

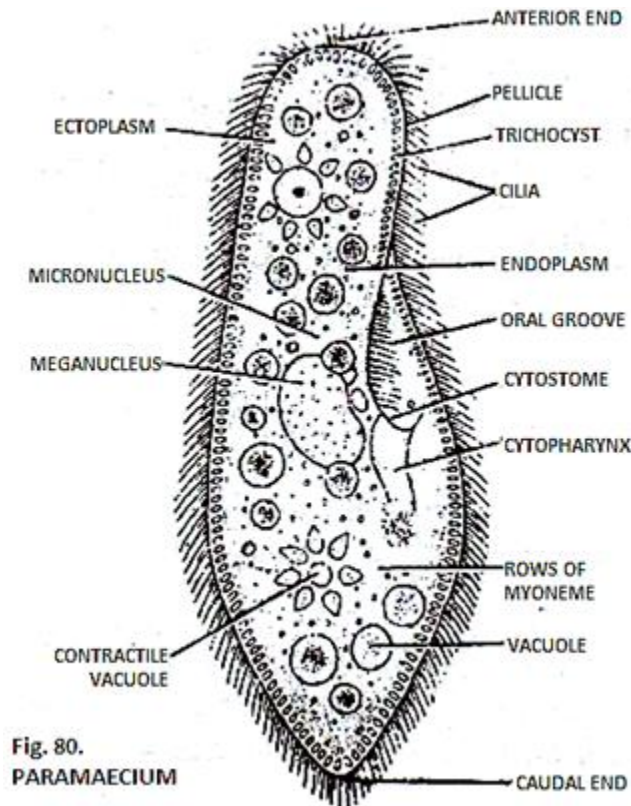
# STRUCTURE OF PARAMECIUM

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It is a single-celled eukaryote belonging to kingdom Protista and is a well-known genus of ciliate protozoa.

Paramecium is a unicellular organism with a shape resembling the sole of a shoe. It ranges from 50 to 300µm in size which varies from species to species. It is mostly found in a freshwater environment.

## Structure (Morphology)



- (1) **Size:** Paramecium is a microscopic, a cellular elongated organism visible to the naked eye as a whitish or greyish spot. The size varies in different species, in length from 80 µ to 350 µ and diameter 170 µ to 290 µ. The greatest diameter of

the cylindrical body is about two third of its entire length. Usually the individuals of the same species may show minor morphological and physiological differences.

(2) **Shape:** Paramecium is a slipper shaped, cigar shaped, or spindle shaped animalcule. Its shape is usually constant and a symmetrical, because slipper like shape. The body is elongated, blunt and rounded at the anterior end and somewhat pointed of the posterior end. In cross section it is circular with greatest diameter behind the centre of body. The anterior half of the body is slightly twisted. The body is distinguished into an oral or ventral surface and an aboral or dorsal surface. The structure is more complicated due to the development of certain organelles in the acellular body.

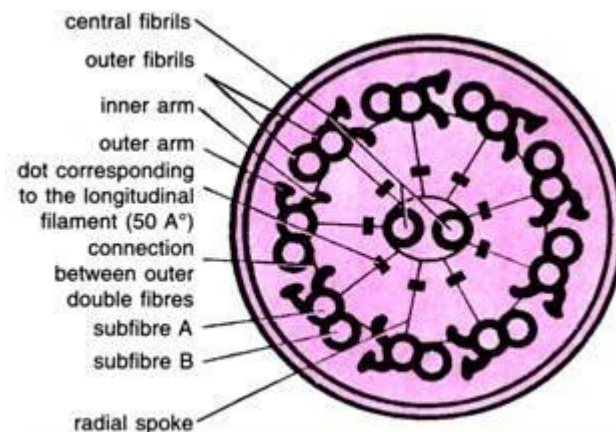
(3) **Oral groove:** The ventral surface of body bears a prominent, oblique and shallow depression is called oral groove, it arise from the middle of body and extends to the left side of anterior end. Posteriorly the oral groove leads into a deeper conical vestibule which is communicates with a buccal cavity having a basal mouth or cytostome.

(4) **Pellicle:** The body of paramecium externally covered by living, thin, clear, firm and elastic cuticular membrane. The pellicle or periplast. It gives a definite body form to the organism.

The pellicle appears to be a regular series of polygonal or hexagonal depressions with their raised margins. Each hexagonal area is perforated by a small aperture through which a single cilium project out. The polygons are defined by a corresponding regular series of cavities is called alveoli. It is the pit in the centre of each alveolus which forms a polygon. The anterior and posterior margins of hexagonal areas bear the openings of trichocysts.

The pellicle of paramecium includes a series of three membranes (i) outer cell membrane (ii) outer alveolar membrane and (iii) inner alveolar membrane.

(5) Cilia: The entire body surface is covered by a uniform covering of numerous, hair like protoplasmic fine projections called cilia. These emerge out from the centre of each polygonal depression (circumelliar space) of pellicles. These measure 10 to 12 $\mu$  in length and upto 0.27 $\mu$  in diameter. There are 10,000 to 14,000 cilia covering the whole body surface. These are arranged in regular longitudinal rows. Their length is uniform throughout, except posterior end of the body forming a caudal tuft so the species name *candatum*. Functions of cilia are locomotion and capturing the food particles.



**Fig. 20.4.** Diagrammatic transverse section of a cilium.

### **Electronic structure**

It consists of a fluid matrix, surrounded by an outer membranes sheath, which is continuous with the outer cell membrane of body. Within matrix are 9 peripheral longitudinal fibres, which run along the whole length of cilium body. Each fibre is formed of two sub fibres, one of which carries a double row of short arms or projections, all running in the same directions (clock wise). In the centre of matrix are two single fibres, which are enclosed within an inner membranous sheath. In between the central and peripheral fibres are nine additional accessory fibres.

### **Internal Structure**

Internal structures are visible through the transparent cytoplasm at fixed positions. The body cytoplasm, beneath the pellicle, is clearly differentiated into two regions, an outer ectoplasm and an inner endoplasm.

- (I) Ectoplasm: The ectoplasm, surrounding the inner mass of endoplasm, forms a clear, dense, thin peripheral layer which is tough, elastic, supporting and protective. It is also called as cortex. The pellicle actually the highly differentiated surface layer of ectoplasm. Beneath pellicle, embedded in the ectoplasm occur three important structures. The infraciliary system, the neuromotor system and trichocysts.
- (II) Infraciliary system: It is constituted by the basal bodies (kinetosome) and kinetodesmata located just beneath the alveoli in the ectoplasm.
  - (a) Kinetosomes or basal bodies: The base of each cilium is produced into a tube like structure, called basal body or kinetosome. It is formed by the thick and basal ends of peripheral fibres of cilium. The central fibres do not enter into it. The wall of basal body consists of 9 triplets of sub fibres. The basal bodies are self duplicating unit and progenitors of new cilia. Each basal body is either a centriole or its derivative. The kinetosomes are arranged in definite longitudinal rows.
  - (b) Kinetodesmata: From kinetosome or basal body of each cilium arises a single fibril of kinetodesmos and runs anteriorly kinetosome of the same row forming a bundle of fibrils called the kinetodesma. The individual fibrils do not run anteriorly further than the five basal bodies. Thus the number of fibrils in each kinetodesma remains constant i.e. five. The kinetodesma and the row of kinetosome associated with it is called a kinety. All the kinetics together form infraciliary system. This is supposed to coordinate the beating of cilia.
  - (c) Neuromotor system: The light microscope reveals that beneath the pellicle of paramecium there are also present ectoplasmic fibrils, other than kinetodesmata, with no surface spinations.

(d) Trichocysts: Beneath the pellicle and alternating with alveoli or basal bodies, are present numerous peculiar, tiny, spindle shaped or bottle shaped organelles and oriented at right angles to the body surface is called trichocysts. These are very small in size, measuring about  $4\ \mu$  in length and  $2\ \mu$  diameter. It opens to the exterior through a minute pore just above it in the pellicle. Each trichocyst consists of an elongated shaft and a terminal pointed tip, called the spike or barb, covered by a cap. The matrix of shaft consists of a dense mass of a fibrous protein, called trichinin. Its fibres remain condensed forming a cross striated lattice work.

If the animal is irritated by mechanical, chemical or electrical stimulation than the trichocyst may be discharged to the exterior in only a few milliseconds. When fully discharged the shaft becomes a long cross striated rod and measure about  $40\ \mu$  in length. It is believed that the discharged process consists of an unfolding of the lattice of trichinin fibres.

## **(II) Endoplasm**

Below the ectoplasm the large, central, granular and sensefluid zone is the endoplasm or medulla. It includes the usual cell components like food vacuoles, reserve food granules of starch, glycogen and fat, mitochondria, golgi bodies, ribosomes and various crystals and other cytoplasm inclusions of varying size, shape and character.

(1) Nuclear apparatus: Paramecium is heterokaryotic as it differs from amoeba in having two types of nuclei which can be seen in properly stained specimens. In *P. caudatum* there is a large macronucleus, two micronuclei are present in *P. Aurelia* and many in *P. multimicronucleatum*.

(a) Macronucleus: The macronucleus is roughly kidney shaped and with in conspicuous nuclear membrane, posses many nucleus and much more chromatin material (DNA). Macronuclear is the somatic or vegetative nucleus and controls the

metabolic activities of the cell. It is derived from micronucleus during reproductive processes. It is situated near the cytostome.

- (b) **Micronucleus:** A small rounded micronucleus is lodged in a depression on the surface of the macronucleus. It has a nuclear membrane and with diploid number of chromosomes. It controls the reproductive activities of the organism.
- (c) **Contractile Vacuoles:** In paramecium, unlike amoeba, there are two large liquid filled contractile vacuoles occurring some what fixed position in endoplasm of one an either end of body close to the dorsal surface.

The contractile vacuole opens to the outside through a distinct discharge canal in the pellicle of dorsal side. Each contractile vacuole is surrounded by six to ten elongated radiating canals, which are also known as feeding canals or radiating canals. Each feeding canals is differentiated into:

- (i) Injector canal, which opens into the vacuole.
- (ii) Aunpulla, which collapses when empty
- (iii) Terminal part, which extends in the cytoplasm. The distal end of terminal part is associated with the nephridial canals.

Each contractile apparatus includes some of the tubules of the endoplasmic reficulum, nephridial tubules feedar canals, accessory vacuoles (radioal canal) and the main contractile vacuole. Main functions of contractile vacuoles are:

- (i) Osmoregulation
- (ii) Excrete excess water taken up from the hypotonic medium.
- (iii) Pasterior vacuole pulsates faster than anterior vacuole.

### **(III) Food Vacuoles**

Numerous non-contractile food vacuoles are found inside the endoplasm is term as gastrides. The food vacuoles move by its streaming movement in that endoplasm is

called cyclosis. The shape and size of the food vacuoles depend upon the nature and shape of food organism, mostly they are rounded in form.

#### **(IV) Oral Apparatus**

In paramecium, there is a broad shallow oral groove leads ventrally and posteriorly. The oral groove extends obliquely backwards into a buccal funnel shaped depression called vestibule. The vestibule leads into a wide tubular passage, the buccal cavity. It leads into a wide cytopharynx through a fixed, oval shaped opening called cytostome. The cytopharynx forms a food vacuole at its proximal end.

The cilia in the oral passage show a good deal of variation in size and arrangement. Some special cilia in the buccal cavity are fused in a crescentic manner to form an endoral membrane. It runs transversely along the right wall and marks the junction of the vestibule and buccal cavity.

Besides, three other ciliary organelles or membranelles are also present in the buccal cavity. These are ventral peniculus, dorsal peniculus and quadrulus. The two peniculi (dorsal and ventral) are located on the left wall of the buccal cavity, each consisting of four rows of cilia. The ventral peniculus is short and stops at the cytostome. The dorsal peniculus is longer, crosses over to the right wall at the cytostome and terminates on the right wall of the cytopharynx. The ventral and dorsal peniculi seat in opposite directions. The quadrulus also consists of four rows of cilia. It extends over to the right wall near the cytostome and terminates near the end of the dorsal peniculus.

#### **(V) Cytopyge or Cytoproct**

Near posterior end of the body, a little behind cytostome and the little to the right side, a small portion of ectoplasm and pellicle is. Somewhat weak, here, at the time of egestion a minute aperture called cell anus, cytopyge or cytoproct is visible. It is

not clear that whether it is a permanent opening or temporary opening formed at the time of egestion.