

3. Protozoa

General Characters

Protozoans are *minute, unicellular* (acellular) organisms without any tissue grade of organization. They are the *first formed* animals and hence the name *Protozoa*. When man is placed at the apex of the animal kingdom, protozoans should be placed at the base.

Phylum Protozoa is characterized by the presence of the following characters:

1. Protozoans are the *simple* and *primitive* organisms.
2. They are *minute* and *microscopic*.
3. They are *free living* or *parasitic*.
4. All the free living forms are *aquatic*.
5. They are *asymmetrical* or *radially symmetrical* or *bilaterally symmetrical*.
6. They are *unicellular* (acellular).

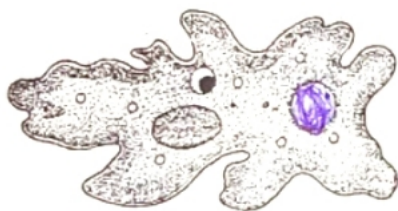
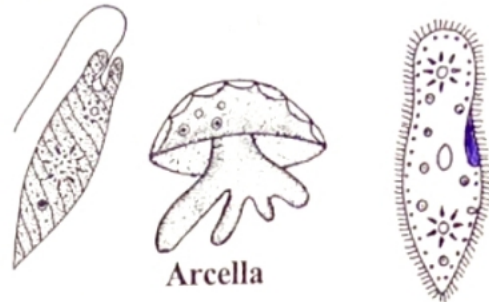


Fig.3.1: Amoeba.

7. They have *protoplasmic grade* of organization.
8. All the activities are carried out by the *cytoplasm* of a single cell.
9. Tissues and organs are absent from protozoans.
10. Locomotion is effected by *flagella*, *cilia* or *pseudopodia*.



Euglena

Arcella

Paramecium

Fig.3.2: Some protozoans.

11. Nutrition is *holophytic, holozoic, saprozoic* or *parasitic*.
12. Digestion is *intracellular*.
13. Respiration occurs by *diffusion*.
14. Excretion occurs by *diffusion*.
15. In freshwater protozoans, osmoregulation is carried out by the *contractile vacuoles*.

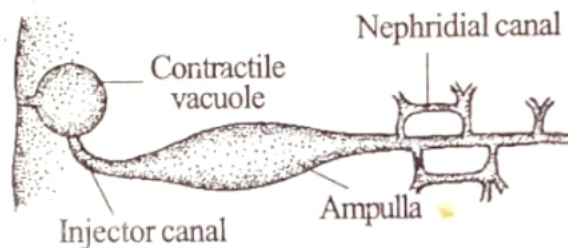


Fig.3.3: Contractile vacuole of Paramecium.

16. *Encystment* is a common phenomenon.
17. Reproduction occurs by *asexual* and *sexual* methods.

Classification

Protozoa includes *unicellular*, first formed animals.

About 50,000 species of protozoans are known. All protozoans are grouped into five classes, namely

8. Plasmodium

Phylum : Protozoa
 Class : Sporozoa
 Order : Haemosporidia

Plasmodium is an unicellular organism. Hence it is included in the phylum *Protozoa*. It is a parasite reproducing by the formation of *spores*. Hence it is included in the class *Sporozoa*.

It is an *endoparasite* living in the *blood* of man. It causes *malaria* in man. It is *cosmopolitan* in distribution.

Plasmodium completes its life cycle in two hosts, namely man and the female *Anopheles* mosquito. Hence it is a *digenic parasite*. Man is the *intermediate host** and the mosquito is the *primary host***.

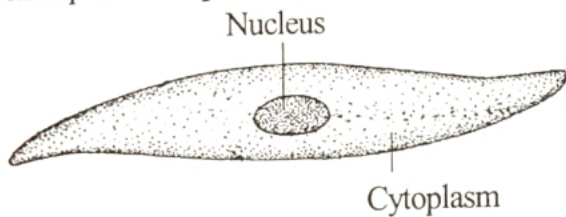


Fig.3.70: Plasmodium.

Life cycle in Man (Cycle of Golgi)

The life cycle of *Plasmodium* in man is called the *cycle of Golgi*. It occurs in three stages. They are

1. Pre-erythrocytic cycle
2. Exo-erythrocytic cycle
3. Endoerythrocytic cycle.

1. Pre-erythrocytic Cycle

(This cycle occurs in the *liver*.) When a mosquito bites a man, it introduces the *parasite* into the blood of man.

****Primary host:** The host in which the parasite completes the sexual reproduction is called the primary host.

Intermediate host*: The host in which the parasite completes the asexual reproduction is called the intermediate host.

The parasite introduced is called *sporozoite*. It is spindle-shaped and is covered with *pellicle*. It contains a large nucleus in the centre.

(The sporozoite enters the *liver cells*, it feeds and grows and becomes spherical in shape.) The parasite in this stage is called *cryptoschizont*.

The cryptoschizont undergoes a special kind of *asexual reproduction* called *schizogony*. It divides and produces about 1000 daughter cells called *cryptomerozoites*.

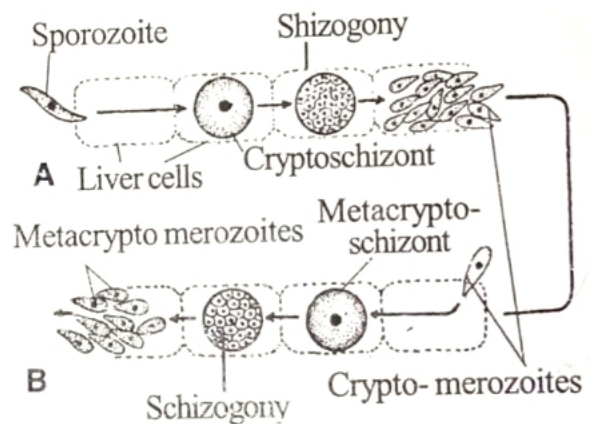
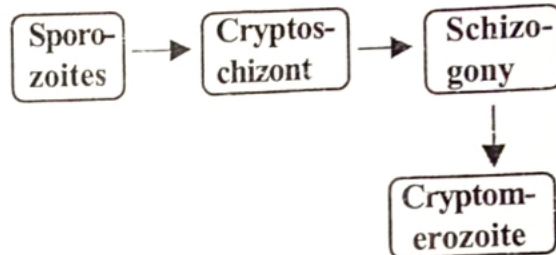


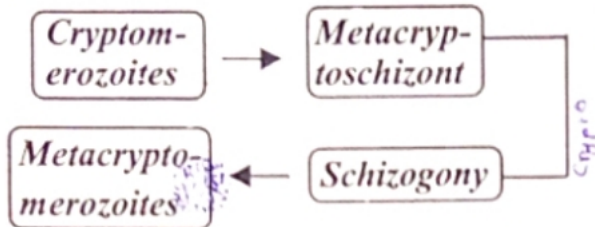
Fig.3.71: Plasmodium-Life history: A. Pre-erythrocytic cycle B. Exo-erythrocytic cycle.

Cryptomerozoites are released into the liver by the *rupture* of liver cells.

2. Exo-erythrocytic Cycle

(This cycle occurs in the *liver*.) The cryptomerozoites enter fresh liver cells. Here they grow and increase in size and become spherical in shape. The parasite in this stage is called *metacryptoschizont*.

The metacryptoschizont undergoes *schizogony* resulting in thousands of daughter individuals called *metacrypto-merozoites*. The metacryptomerozoites are released by the rupture of liver cells.



The pre-erythrocytic cycle and the exo-erythrocytic cycle are completed within 8 days. After this period the metacryptomerozoites, enter the blood. Until this time there will not be any symptom of malaria.)

3. Erythrocytic Cycle or Endoerythrocytic Cycle

This cycle occurs within the RBC.

The metacryptomerozoite penetrates the RBC. Inside the RBC the parasite becomes rounded. This stage of the parasite is called *trophozoite*.

It grows and increases in size.

It becomes ring-like and is called *signet ring*. It has a *vacuole inside*.

After sometime the vacuole disappears and the parasite develops many *pseudopodia*. At this time the parasite is in the *amoeboid stage*.

It feeds on the contents of the RBC. The parasite secretes digestive enzymes which break the haemoglobin of RBC into *haem* and *globin*. Globin is digested and used as food

by the parasite. The haem is converted into a toxic pigment called *haemozoin* which remains scattered in the cytoplasm of the parasite.

When feeding stops, the pseudopodia disappear and the parasite becomes rounded. This stage of the parasite is called *schizont*. The schizont contains a single nucleus and haemozoin pigments in the cytoplasm. Then the schizont undergoes *schizogony*.

In schizogony, the nucleus and cytoplasm divide into 12 to 24 daughter parasites called *merozoites*.

The merozoites are arranged more or less like the petals in a rose flower. Hence this stage is called *rosette*.

The merozoites are released into the blood by the rupture of RBC.

The erythrocytic cycle takes 48 hours (two days) for completion.

The merozoites again attack fresh RBC and the cycle is repeated several times until almost all the RBCs are attacked.

After several generations, the merozoites entering the RBC, increase in size and become rounded. They are now called *gametocytes*.

Some gametocytes are smaller in size and their nuclei are larger in size. These gametocytes are called male or *microgametocytes*.

Others are larger in size but with smaller nuclei. These gametocytes are called female or *megagametocytes*.

For further development the gametocytes must be taken into the body of the female Anopheles mosquito.



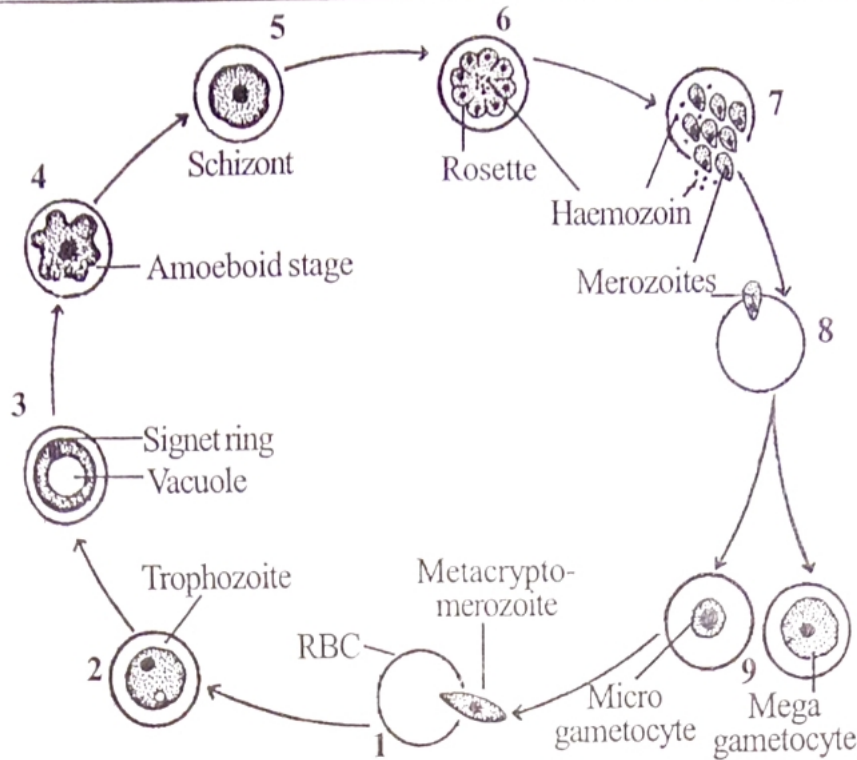


Fig.3.72: Plasmodium-Life history; Endoerythrocytic cycle.

Life cycle in Mosquito (Cycle of Ross)

The life cycle of *Plasmodium* in mosquito was first studied by **Sir Ronald Ross**. Hence this cycle is called the *cycle of Ross*.

Plasmodium undergoes **sexual reproduction** in *Anopheles*. Hence *Anopheles* is the **primary host**. As it transmits the parasite from one man to another, it is called a **vector**.

When a female *Anopheles* mosquito sucks the blood of man, the gametocytes enter the gut. The RBCs are digested and the gametocytes are released.

The megagametocyte is reorganized and becomes a **female gamete** or **megagamete**.

In microgametocyte, the nucleus divides into 6 to 8 daughter nuclei. The daughter nuclei are arranged in the periphery of the gametocyte. The cytoplasm grows out into 6 to 8 long thin flagella-like structures. Each nucleus moves into a flagellum-like structure. Each flagellum-like structure is now called a **microgamete**.

The microgametes break off from the microgametocyte by violent movements. The formation of microgametes from microgametocyte is called **exflagellation**.

The microgametes exhibit gliding movement inside the lumen of the gut. The megagametocyte gives out a small cytoplasmic projection. It is called **fertilization cone**.

When a microgamete comes into contact with the megagamete, it penetrates through the fertilization cone. Now the two gametes fuse together. This is called **fertilization** or **syngamy**. The resulting structure is called **zygote** or **syngaryon**.

The zygote is spherical in shape. It is a diploid cell. It is non-motile. Soon it becomes elongated and spindle-shaped; it exhibits gliding movement. At this stage the parasite is called an **ookinete**.

The parasite penetrates the wall of the gut and comes to lie beneath the outer layer of the

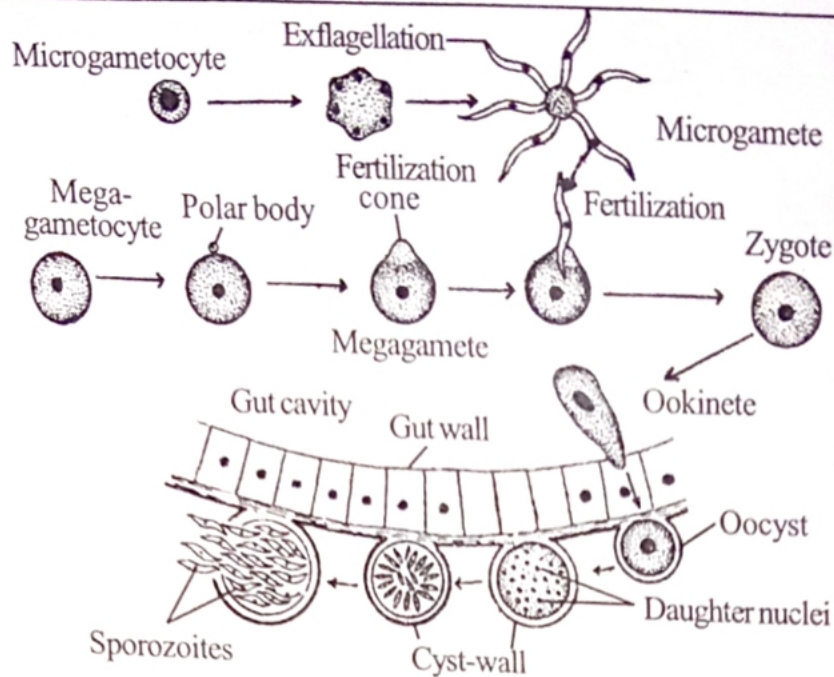


Fig.3.73: *Plasmodium*: Life history(Cycle of Ross).

gut wall. Here it becomes spherical and secretes a **cyst wall** around it. Now the parasite is called **oocyst**.

It grows by absorbing nutritive materials from the mosquito through the cyst wall. As a result it increases in size. The fully grown oocysts are seen as projections on the surface of the gut.

The oocyst now undergoes a special kind of sexual reproduction called **sporogony**. During sporogony the nucleus and cytoplasm divide into about 1000 parasites called **sporozoites**.

Each sporozoite is spindle-shaped. They are released into the body cavity of the mosquito by the rupture of the oocyst and the outer layer of the gut wall. They then enter the salivary gland.

For further development, the sporozoites must be introduced into the blood of man.

When a mosquito bites a man, it introduces a small amount of saliva to prevent the coagulation of blood. Along with the saliva the sporozoites are also introduced into the blood of man and the cycle is repeated.

Malaria

It is a kind of fever caused by *Plasmodium* and transmitted by the female *Anopheles* mosquito. Malaria shows the following symptoms:

1. Loss of appetite
2. Nausea
3. Constipation
4. Headache
5. Muscular pain and ache in joints
6. Shaking chillness
7. Sweating
8. Rise in body temperature as high as 106°F at an interval of 48 hours and
9. Anaemia.

Control and Prevention of Malaria

Malaria can be controlled and prevented by the following methods:

1. Destruction of mosquito and its larva.
2. Spraying DDT in and around the houses.
3. Sterilization of mosquito..

4. Rearing the enemies of mosquito and its larvae like larvivorous fishes (stickle backs, minnows and trouts), ducks, dragon flies, etc. This method is called **biological control**.

5. Constructing mosquito proof houses.

6. Using mosquito nets.

7. Applying anti mosquito creams on the surface of the body.

Treatment

Malaria can be treated with the following drugs: **Quinine, Daraprim, Chloroquine, Paludrine, Plasmoquine**, etc.

9. Paramecium

Phylum : Protozoa
 Class : Ciliophora
 Order : Holotricha

(2) *Paramecium* is a **unicellular or acellular or non-cellular animalcule**. Hence it is included in the phylum Protozoa. (It moves

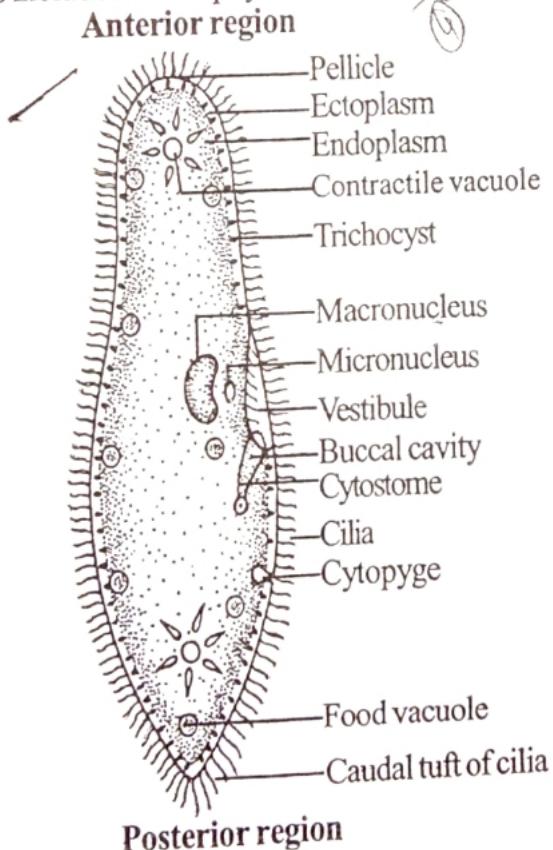


Fig.3.74: *Paramecium*.

with the help of *cilia*. Hence it included in the class *ciliata* or *ciliophora*.)

(1) (*Paramecium* lives in freshwater formations like ponds, pools, ditches, rivers, lakes) and so on. It swims freely in the water. It is omnivorous in habit.

(*Paramecium* looks like a slipper. Hence it is called **slipper animalcule**.) It has a distinct anterior end, a posterior end, a dorsal side and a ventral side. The anterior end is blunt; the posterior end is pointed; the **ventral** side has an oral groove. *Paramecium* is smaller in size. It is minute and microscopic. It has a length of 0.17mm to 0.29mm..

(3) (*Paramecium* is covered by a thin, elastic membrane called **pellicle**.) The pellicle bears hair-like structures called **cilia**. The body is filled with cytoplasm. The cytoplasm contains nucleus, contractile vacuole, food vacuoles, basal granules, trichocysts, etc.

Oral Apparatus

On the ventral side, there is a groove called **oral groove**. The oral groove leads into a funnel-like structure called **vestibule**. The vestibule leads into **buccal cavity**. The buccal cavity is followed by a small opening called **cytostome**. The cytostome opens into a short tubular structure called **cytopharynx**. The cytopharynx ends in the cytoplasm where new food vacuoles are formed. Just behind the cytopharynx there is a temporary opening called **cytophyge** or **cell anus** or **anal spot**.

Cytoplasm

The body of the *Paramecium* is filled with a colloidal substance called **cytoplasm**. The cytoplasm is formed of two regions, namely ectoplasm and endoplasm. Ectoplasm is located just below the pellicle. It is a denser fluid. It contains **basal granules** and **trichocysts**. The central part of the cytoplasm is called **endo-**

4. Porifera

The phylum Porifera includes *pore-bearing* animals called *sponges*. They are the *first multicellular* animals.

General Characters

1. *Porifera* includes pore-bearing animals. They are commonly called *sponges*.
2. All the sponges are *aquatic*.
3. They are *sedentary* in habit.



Leucosolenia



Sycon

Fig.4.1: Some common sponges.

4. They are *asymmetrical* or *radially symmetrical*.
5. They are the first *multicellular* organisms.
6. They have *cellular grade* of organization.
7. They are *diploblastic*. The body wall is formed of two layers, namely an outer *ectoderm* and an inner *endoderm* (choanoderm). The two layers are cemented together by a gelatinous substance called *mesenchyme*.
8. The endoderm is formed of flagellated cells called *choanocytes*.
9. The body is perforated by numerous minute pores called *ostia*.
10. The ostia open into a large cavity called *spongocoel*.

11. The spongocoel opens to the outside by a large opening called *osculum*.

12. The sponges possess an endoskeleton in the form of calcareous *spicules*.

13. Excretion and respiration occur by *diffusion*.

14. They have greater power of regeneration.

15. Reproduction takes place by *asexual* or *sexual* methods.

16. Asexual reproduction is by *budding* or *gemmule* formation.

17. Development is *indirect* or *direct*. The common larval forms are *parenchymula*, *amphiblastula*, etc.

Eg. *Olynthus*, *Leucosolenia*, *Sycon*, etc.

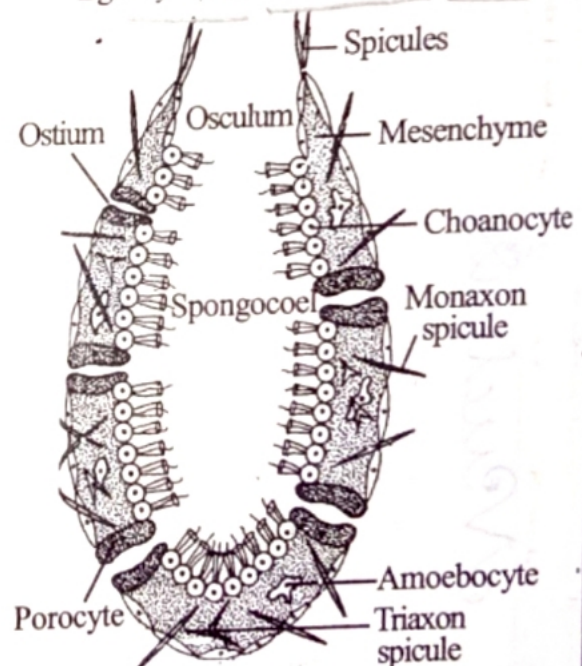


Fig.4.2: L. S. of *Leucosolenia*.