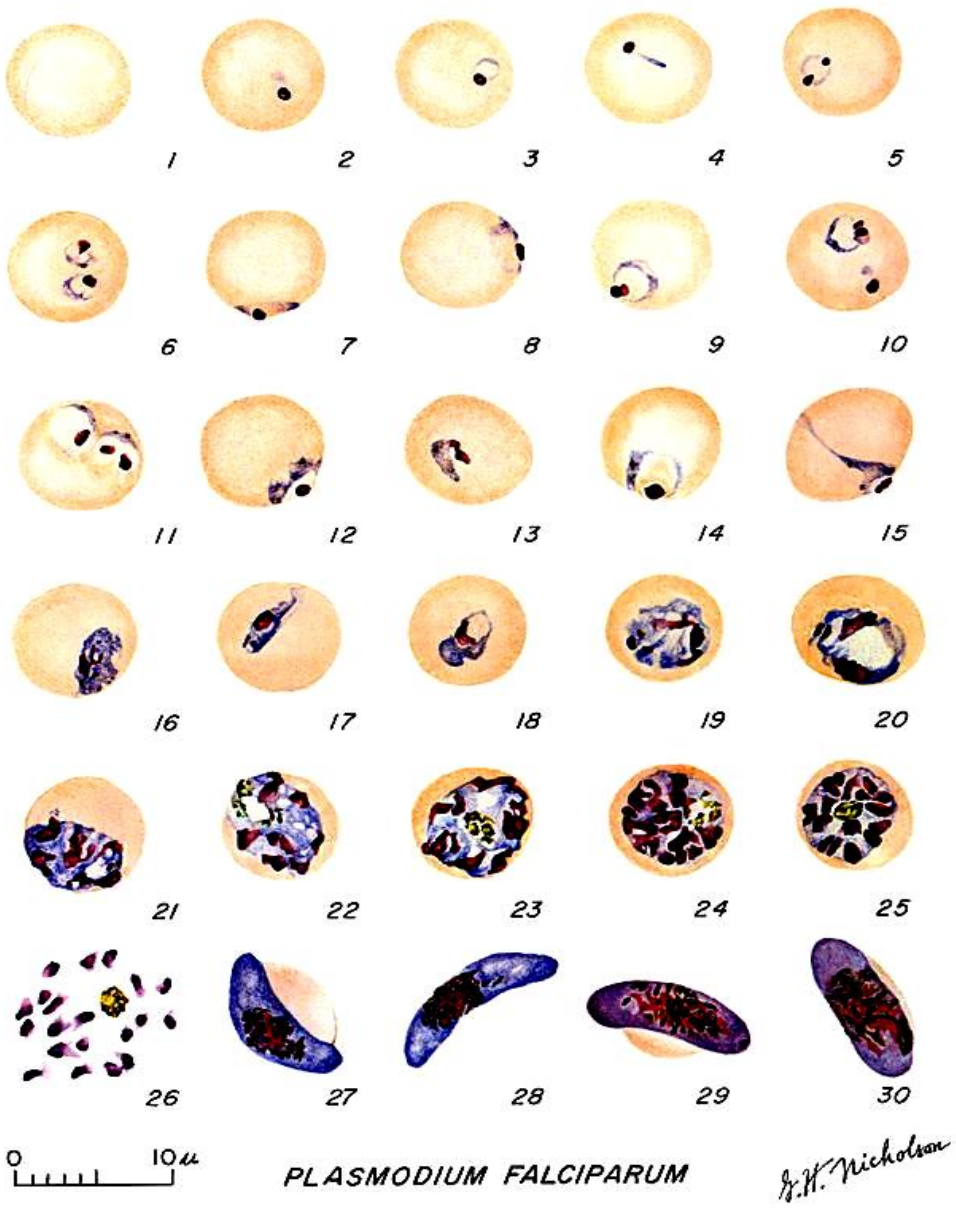


Fig. 1: Normal red cell

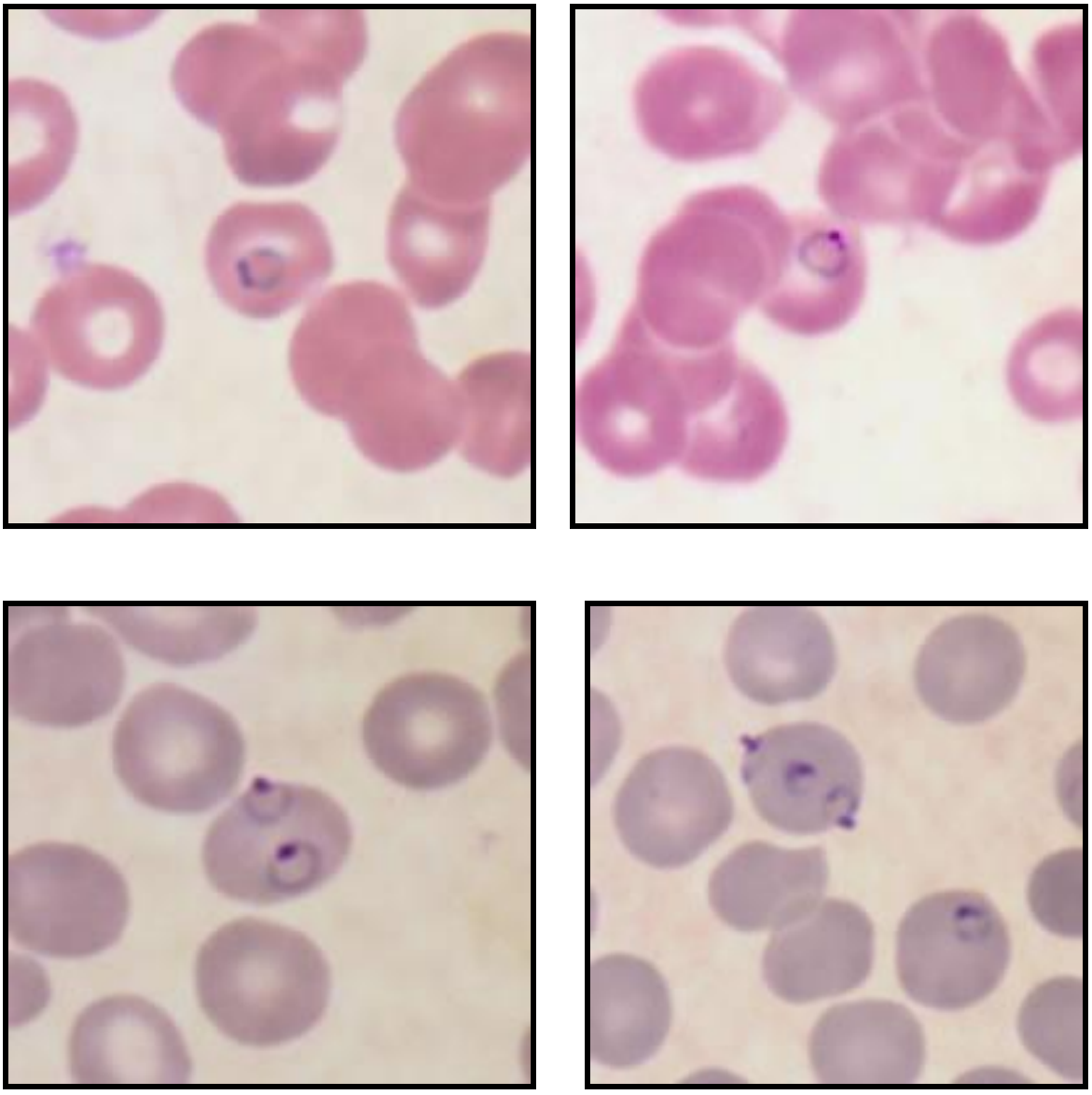
Figs. 2-**18:** Trophozoites (among these,

Figs. 2-**10** correspond to ring-stage trophozoites);

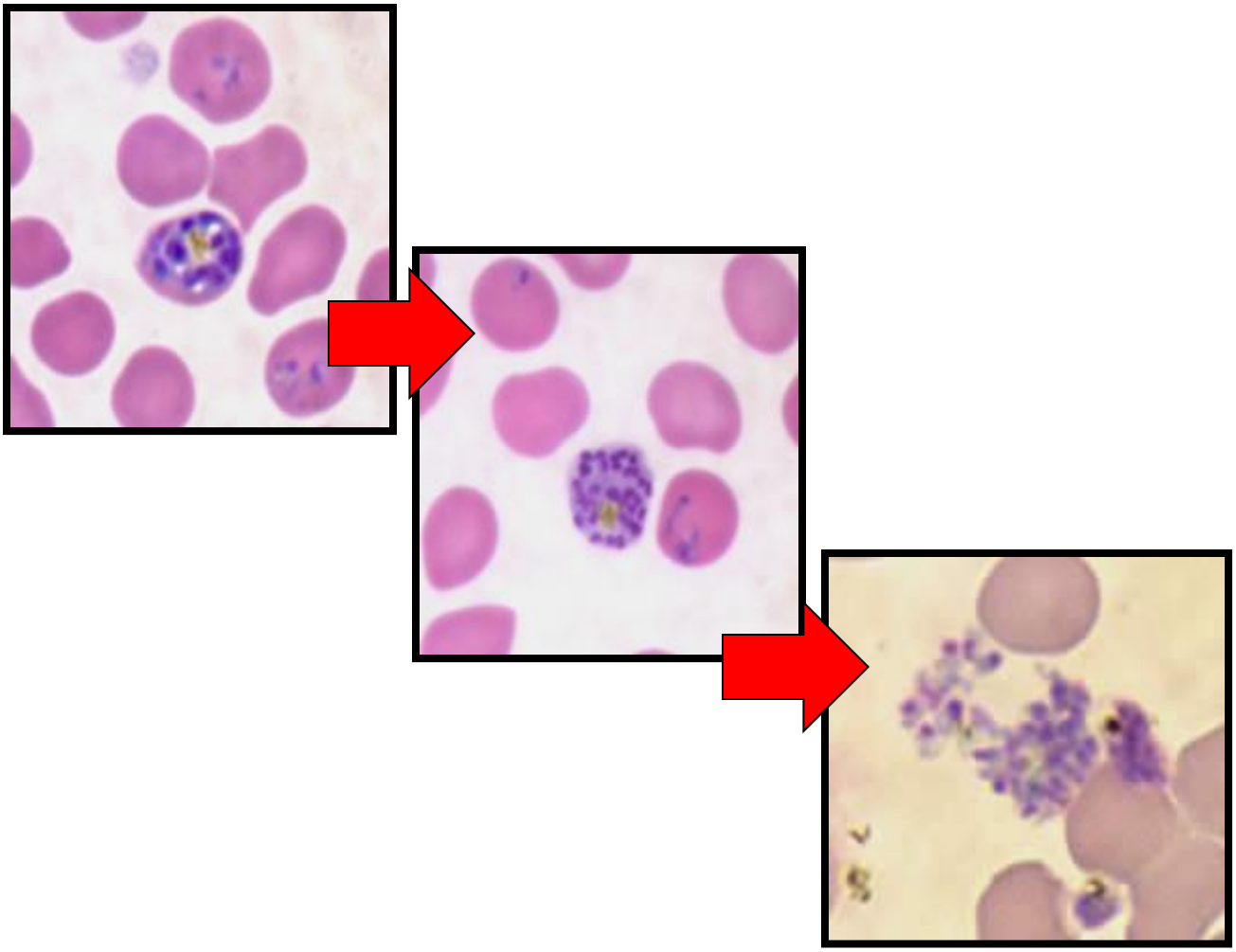
Figs. 19-**26:** Schizonts (**Fig. 26** is a ruptured schizont);

Figs. 27, **28:** Mature macrogametocytes (female);

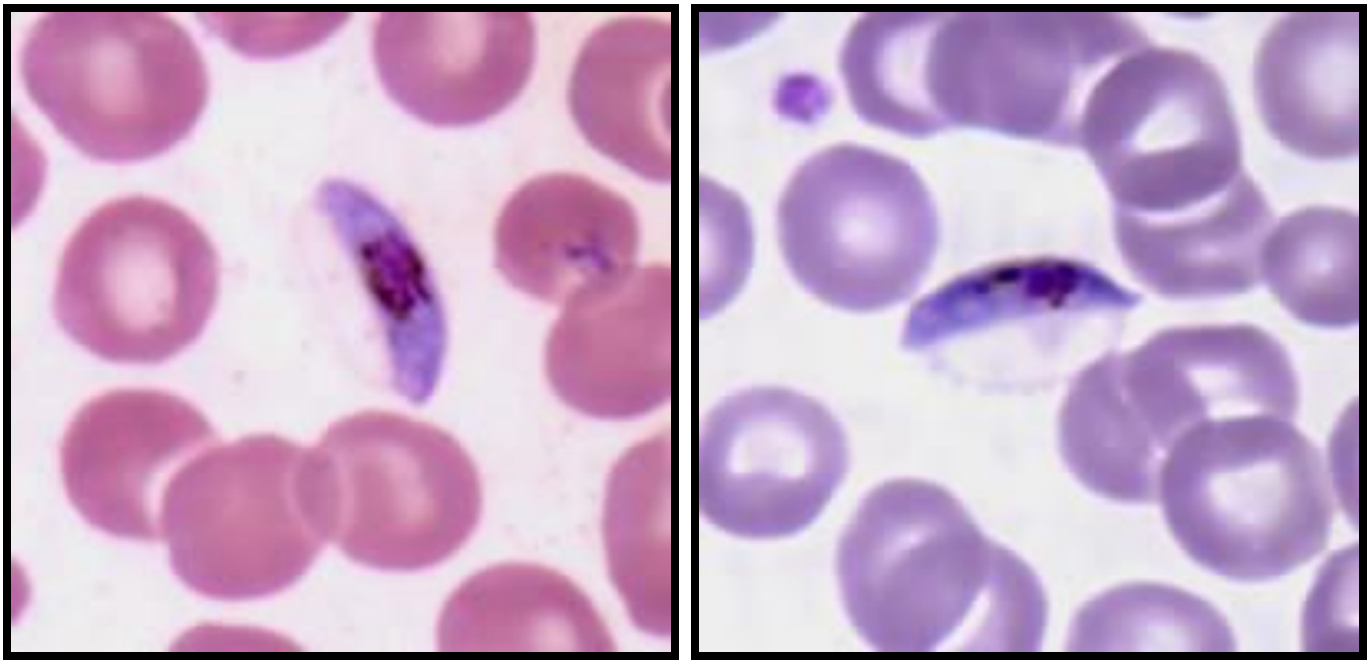
Figs. 29, **30:** Mature microgametocytes (male).



P.falciparum
(trophozoites – ring stages)



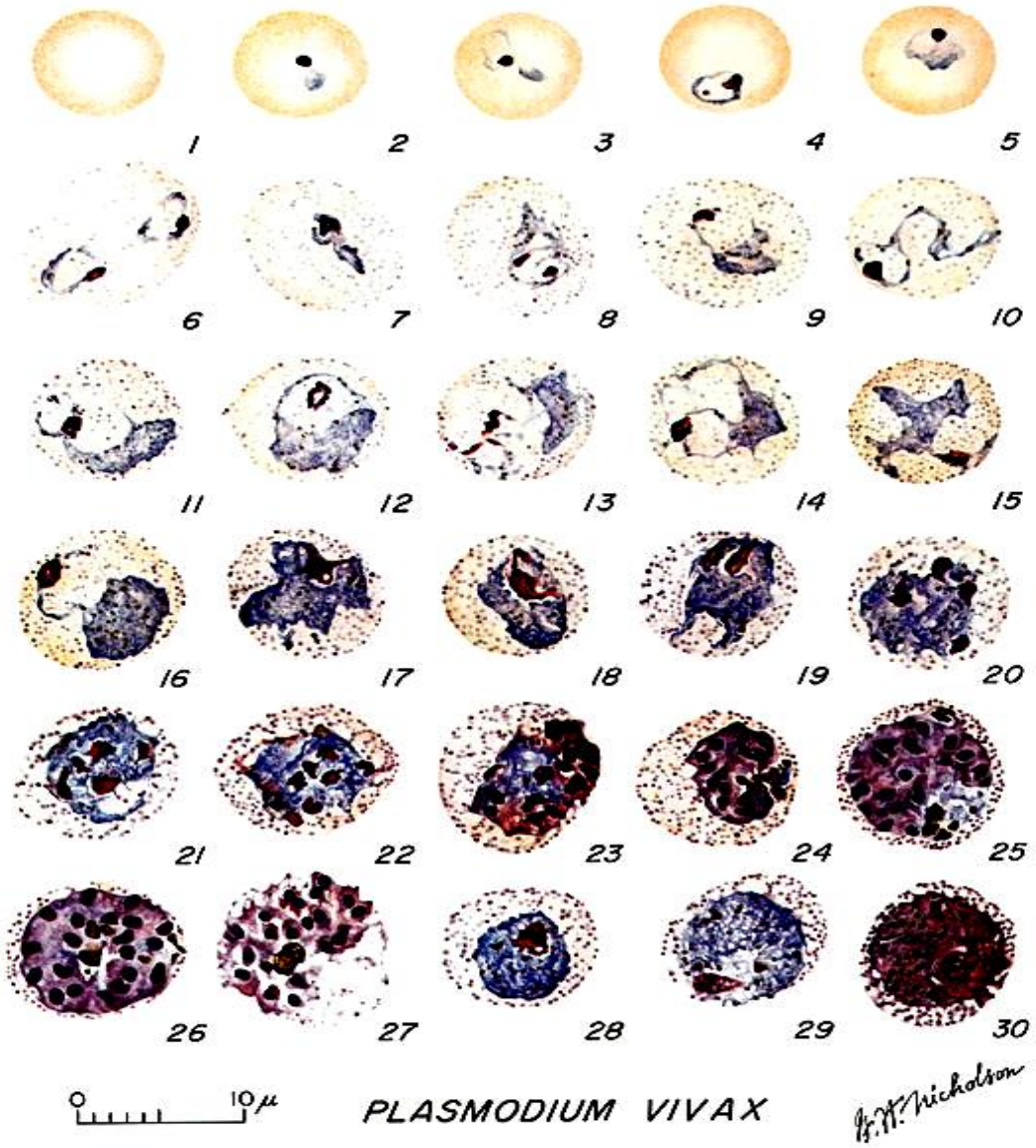
P.falciparum
(schizonts – ring stages)



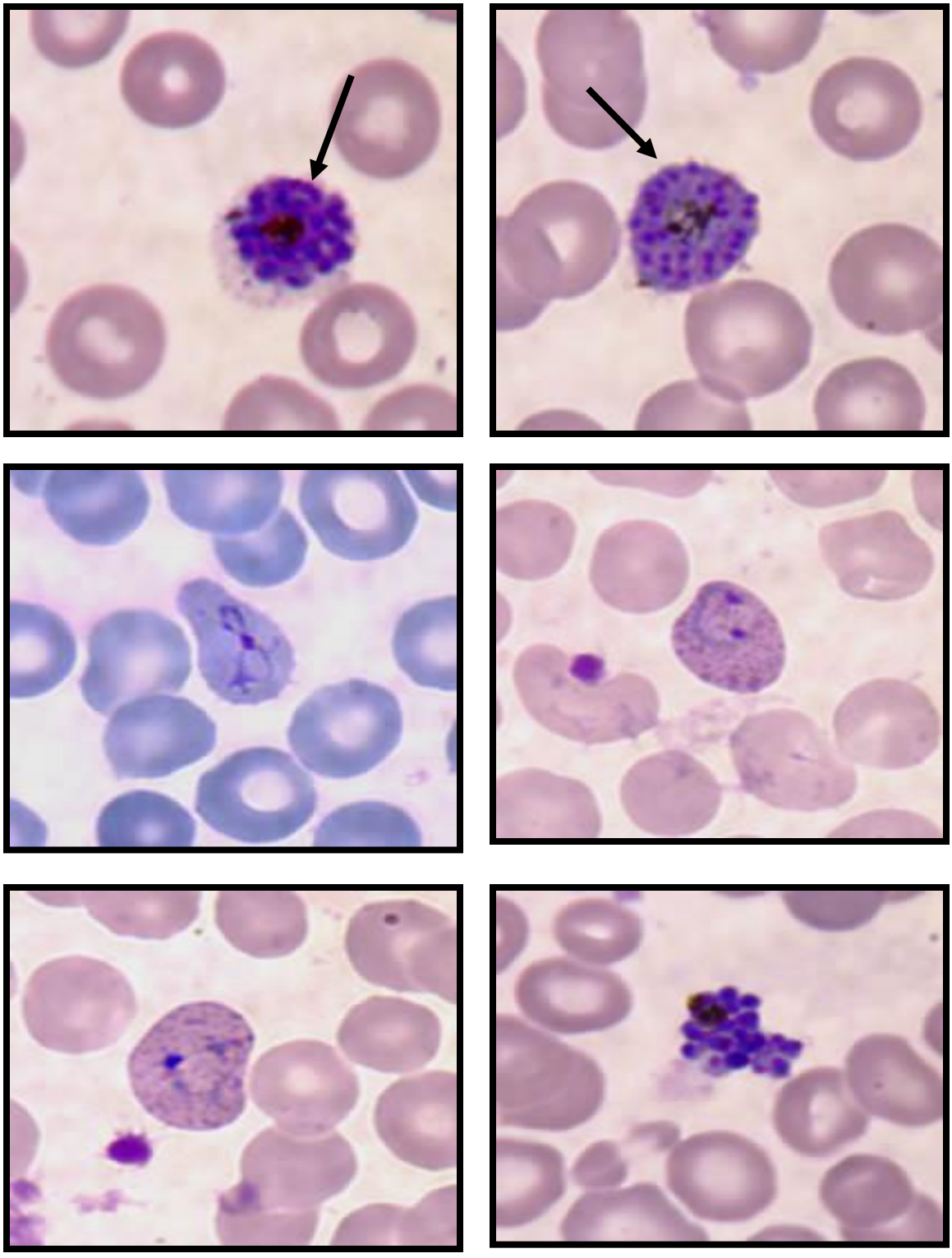
Plasmodium falciparum (gametocyte)

5.2 Plasmodium vivax

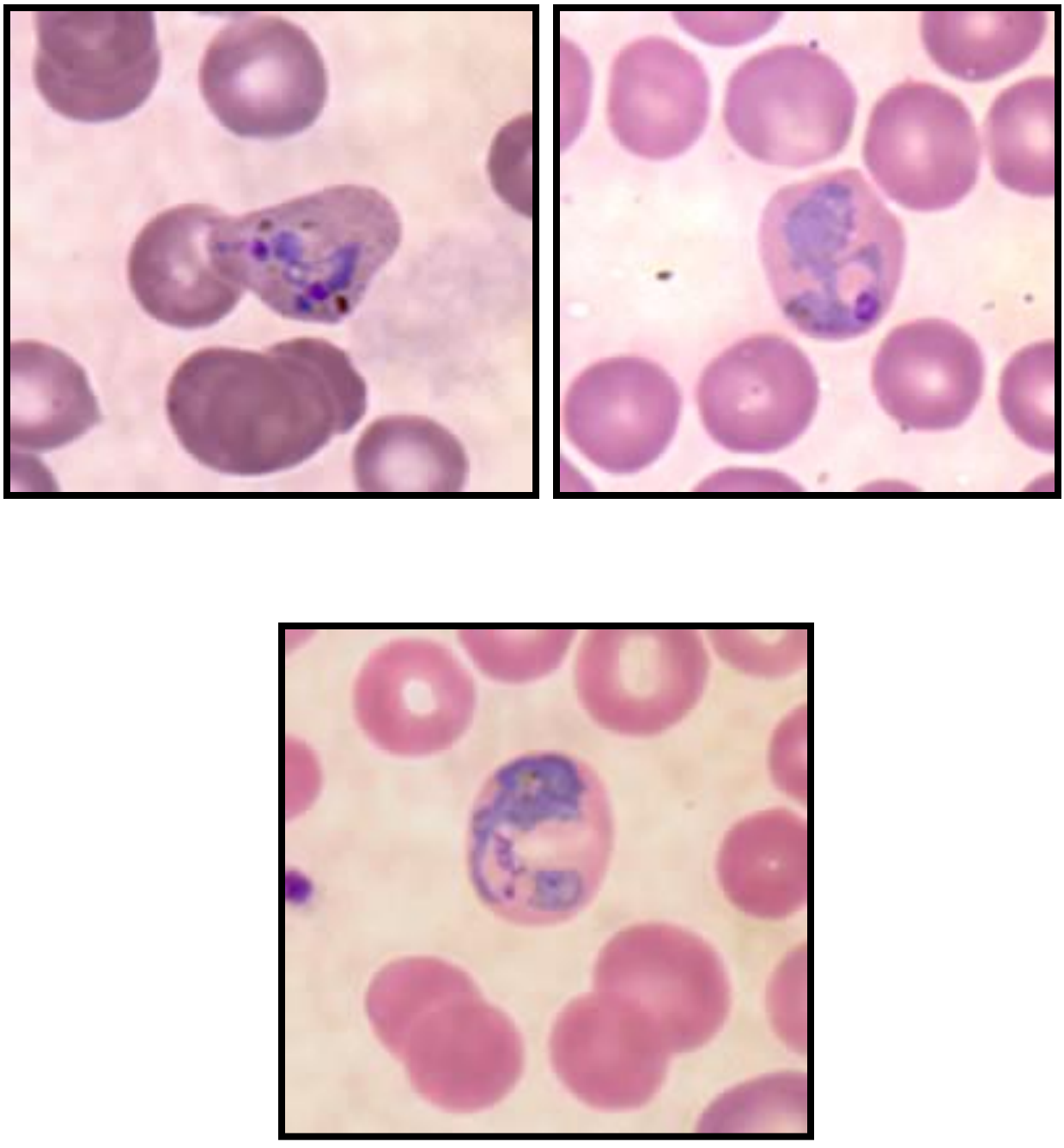
Thin Blood Smears



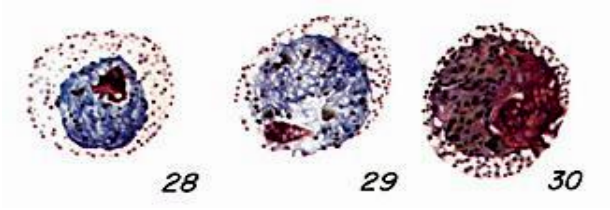
- **Fig. 1:** Normal red cell
- **Figs. 2**-6**:** Young trophozoites (rings)
- **Figs. 7**-**15:** Trophozoites
- **Figs. 16**-**25:** Schizonts
- **Fig. 26-28:** Developing gametocyte
- **Fig. 29:** Microgametocyte (Male)
- **Fig.30:** Macrogametocyte (female).

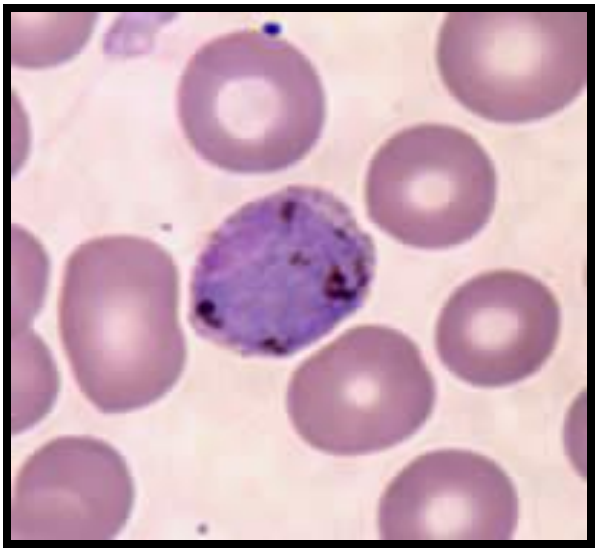


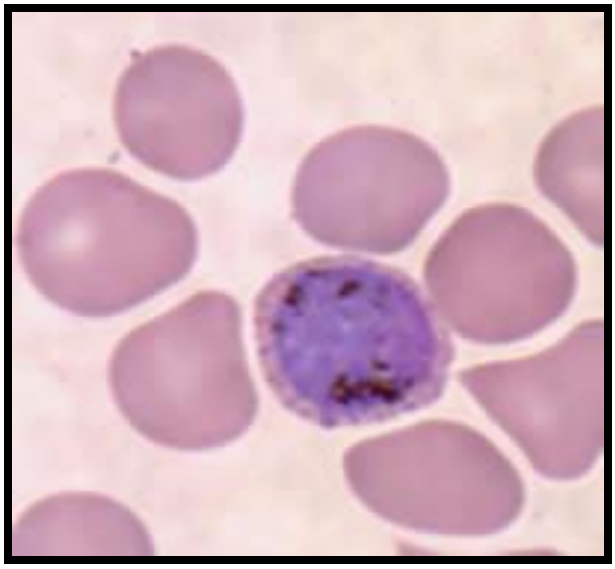
P.vivax (schizonts)

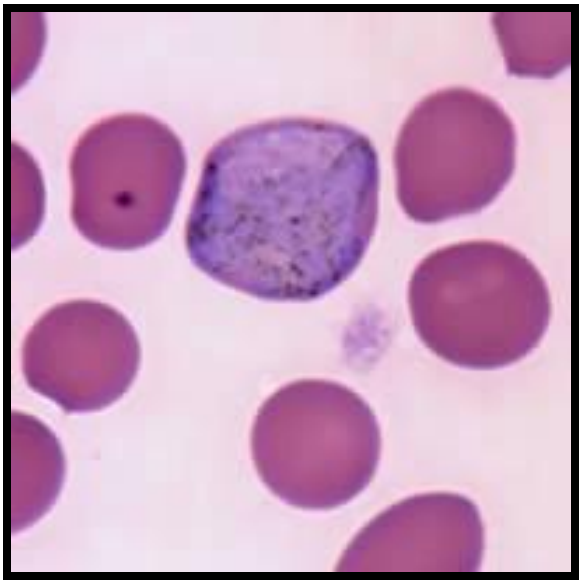


***P.vivax* (trophozoites)**



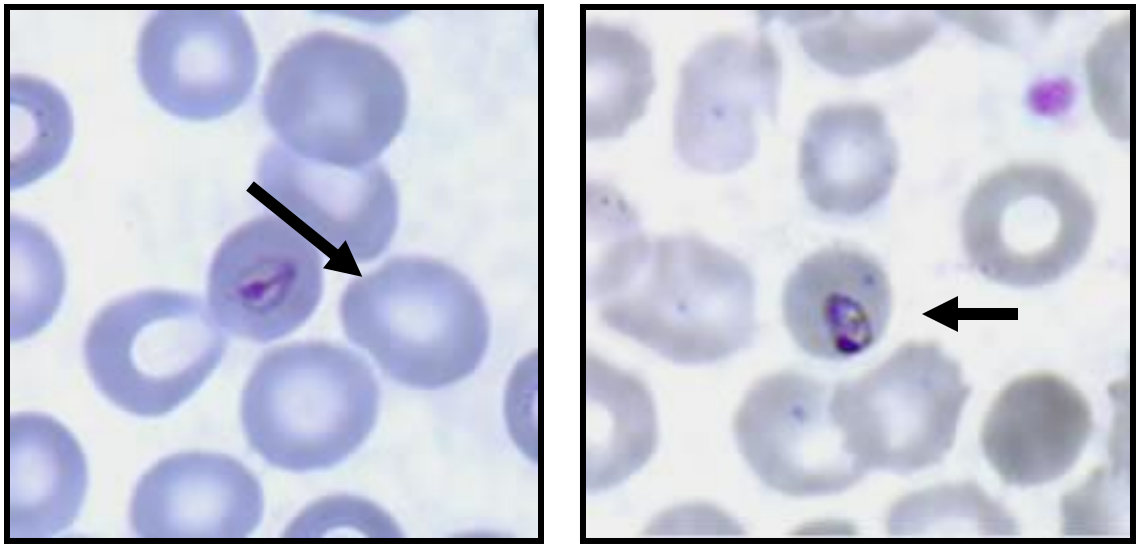




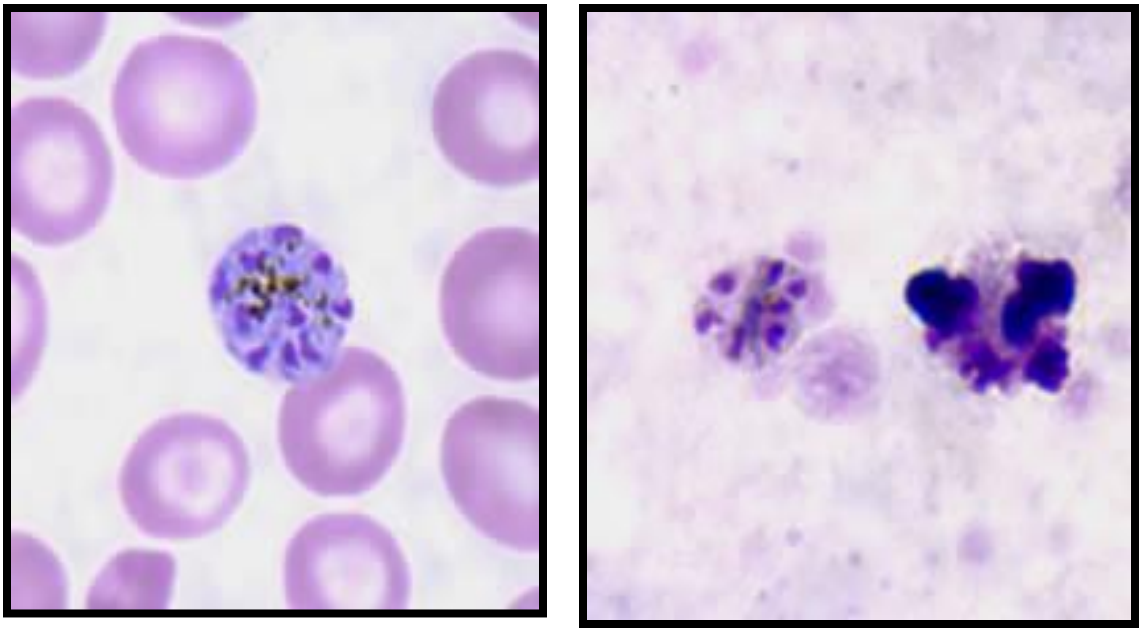


***P.vivax* (gametocytes)**

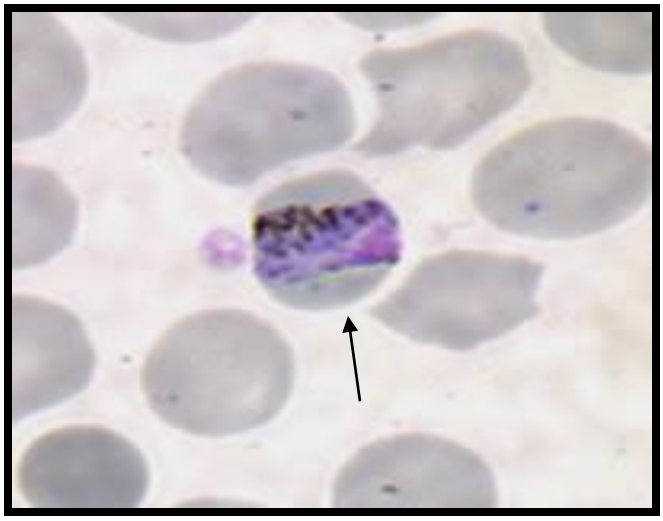
5.3 Plasmodium malariae

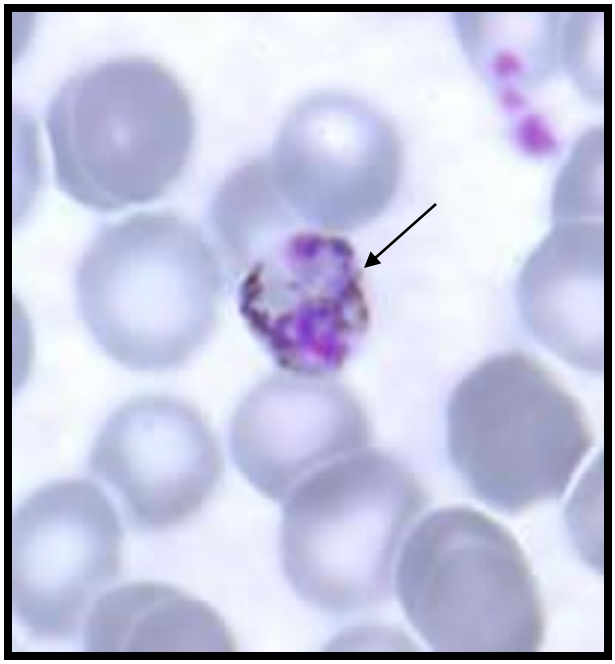


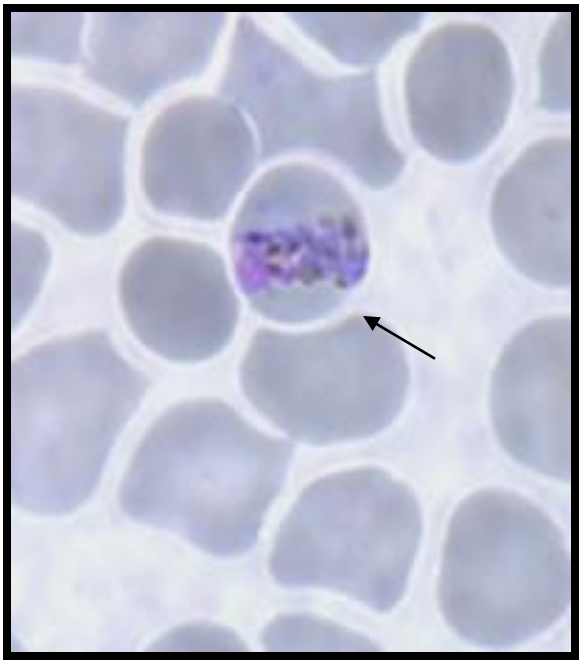
P.malariae (schizonts - ring stage)



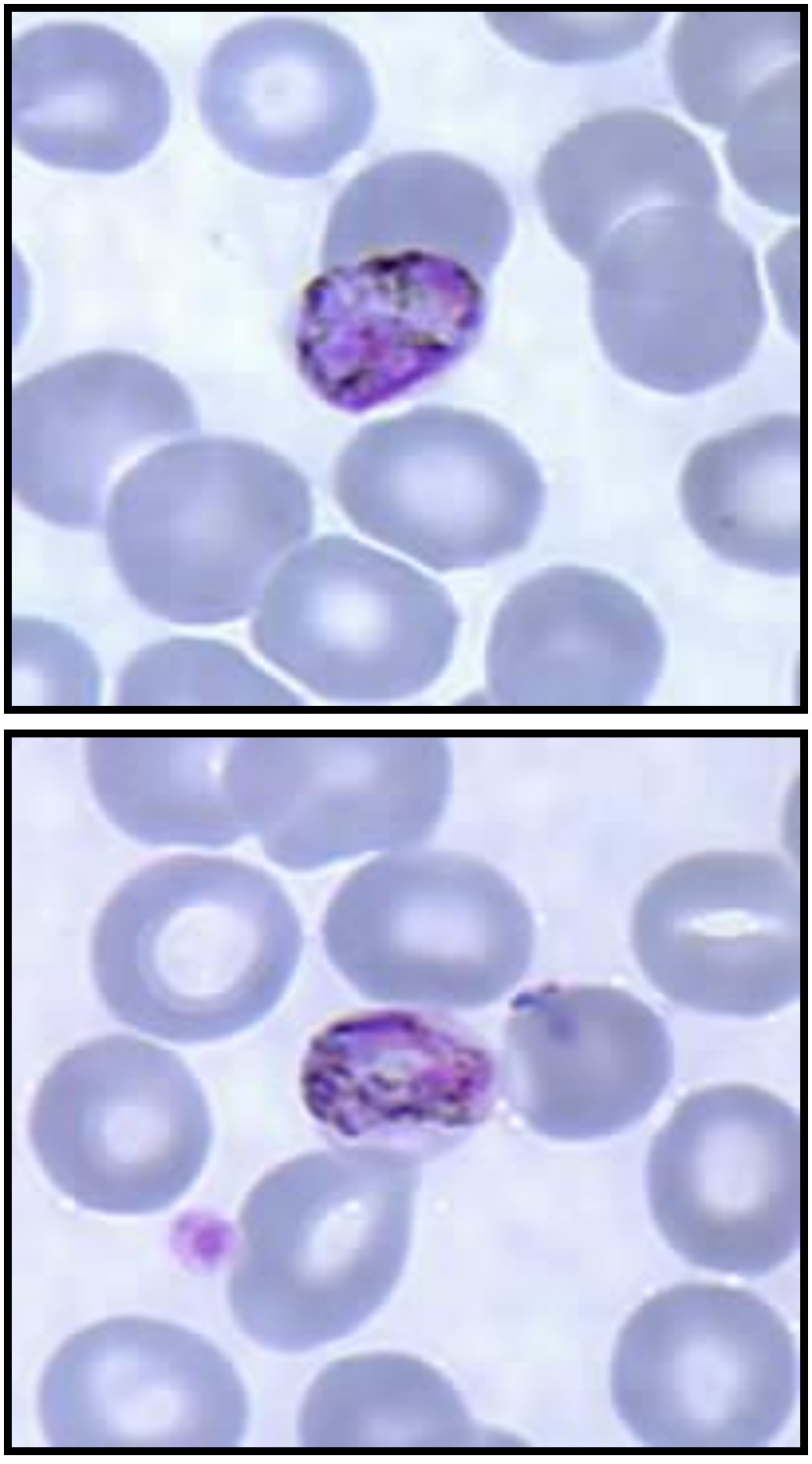
P.malariae (Schizonts)





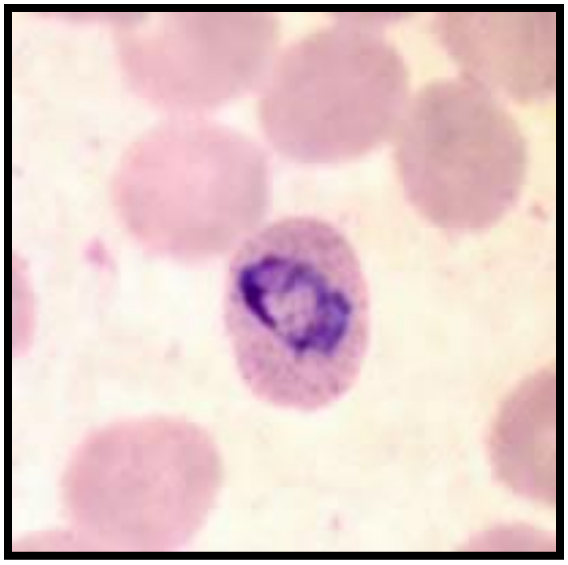


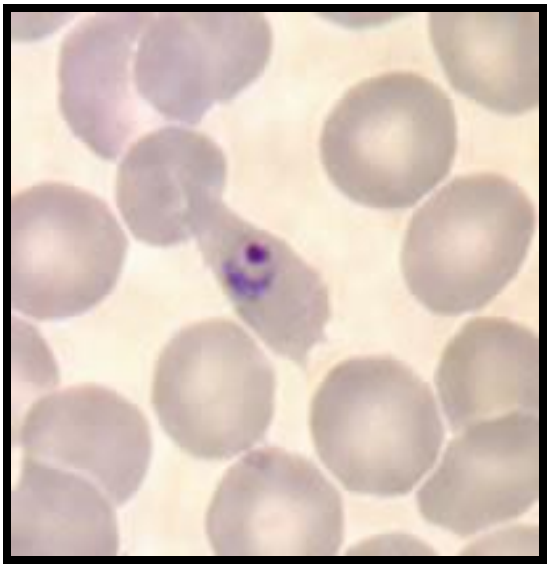
P.malariae (Trophozoites)



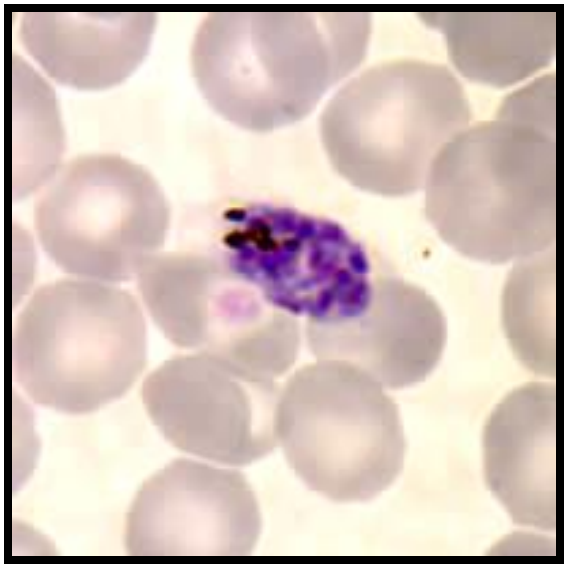
P.malariae (Gametocytes)

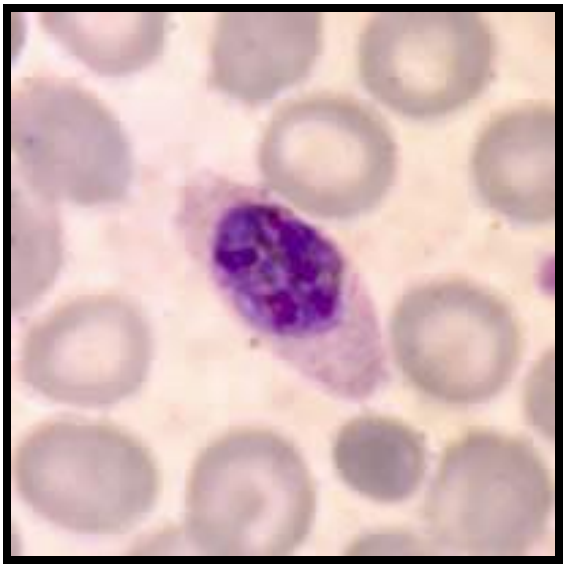
5.4 Plasmodium ovale



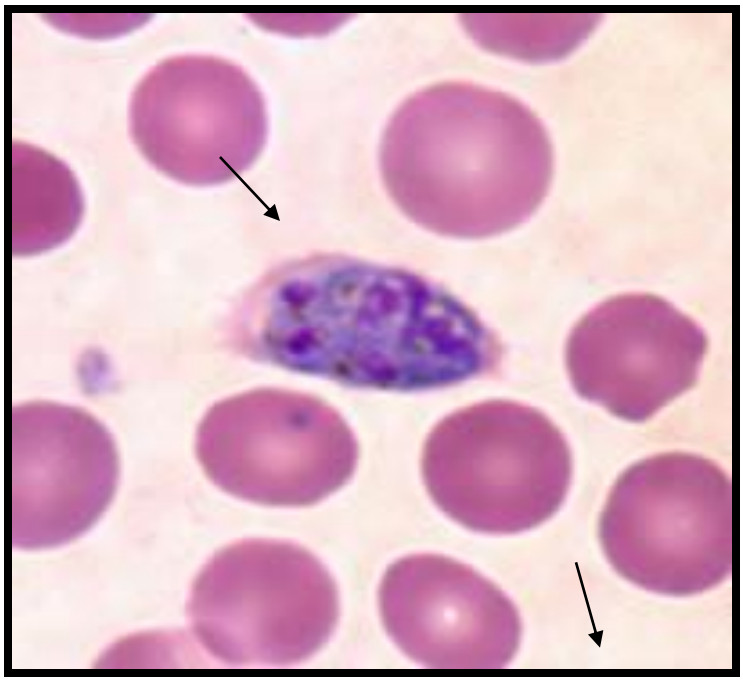


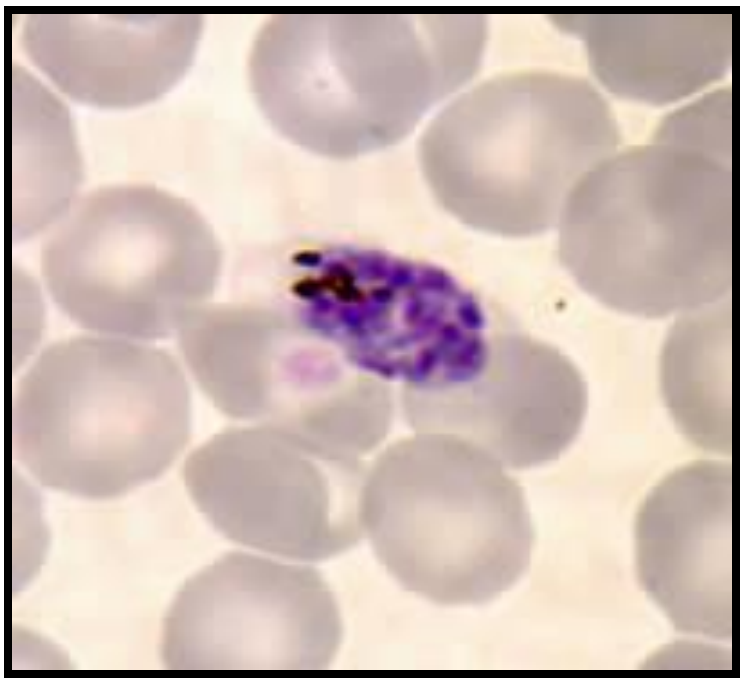
P.ovale (Schizonts – ring stage)



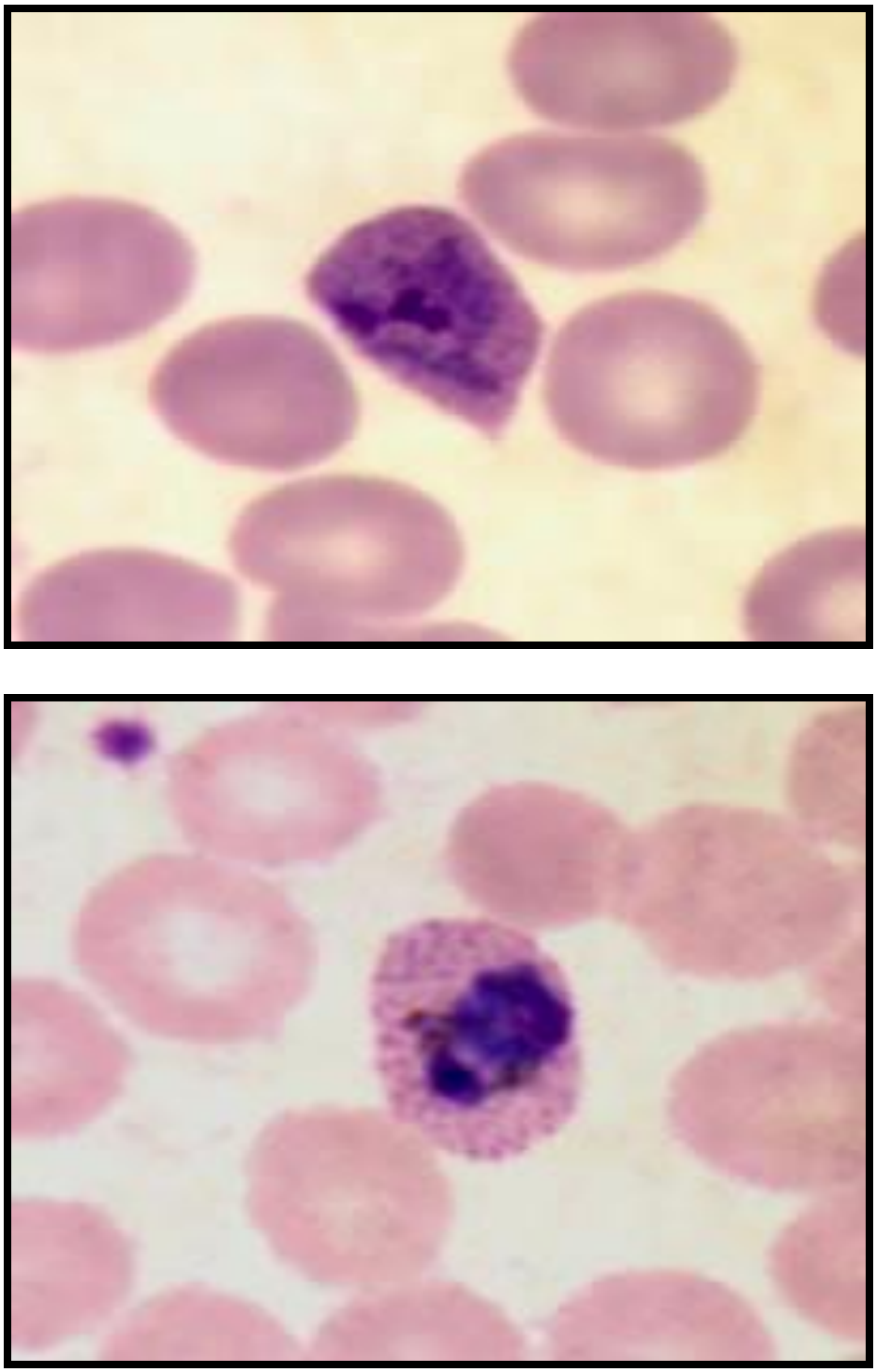


P.ovale (Schizonts)

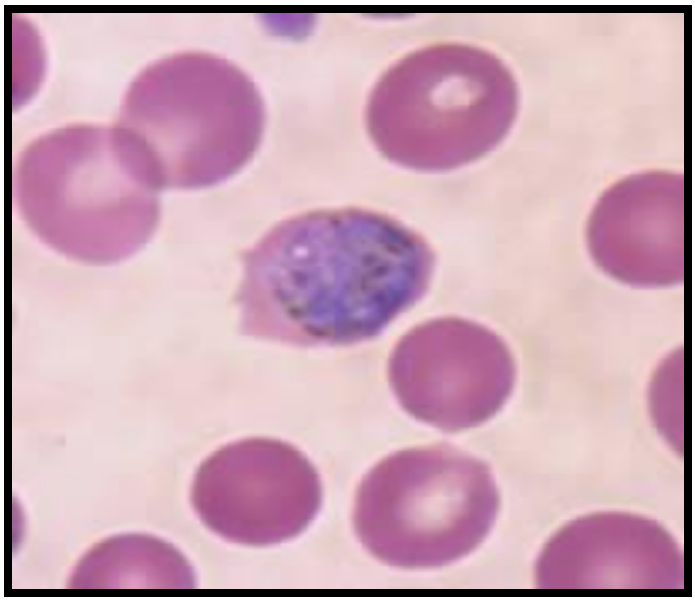


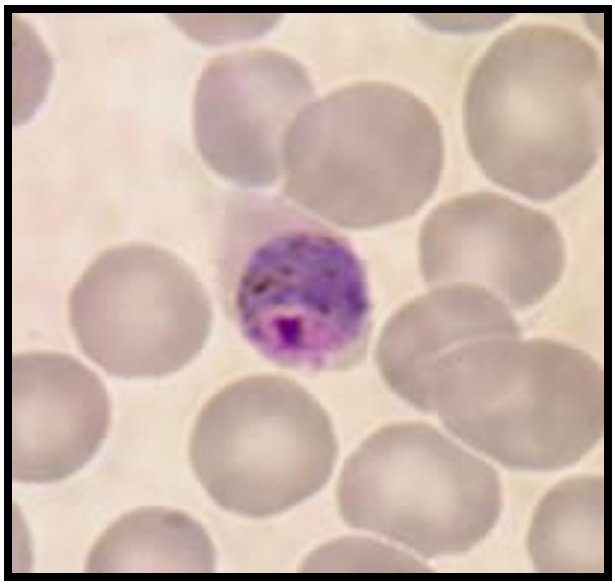


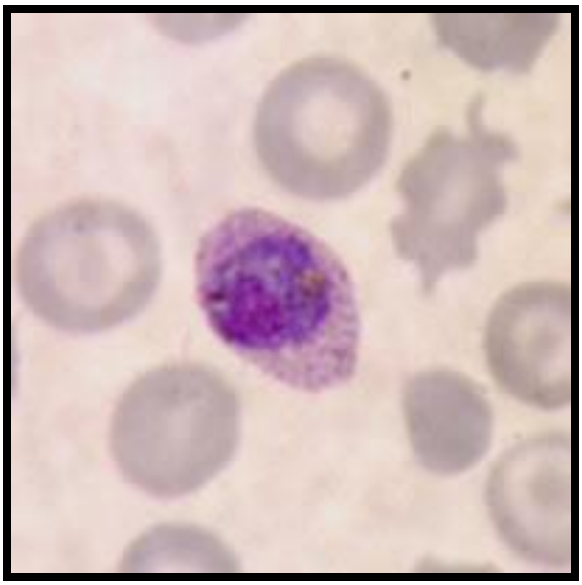
P.ovale (Schizonts)



P.ovale (trophozoites)





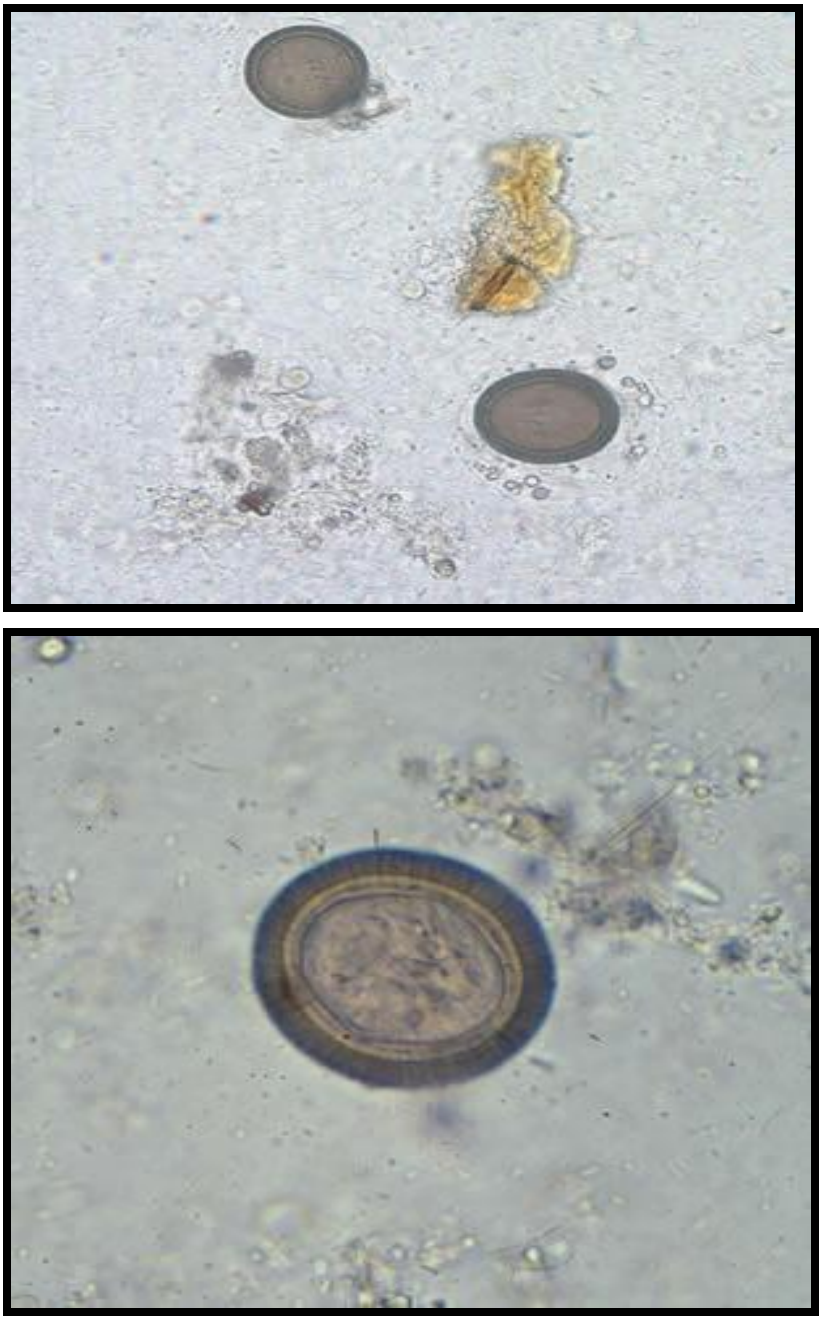


P.ovale (gametocytes)

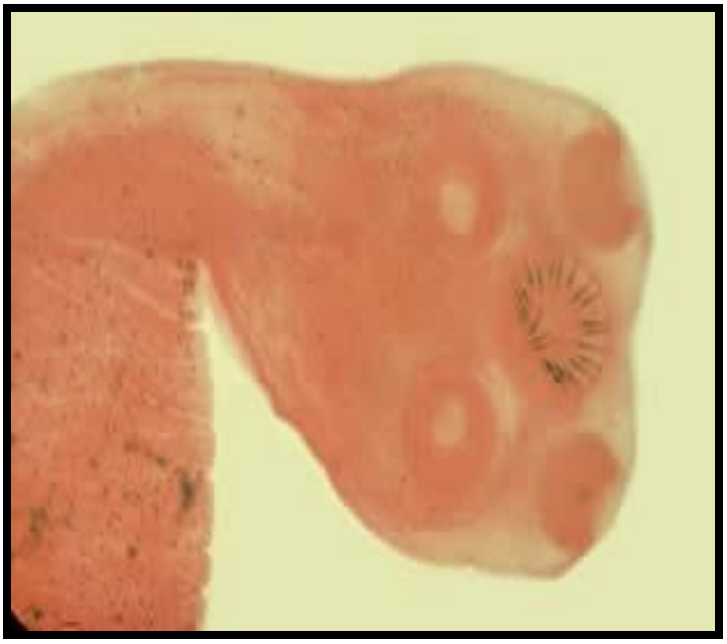
CHAPTER 6

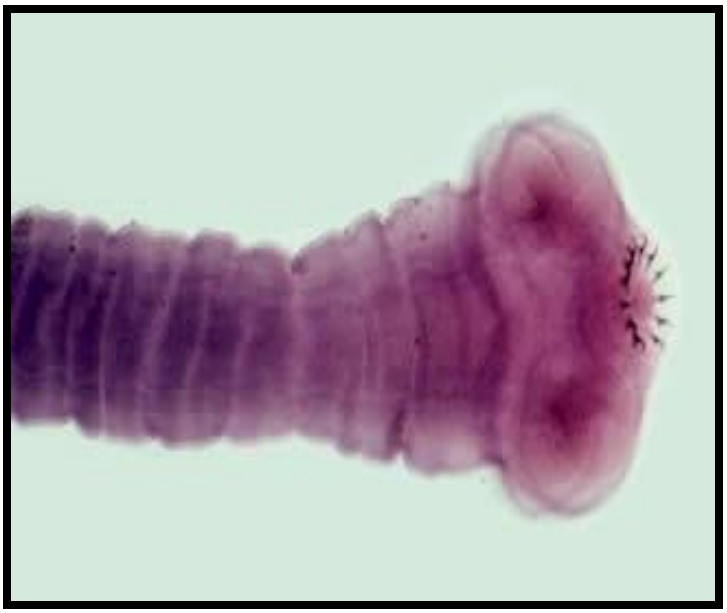
CESTODE
(TAPEWORMS)

6.1 Taenia spp.



Taenia spp. eggs in unstained wet mounts.



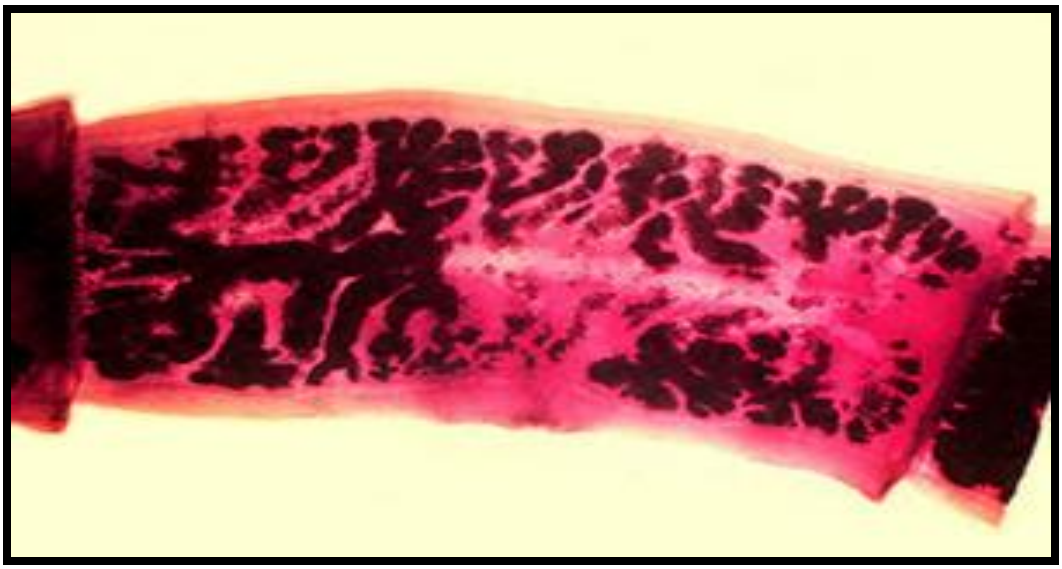


Scoleces of *T. solium*.

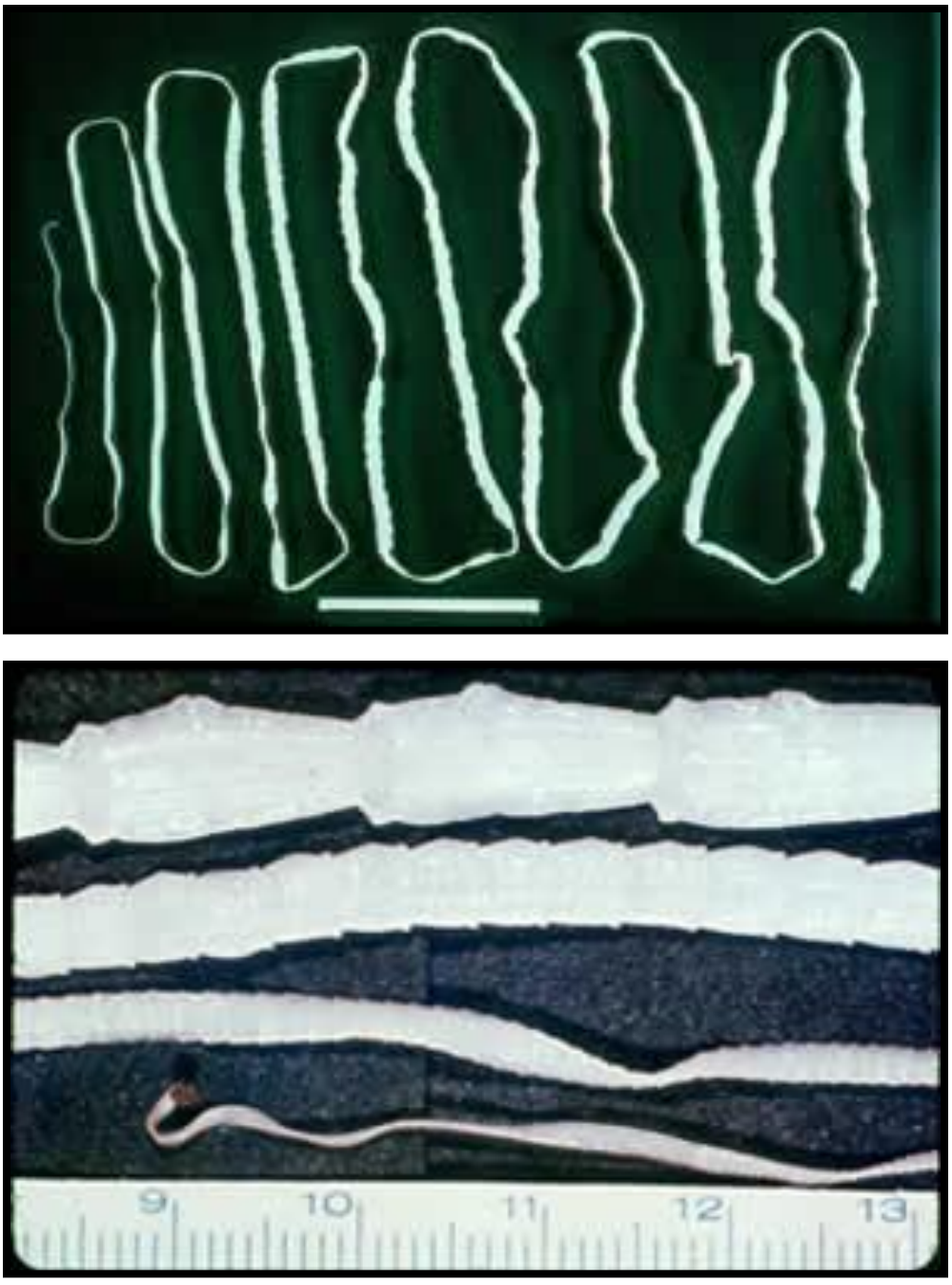
Note: The four large suckers and rostellum containing two rows of hooks

Scolex of *T. saginata*.

Note: The four large suckers and lack of rostellum and rostellar hooks



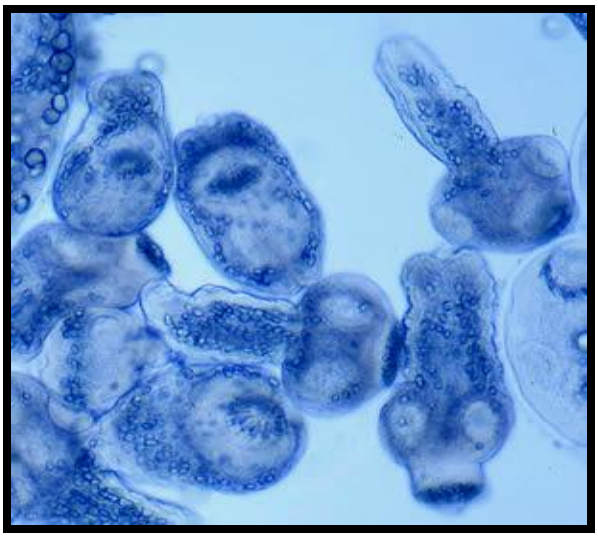
Mature proglottids of *T. solium*.
Injection of India ink into the genital pore helps with the visualization of the primary lateral uterine branches. Note the number of branches (<13).



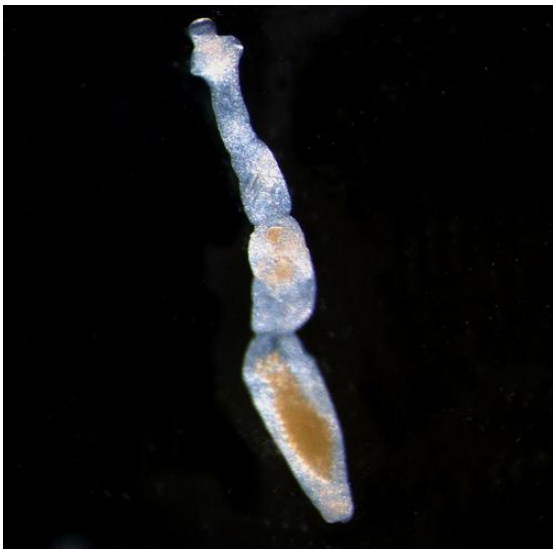
Taenia saginata adult worms.
The adult in Figure **A** is approximately
4 meters in length.

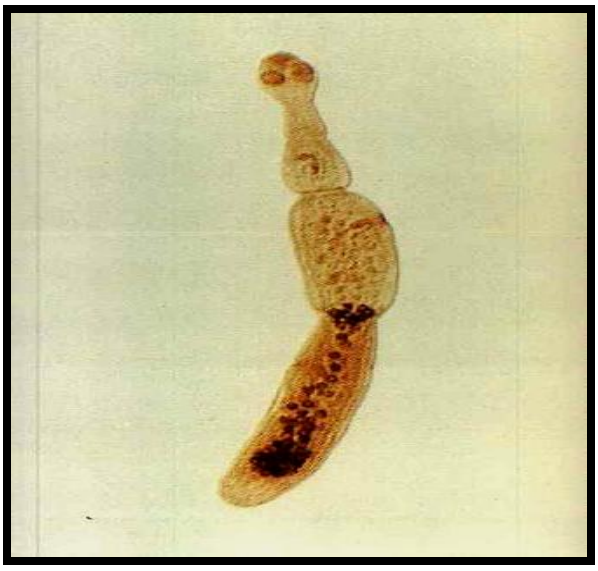
6.2 Echinococcus spp.

Scolex from hydatid cyst



Multiple protoscolices liberated from a hydatid cyst

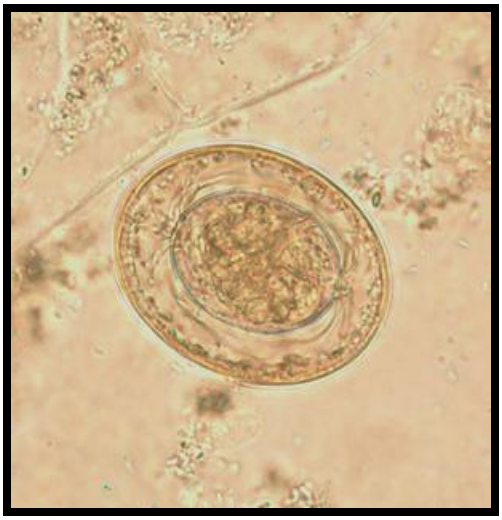




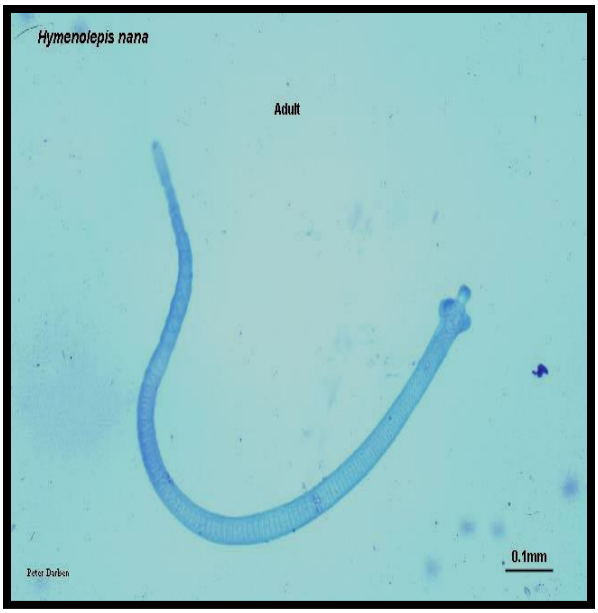
Adult E.granulosus (6mm long)

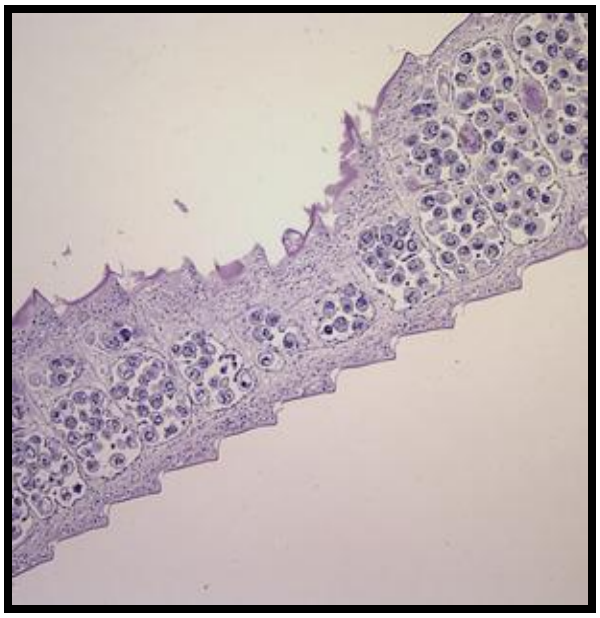
6.3 Hymenolepis spp.

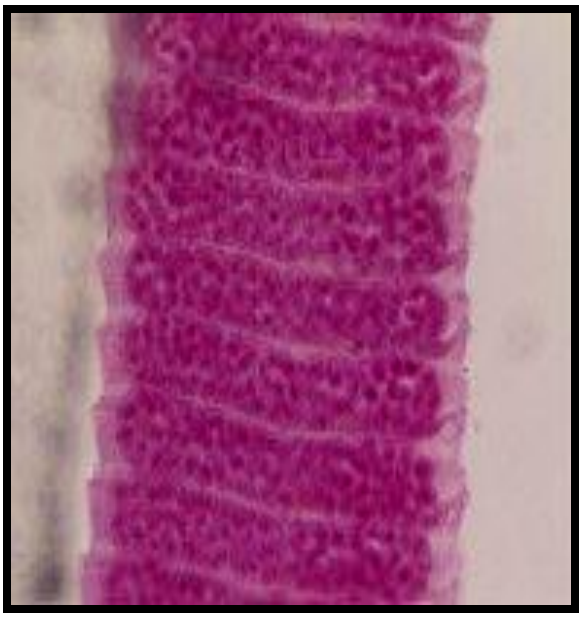
Egg of *H. diminuta* in a wet mount stained with iodine.
Four of the hooks are visible at this level of focus.



Eggs of *H. nana* in an unstained wet mount.
In these two images, the polar filaments
in the space between the oncosphere and outer shell are clearly visible.

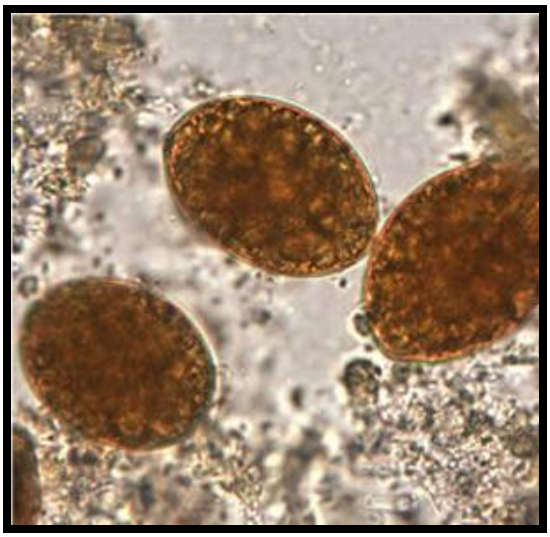






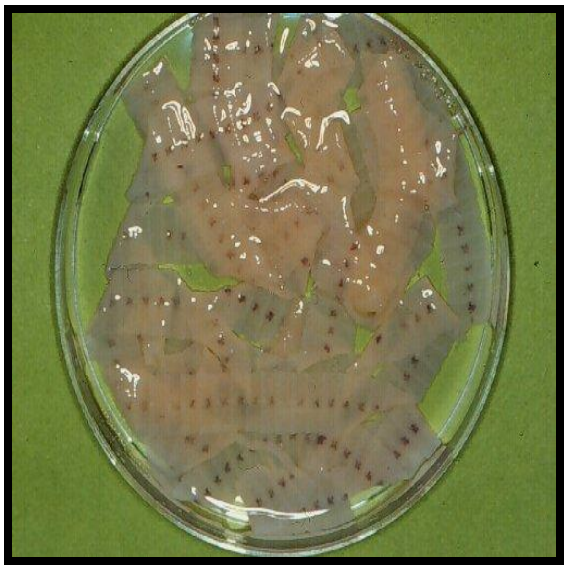
Cross-sections of proglottids of *hymenolepis nana*

6.4 Diphyllobothriasis

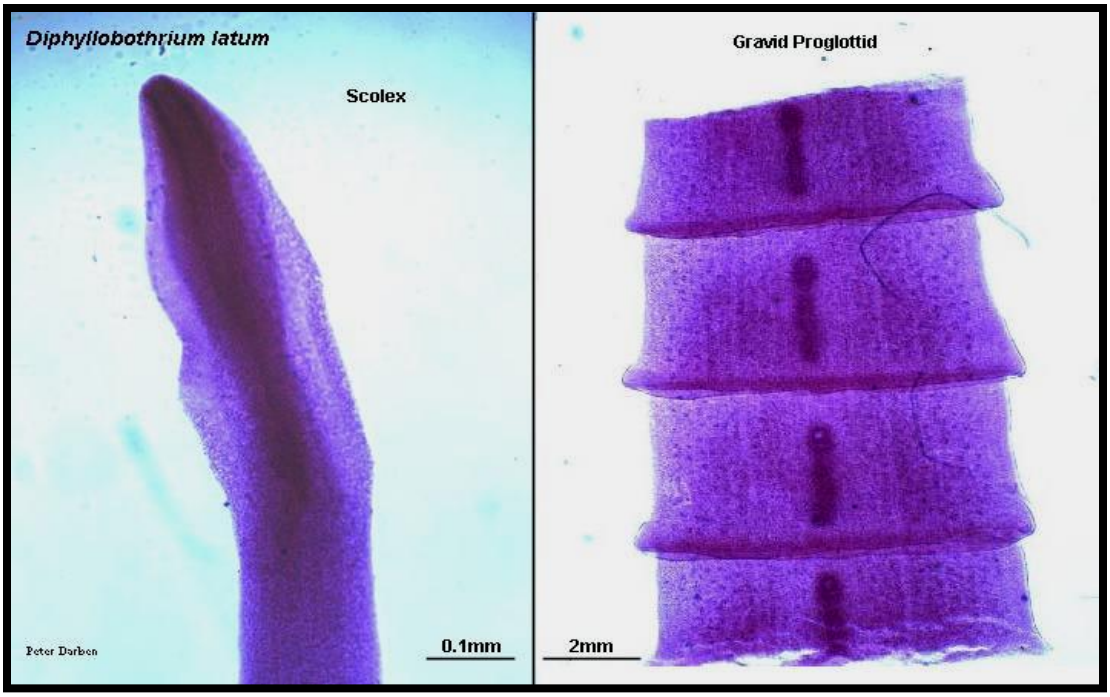


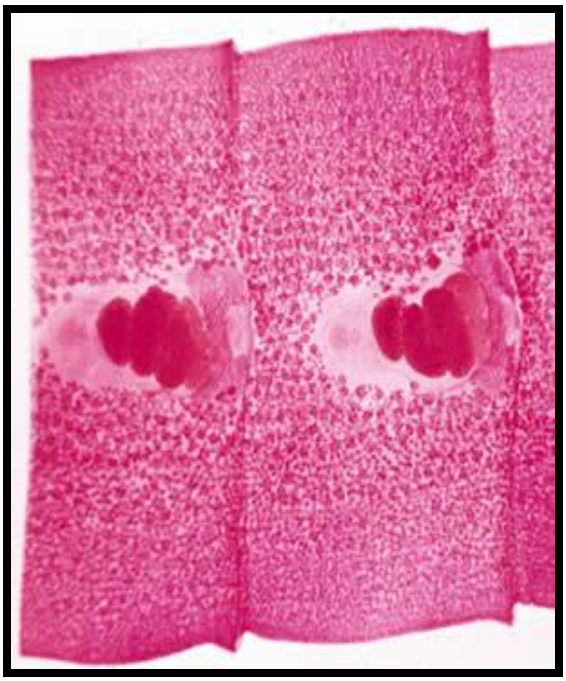
Eggs of D. latum in an iodine-stained wet mount

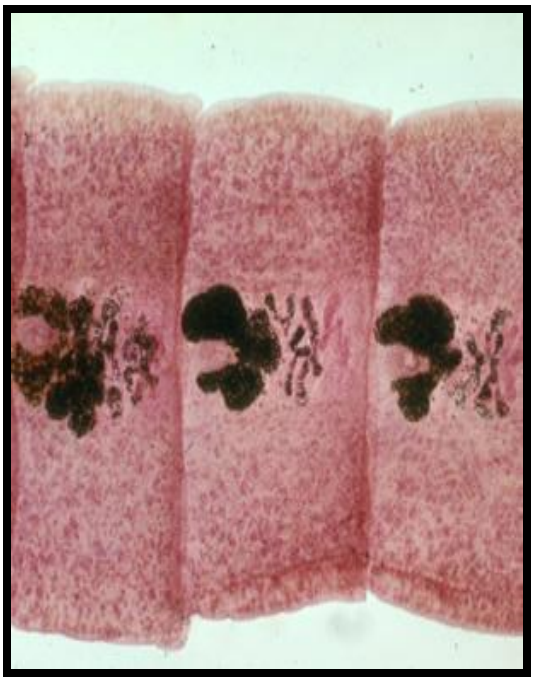
Eggs of *D. latum* in an unstained wet mount. The opercula are open.



Section of an adult *D.latum* containing many proglottids







Carmine-stained proglottids of *D. latum*, showing the rosette-shaped ovaries

CHAPTER 7

TREMATODE
(FLUKES)

7.1 Metagonomiasis

Adult *M. yokogawai*

7.2 Fascioliasis

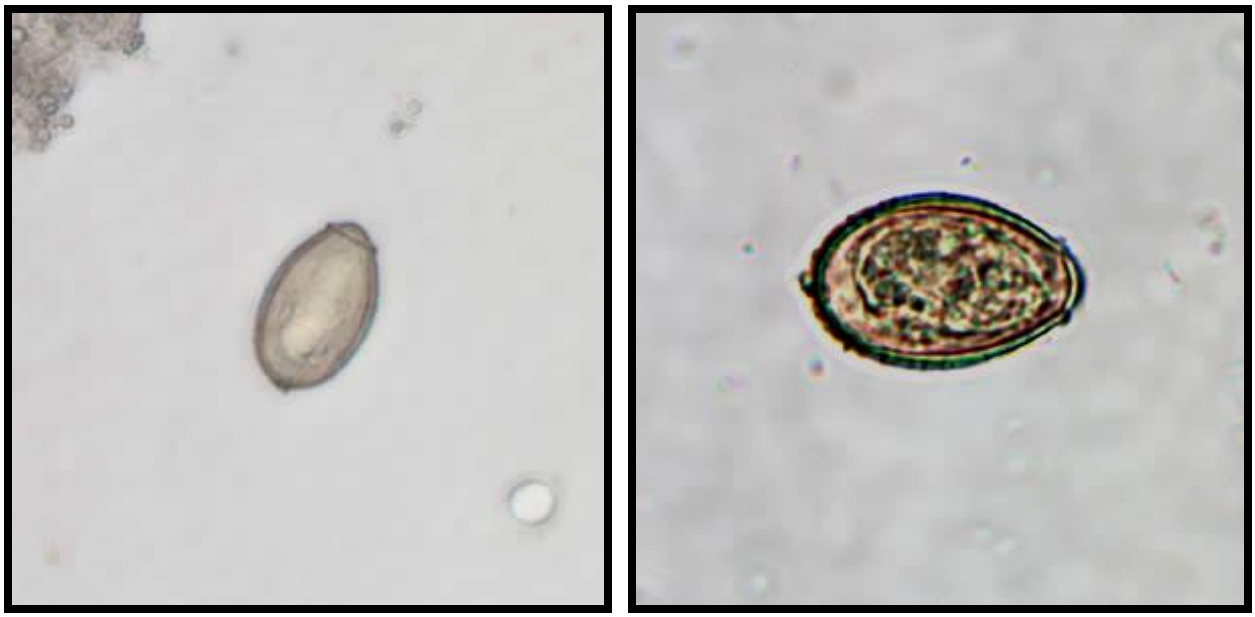
Egg of *F. hepatica* in an unstained wet mount

7.3 Fasciolopsiasis

Eggs of *F. buski* in a unstained wet mount
(400x magnification)

Adult fluke of *F. buski*

7.4 Clonorchiasis

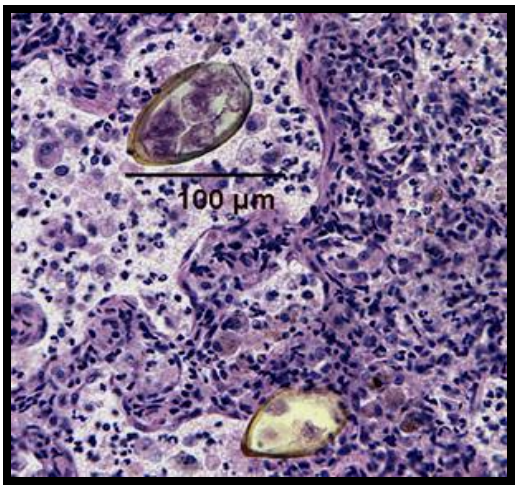


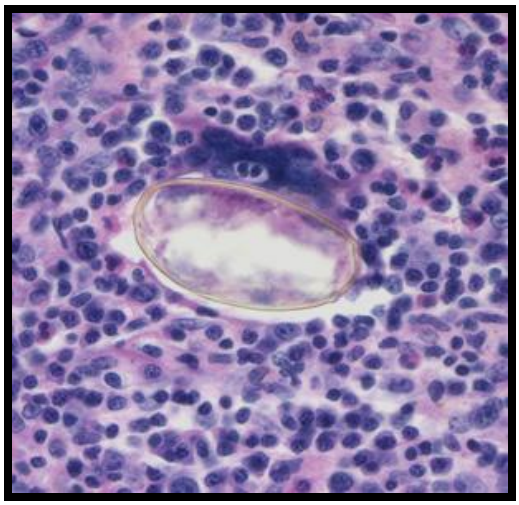
C. sinensis egg.
Note the operculum resting on "shoulders;" image taken at 400× magnification

Adult of *C. sinensis*

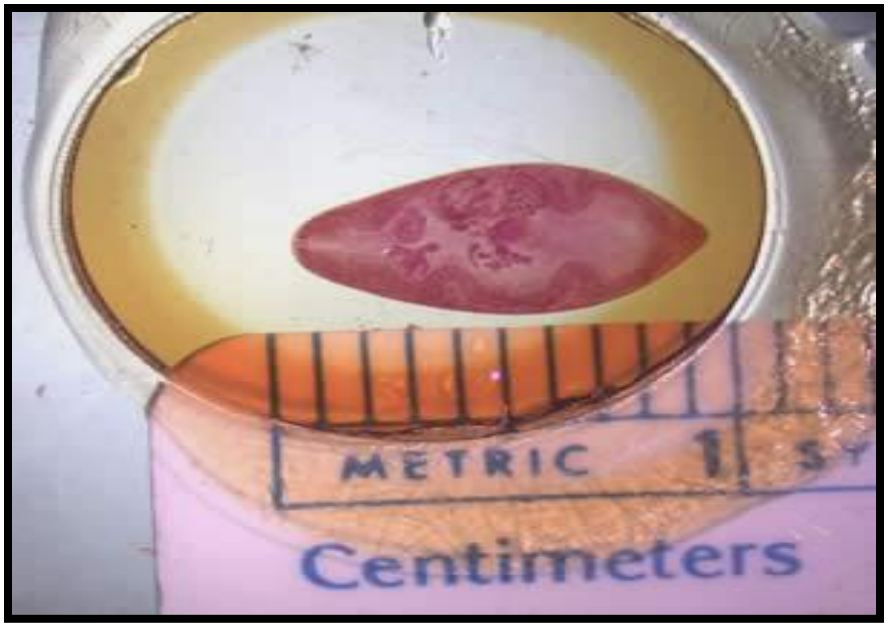
7.5 Paragonimiasis

Eggs of *P. westermani* in unstained wet mounts



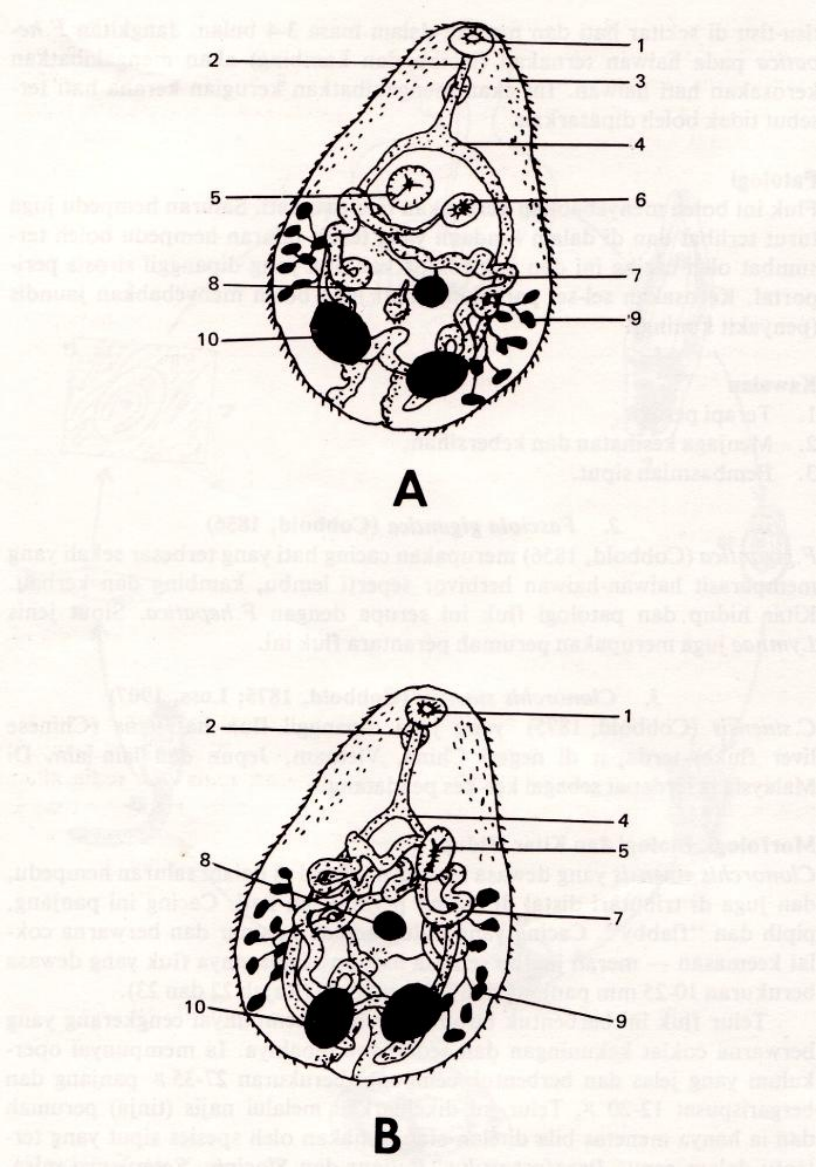


Eggs of *Paragonimus* sp. taken from a lung biopsy stained with hematoxylin and eosin (H&E).
These eggs measured 80-90 µm.



Adults of *P. westermani*.

7.6 Heterophyiasis

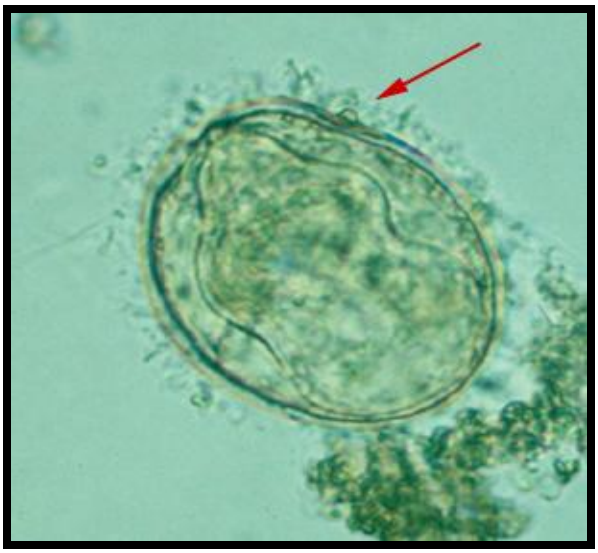


7.7 Schistosomiasis

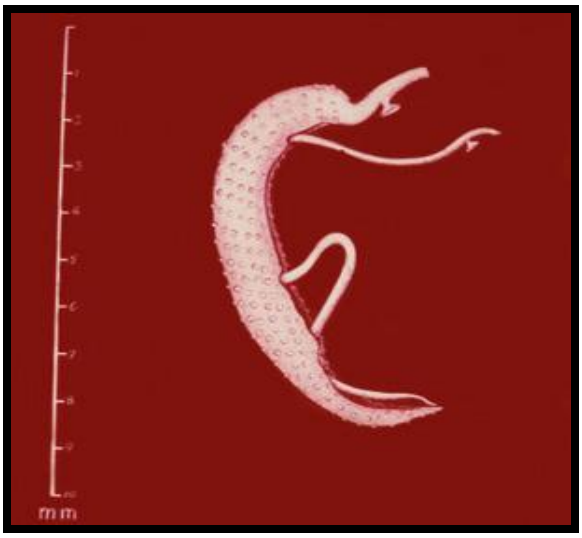
Eggs of *S. mansoni* in unstained wet mounts.

Eggs of *S. haematobium* in wet mounts of urine concentrates, showing the characteristic terminal spine

Egg of *S. intercalatum* in a wet mount



Egg of *S. mekongi*. Note the inconspicuous spine (red arrow).



Adults of *S. mansoni*.
The thin female resides in the gynecophoral canal of the thicker male.

The intermediate hosts of *Schistosoma* spp.
are various species of freshwater snails

Bulinus sp., the intermediate host for *S. haematobium* and *S. intercalatum*

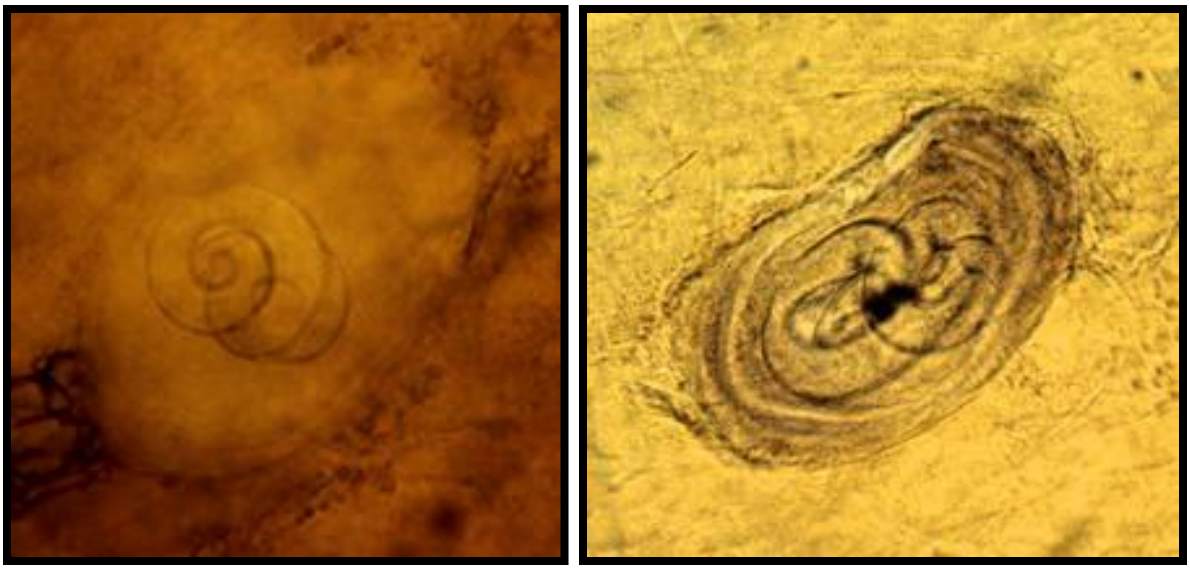
Biomphalaria sp., the intermediate host for *S. mansoni*

CHAPTER 8

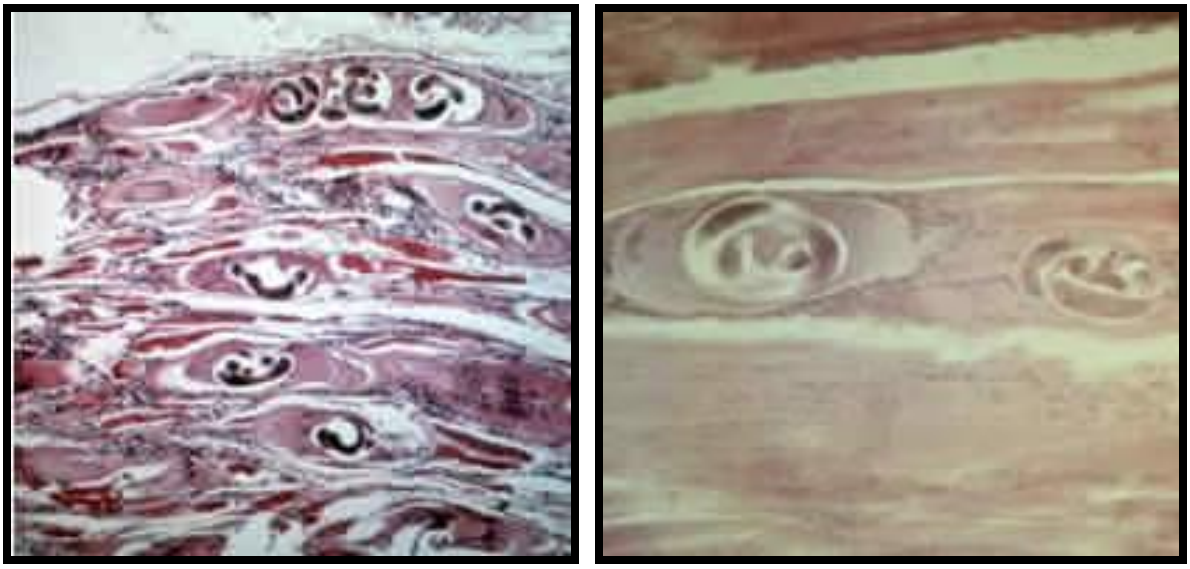
NEMATODE
(ROUND WORMS)

Order: Enoplida

8.1 Trichinella sp.

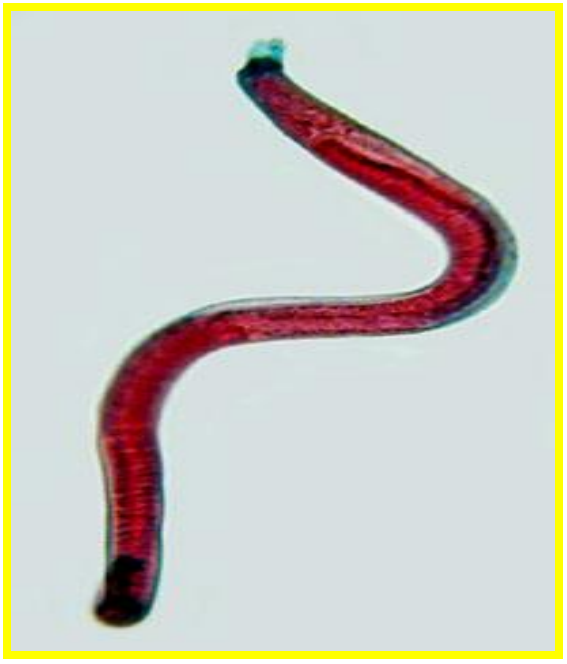


Encysted larvae of *Trichinella* sp. in pressed muscle tissue.
The coiled larvae can be seen inside the cysts.



Trichinella spiralis larvae in muscle tissue

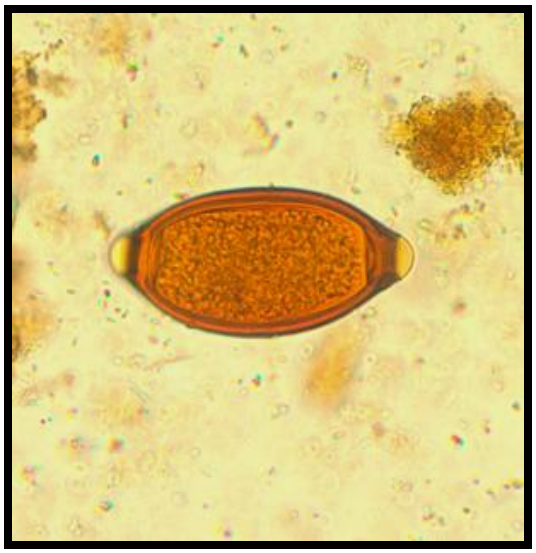
Trichinella larvae, freed from their cysts from the muscle tissue of an Alaskan bear



T. spiralis, male (Mag. ~100X)

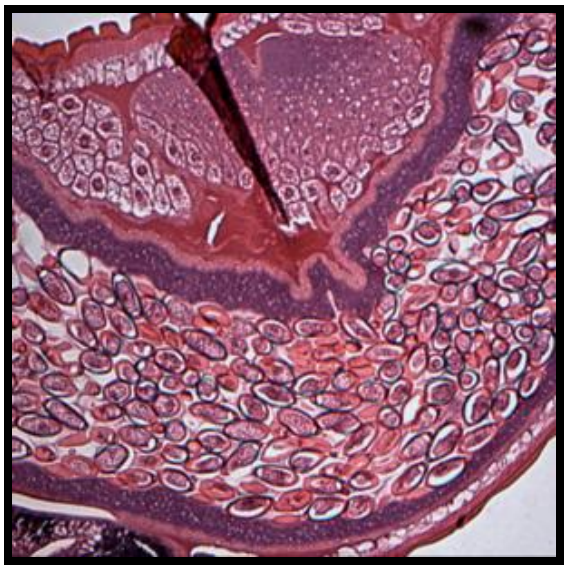
T. spiralis, female (Mag. ~100X)

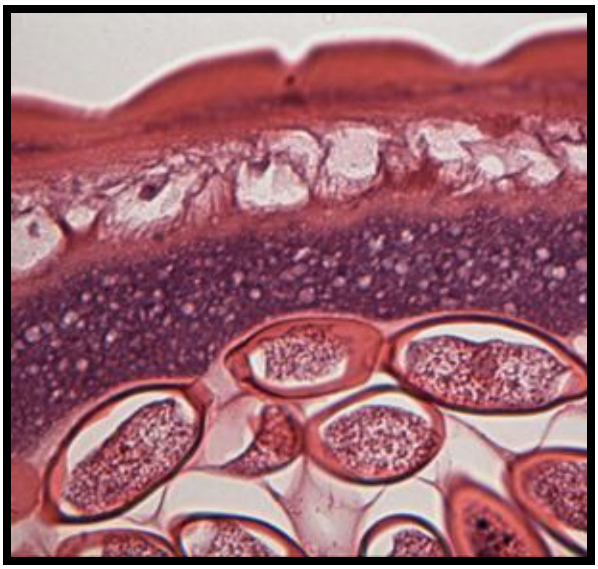
8.2 Trichuris trichuria



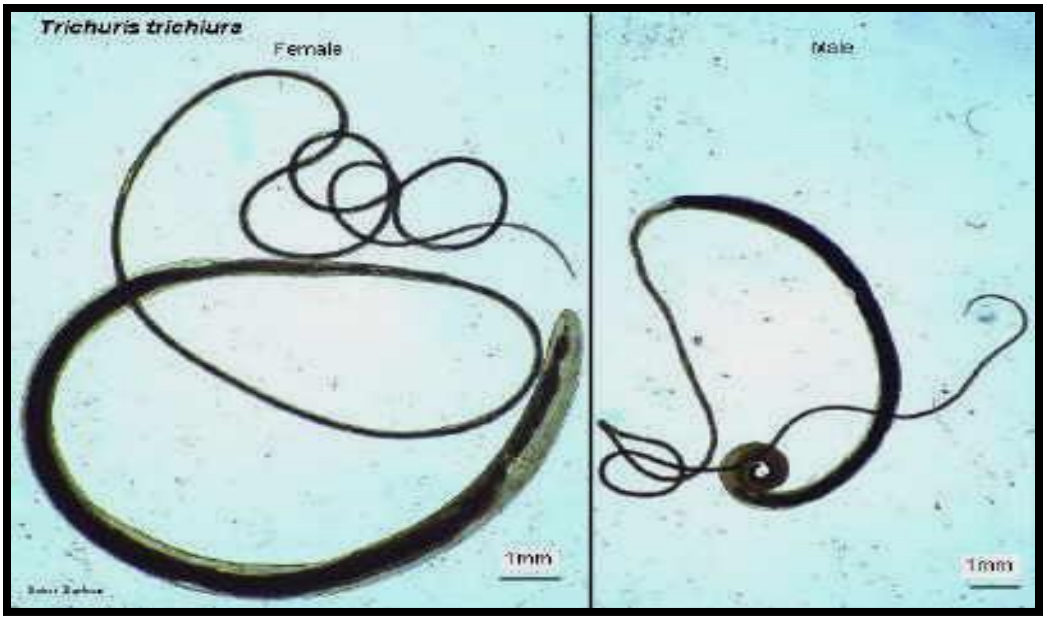
Egg of *T. trichiura* in an unstained wet mount

Atypical egg of *T. trichiura*





Cross-section of an adult female *T. trichiura* stained with H&E showing numerous eggs. (Magnification at 100X & 400X)



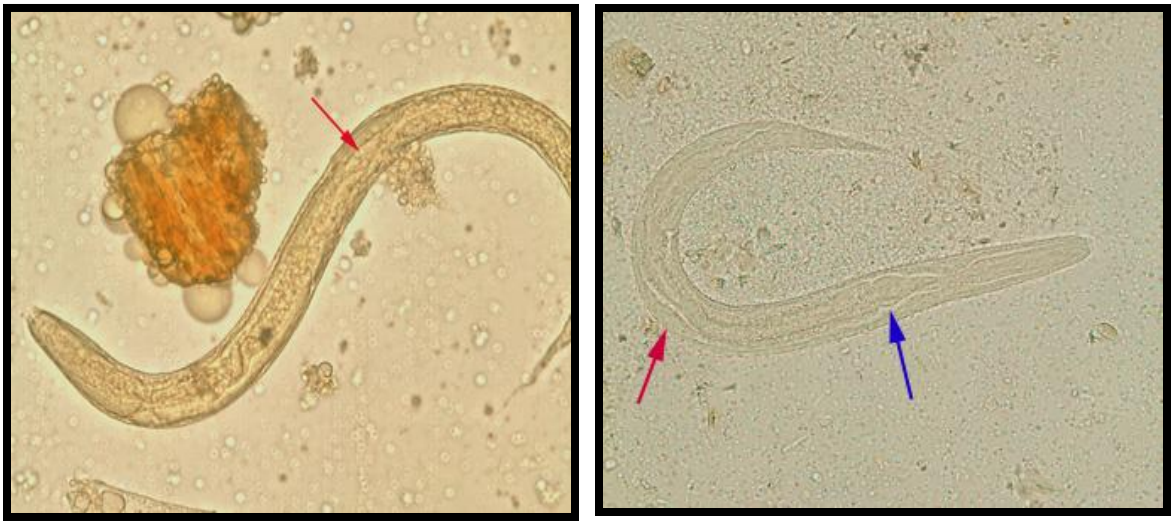
Adult Female

Adult Male

Posterior end of an adult *T. trichiura*, taken during a colonoscopy

Order: Rhabditida

8.3 Strongyloides stercoralis

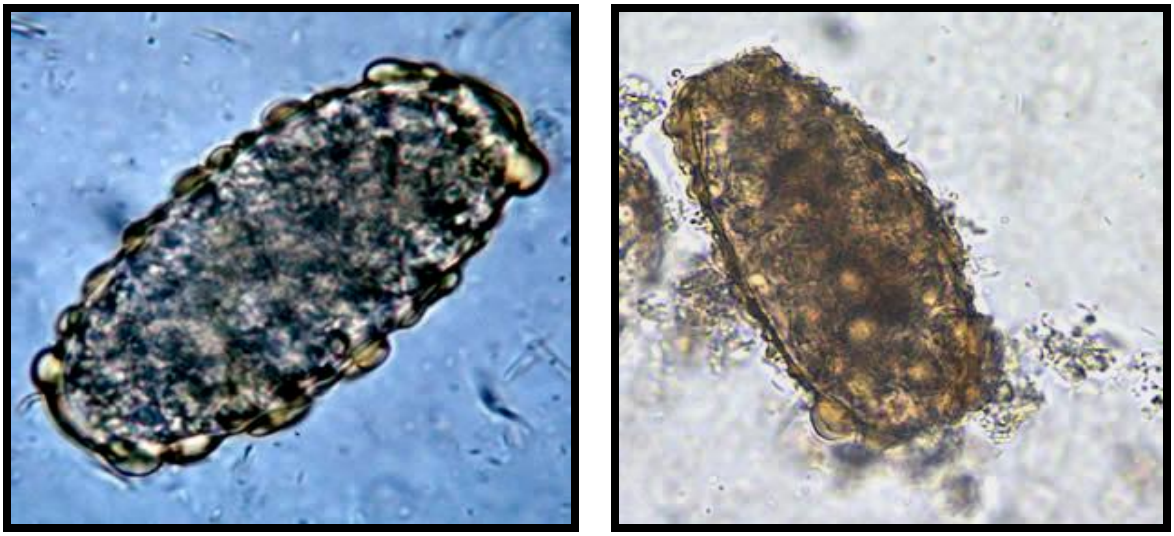


Rhabditoid larva of *S. stercoralis* in an unstained wet mount of stool.

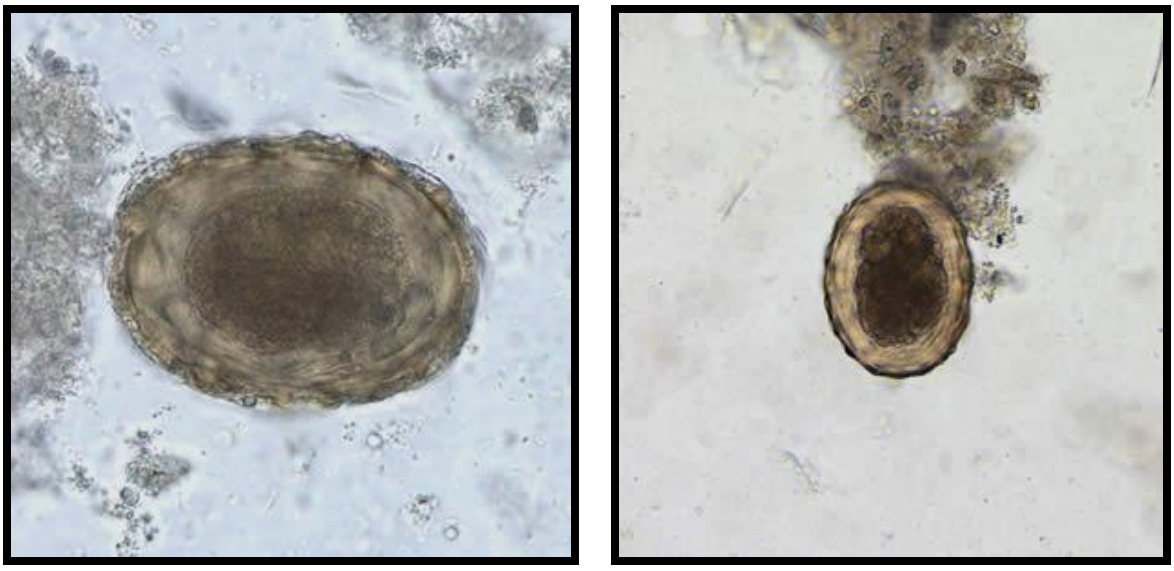
Filariform (L3) larva of *S. stercoralis* in an unstained wet mount

Longitudinal-section of a larva of *S. stercoralis* in skeletal muscle. (400x Magnification, H&E)

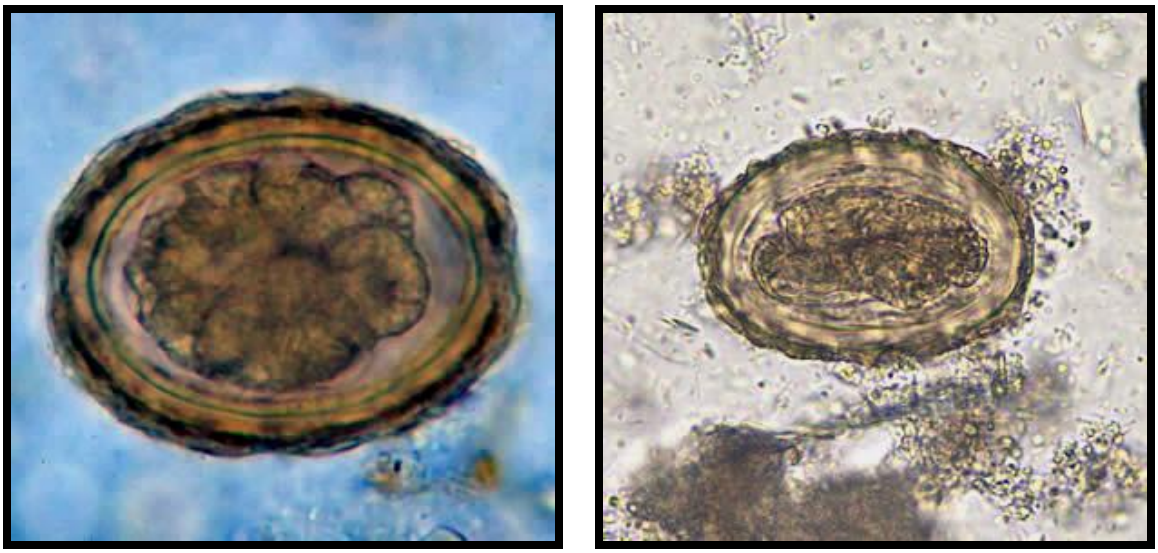
8.4 Ascaris lumbricoides



A. lumbriocoides unfertilized egg in a wet mount, 200× magnification



A. lumbriocoides fertilized egg in a wet mount



A. lumbricoides fertilized eggs in a wet mount, 200× magnification.
(A larva is visible in the egg)

A. lumbriocoides larva hatching from an egg.

An adult *Ascaris lumbriocoides* worm.
Diagnostic characteristics:
tapered ends; length 15 to 35 cm
(the females tend to be the larger ones)

These are intestinal worms.
A child in the area has from 20 to 100 worms in his belly.

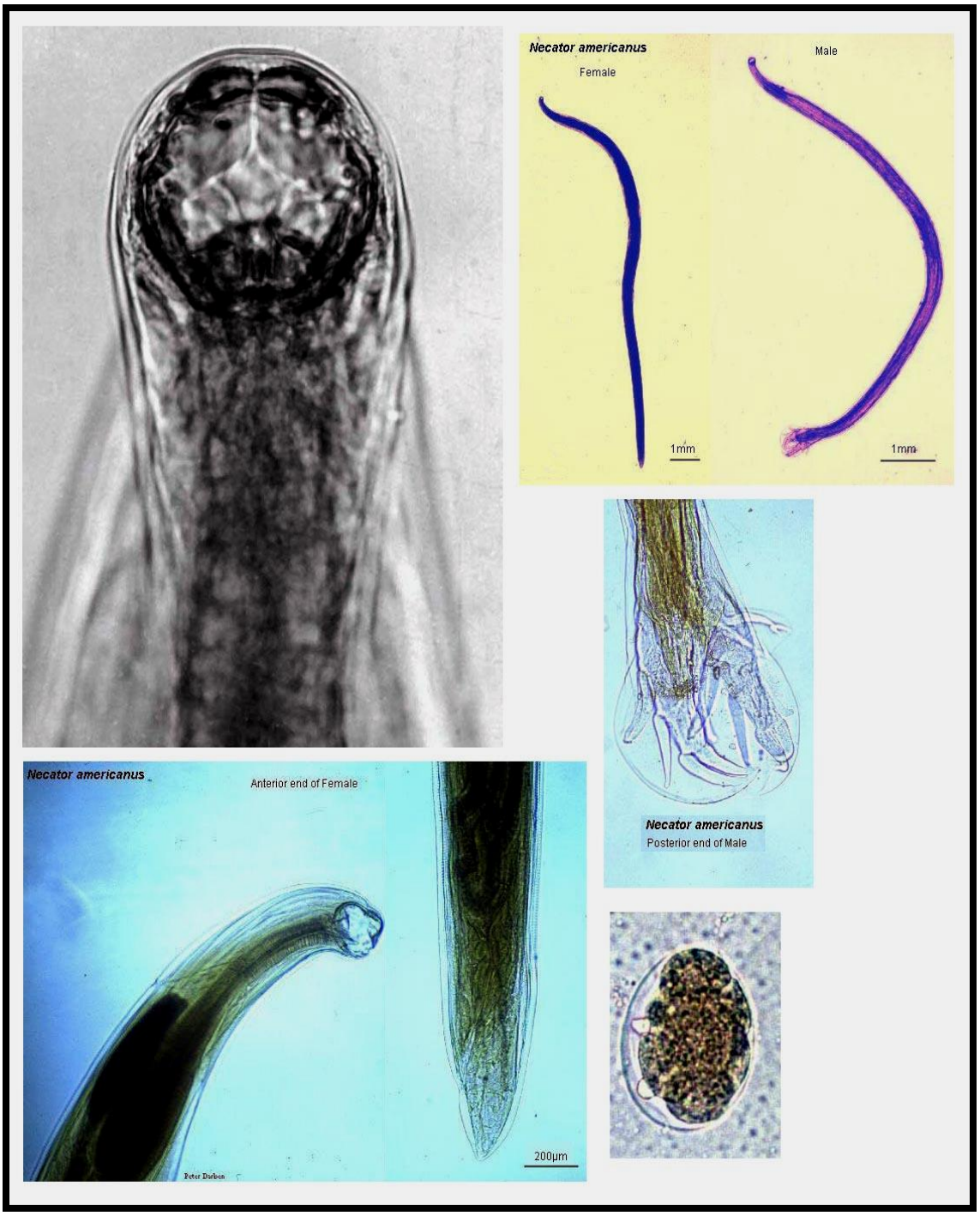
8.5 Necator americanus

Hookworm eggs in unstained wet mounts, taken at 400× magnification

Hookworm rhabditiform larva (wet preparation).

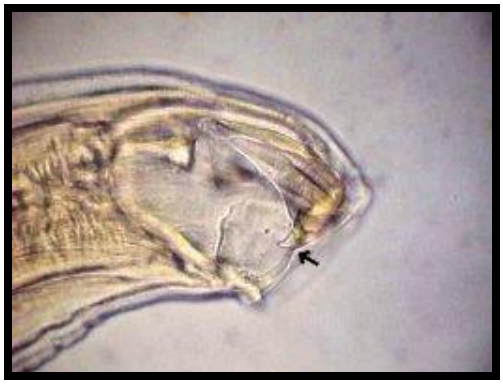
Necator americanus, anterior detail
(Magnification 100x)

Filariform (L3) hookworm larvae.

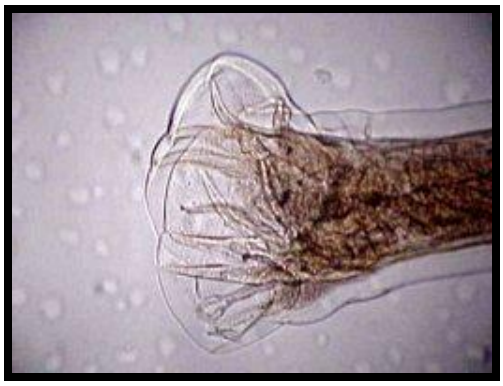


***Necator americanus* (hook worm)**

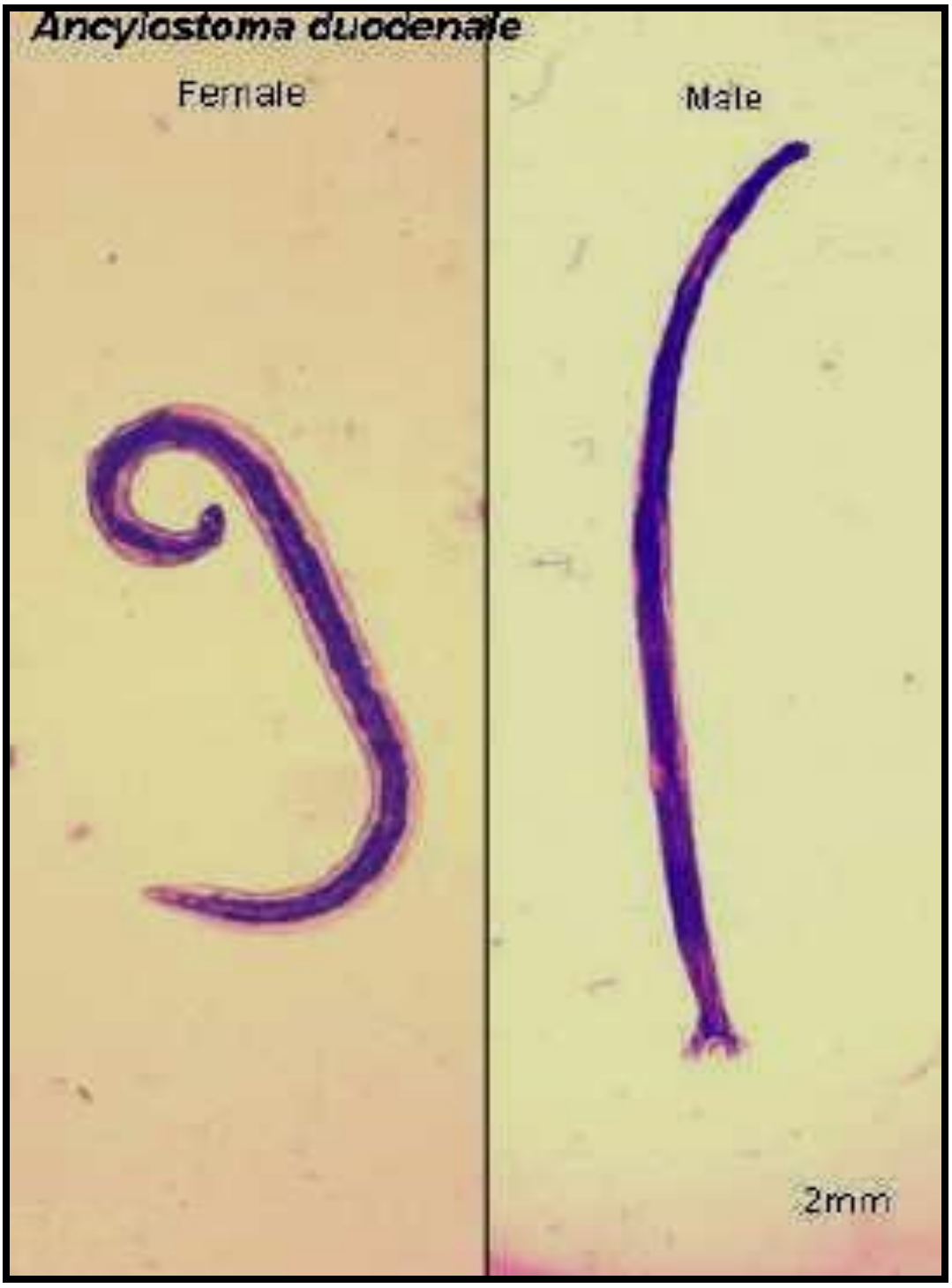
8.6 Ancylostoma sp.



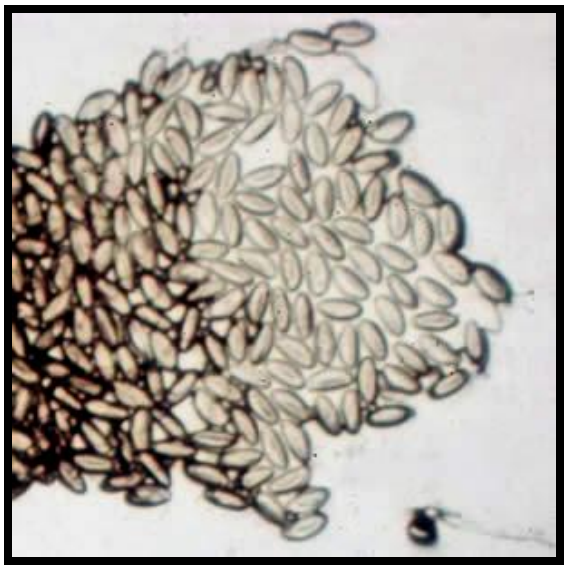
lateral



Caudal (tail, male)


Ancylostoma duodenale
Female
Male
2mm

8.7 Enterobius vermicularis



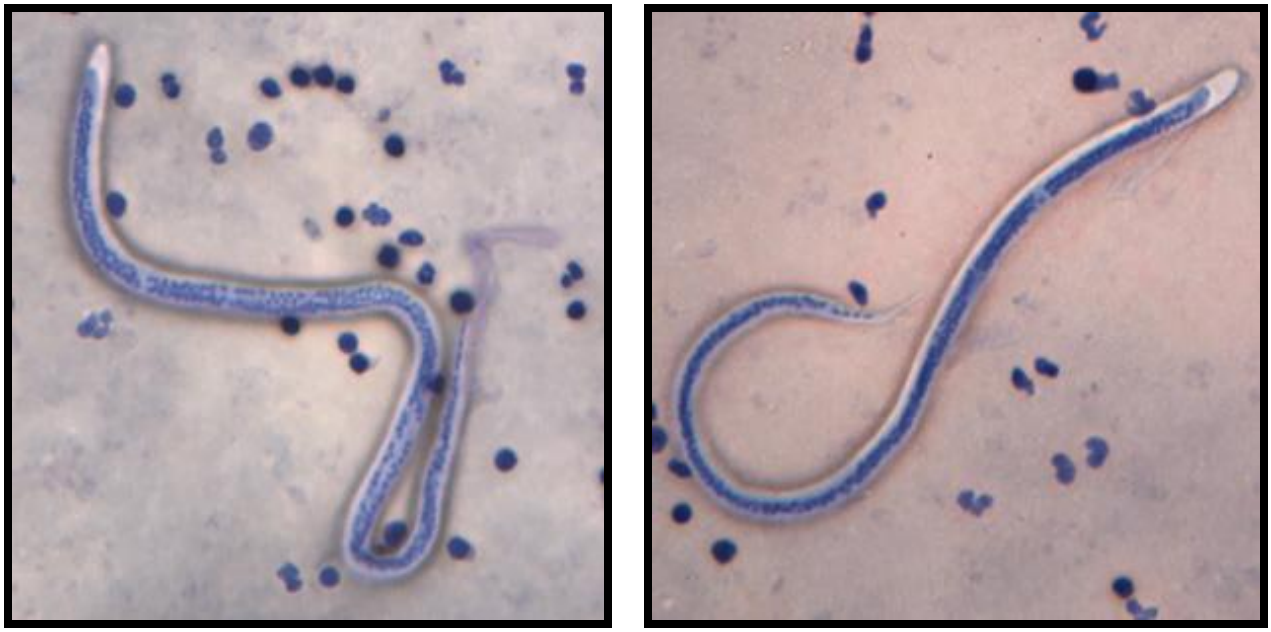
Eggs of *E. vermicularis* in a cellulose-tape preparation.

Eggs of *E. vermicularis* in a wet mount.

Adult male of *E. vermicularis*.
The worm measured 1.4 mm in length.

Anterior end of an adult female of *E. vermicularis*, recovered from a colonscopy

Order : Spirurida
8.8 Wuchereria bancrofti

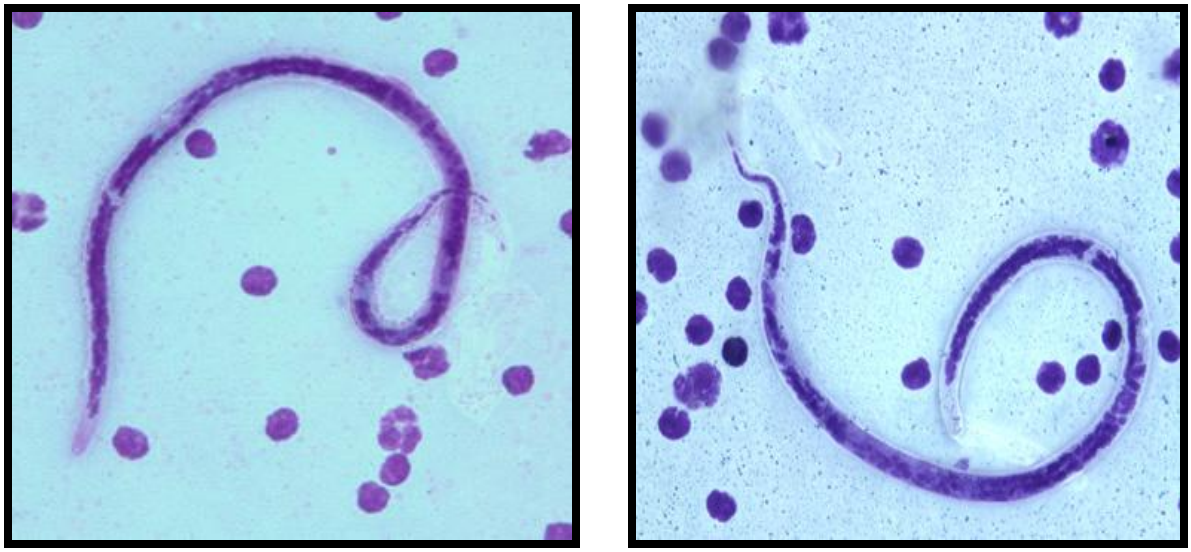


Microfilariae of W. bancrofti in thick blood smears stained with Giemsa.

Adults of *W. bancrofti*. The male worm is on the left; the female is on the right

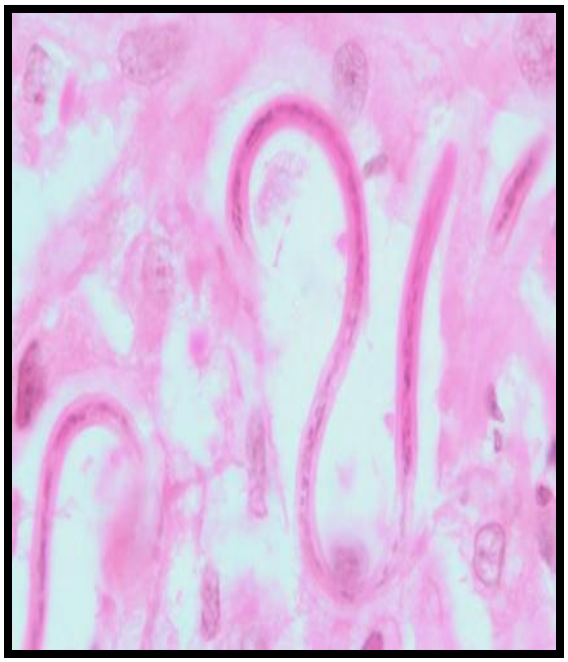
Order : Spirurida
8.9 Brugia malayi

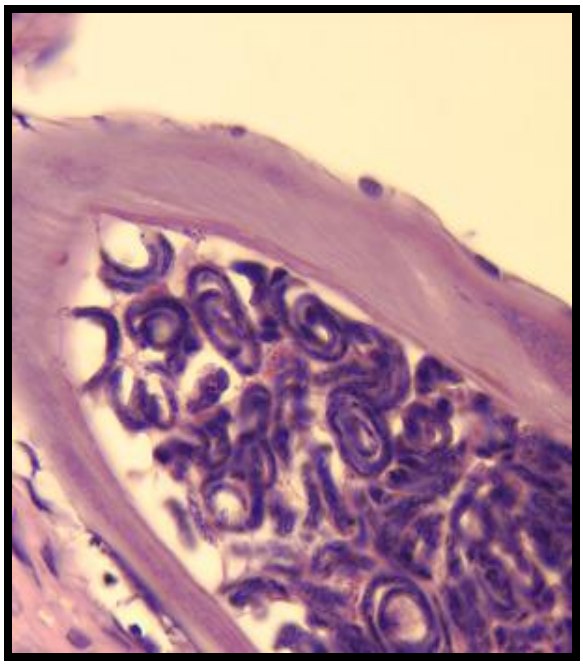
Microfilaria of *B. malayi* in a thick blood smear, stained with Giemsa



Microfilariae of *B. timori* in a thick blood smear.
(500x magnification)

Order : Spirurida
8.10 Onchocerca volvulus





Cross-section of an adult female *O. volvulus*, stained with H&E.
Note the presence of many microfilariae within the uterus

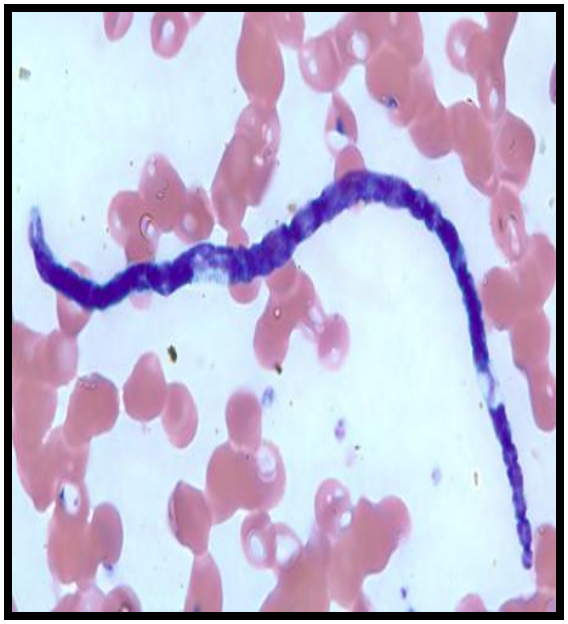
Adult of *Onchocerca volvulus*

Order : Spirurida
8.11 Loa loa

Microfilaria of *Loa loa* in a thick blood smear, stained with Giemsa

Adults of *Loa loa* removed from the eye of a patient.

Order : Spirurida
8.12 Mansonella sp.

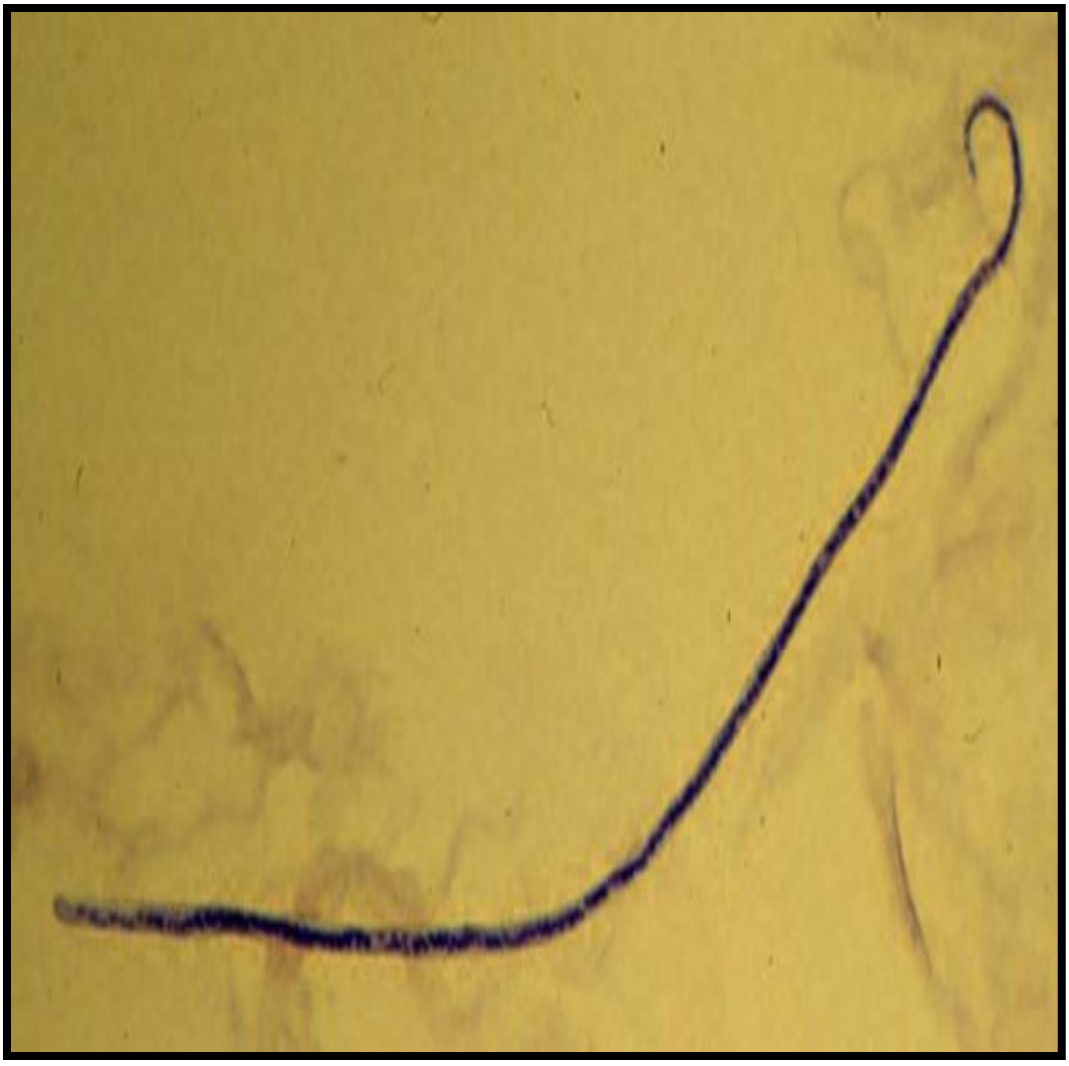


Microfilariae of *Mansonella perstans* are unsheathed and measure 190-200 µm

Microfilaria of *M. perstans* in a thin blood smear

Microfilariae of *Mansonella ozzardi* are unsheathed and measure 160-205 µm

Microfilariae of *M. ozzardi* in thick blood smears, stained with Giemsa



Microfilariae of *Mansonella streptocerca* are unsheathed and measure 180-240 µm. The tail is been into a hook-like shape and the nuclei extend to the end of the tail.
Microfilariae are found in skin and do not circulate in the blood

CHAPTER 10

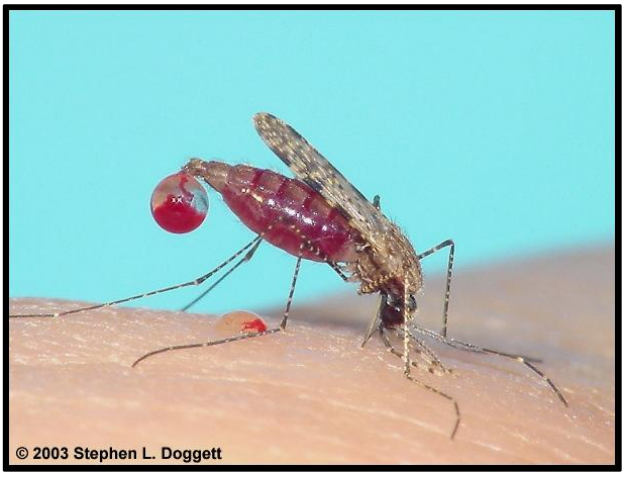
ENTOMOLOGY
(MOSQUITOE)

10.1 *Anopheles spp.*

10.1 (a)

10.1 (b)

10.1 (c)



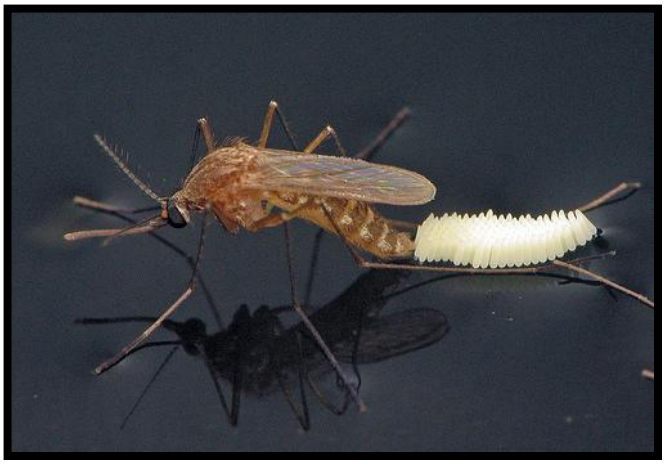
10.1 (d)

10.2 *Culicinae spp.*

10.2 (a)

10.2 (b)

10.2 (c)



10.2 (d)

10.3 Aedes *spp.*

10.3 (a)

10.3 (b)

10.3 (c)

10.3 (d)

10.4 *Mansonia spp.*

10.4 (a)

10.4 (b)

10.4 (c)

10.4 (d)

10.5 *Toxorhynchites spp.*

10.5 (a)

10.5 (b)

10.5 (c)

10.5 (d)

Acknowledgements

References