Nutrition of Paramecium Caudatum

In Paramecium Caudatum, nutrition is holozoic. The food comprises chiefly bacteria and minute Protozoa. Paramecium does not wait for the food but hunts for it actively.

It is claimed that Paramecium Caudatum shows a choice in the selection of its food, but there seems to be no basis for this though it engulfs only certain types of bacteria; available data suggest that 2 to 5 million individuals of Bacillus coli are devoured by a single Paramecium in 24 hours. It also feeds on unicellular plants like algae, diatoms, etc., and small bits of animals and vegetables.

Feeding Mechanism

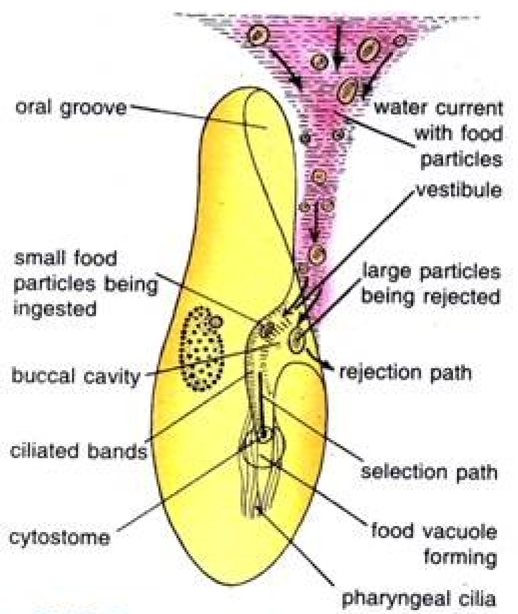

Fig. 20.16. *Paramecium.* Ciliary action creating vortex and drawing food particles into the oral groove with the water current.

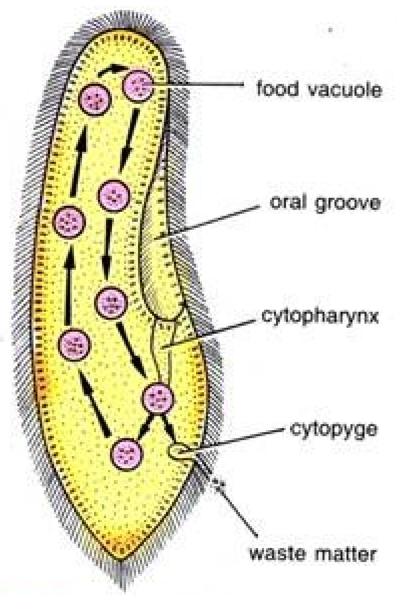

Fig. 20.17. *Paramecium.* Showing cyclosis and the course of food vacuoles in the endoplasm.

- When Paramecium Caudatum enters a region of abundant food, it comes to rest.
- It feeds only at rest or when swimming very slowly, it never feeds when swimming fast.
- The beating of cilia of the oral groove causes a cone-shaped vortex of food-laden water to be swept into the oral groove from a distance in advance of the anterior end.

- The particles of food then go to the vestibule from where some food particles are rejected and thrown out, but others pass into the cytostome.
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  At the end of the cytopharynx, a food vacuole is formed which gets filled with particles of food.
- The quadrulus and peniculi control the passage of food into the food vacuole which is formed laterally. When the food vacuole reaches a certain size the post-buccal fibres clasp the food vacuole and it is pinched off by them and started on its course.
- The vacuole contains some water besides the food. Rotary streaming movements of endoplasm called cyclosis carry the food vacuoles along a definite course which is functionally equivalent to a digestive tract.
- The tract begins from the end of the cytopharynx, then to the posterior side, then forwards to circulate with the endoplasm, then to the dorsal surface, then towards the anterior end, then downwards to the cytopyge.
- Early on its journey the food vacuole decreases in size, then increases again.

Digestion and Egestion of Paramecium Caudatum

- During cyclosis, digestion occurs by enzymes secreted by protoplasm into the vacuoles.
- In digestion, proteins are changed into amino acids, carbohydrates into soluble sugars and glycogen, and fats are probably also digested.
- The contents of food vacuoles are at first acidic (pH about 4) and then become alkaline, major digestion occurs during the alkaline phase.
- The undigested matter is egested through the cytopyge with some force.
- Cyclosis can be demonstrated experimentally; if milk stained with Congo red is fed to Paramecium, the fat globules of milk in the food vacuoles will first turn red due to acidic reaction of enzymes, then they will change from shades of purple to blue due to alkaline reaction, the vacuoles will show the course of cyclosis.

Respiration and Excretion of *Paramecium caudatum*

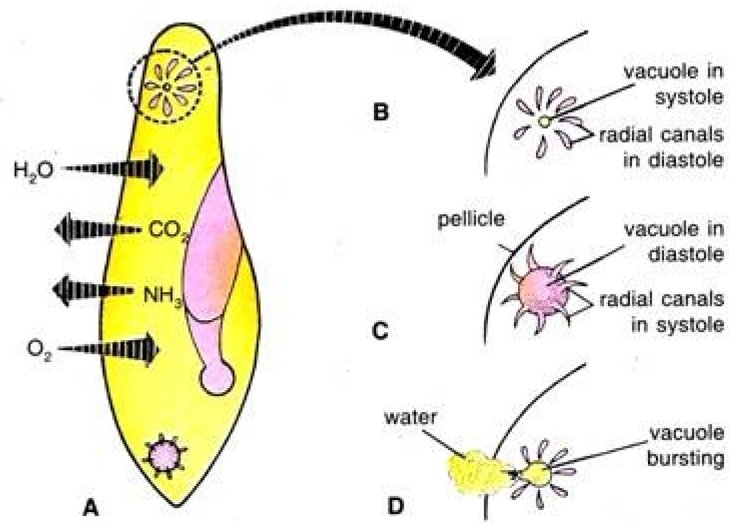
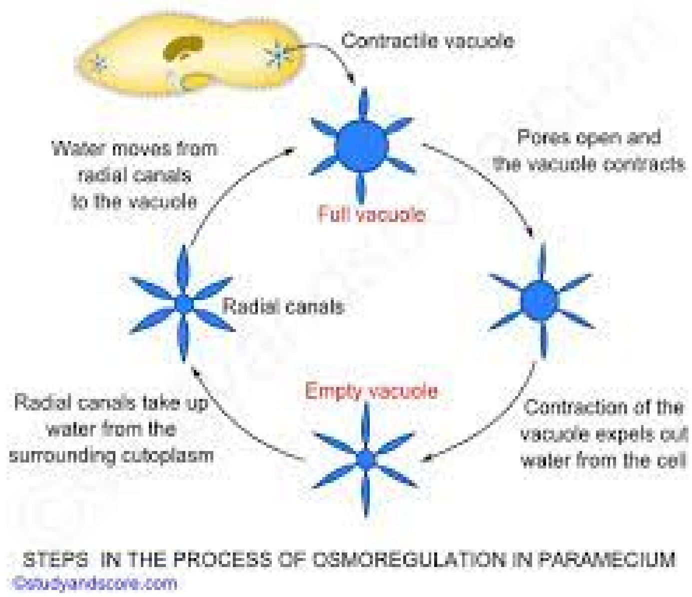


Fig. 20.18. *Paramecium.* Diagrammatic sketch to show the process of respiration, excretion and osmoregulation.

- The exchange of gases (oxygen and carbon dioxide) takes place through the semi-permeable pellicle like other freshwater protozoans by the process of diffusion.
- Paramecium Caudatum obtains its oxygen from the surrounding water.
- Carbon dioxide and organic wastes like ammonia resulting from metabolism are probably excreted by diffusing outward into the water in the reverse direction.

Osmoregulation in Paramecium Caudatum



- Paramecium Caudatum has two contractile vacuoles, one anterior and one posterior.
- The function of the contractile vacuoles is osmoregulation, i.e., to regulate the water contents of the body and may serve also in excretion of nitrogenous wastes such as urea and ammonia.
- Excess of water (because of continuous endosmosis) within cytoplasm is secreted into the tubules of endoplasmic reticulum and goes to nephridial tubules → feeder canals → and collect into ampulla of a series of 6 to 11 radiating canals that converge toward and discharge into each vacuole.
- The canals are most conspicuous as a vacuole is forming.
- When each vacuole is swelled (diastole) to a certain size, it contracts (systole) and discharges to the exterior probably through a pore. The contractile vacuoles contract alternately, at intervals of 10 – 20 seconds.
- The posterior contractile vacuole works faster than anterior vacuole because of intake of large amount of water into the posterior region by the cytopharynx.
- The contractile vacuoles maintain an optimum concentration of water in the body cytoplasm by disposing of the excess.

Behaviour of *Paramecium caudatum*

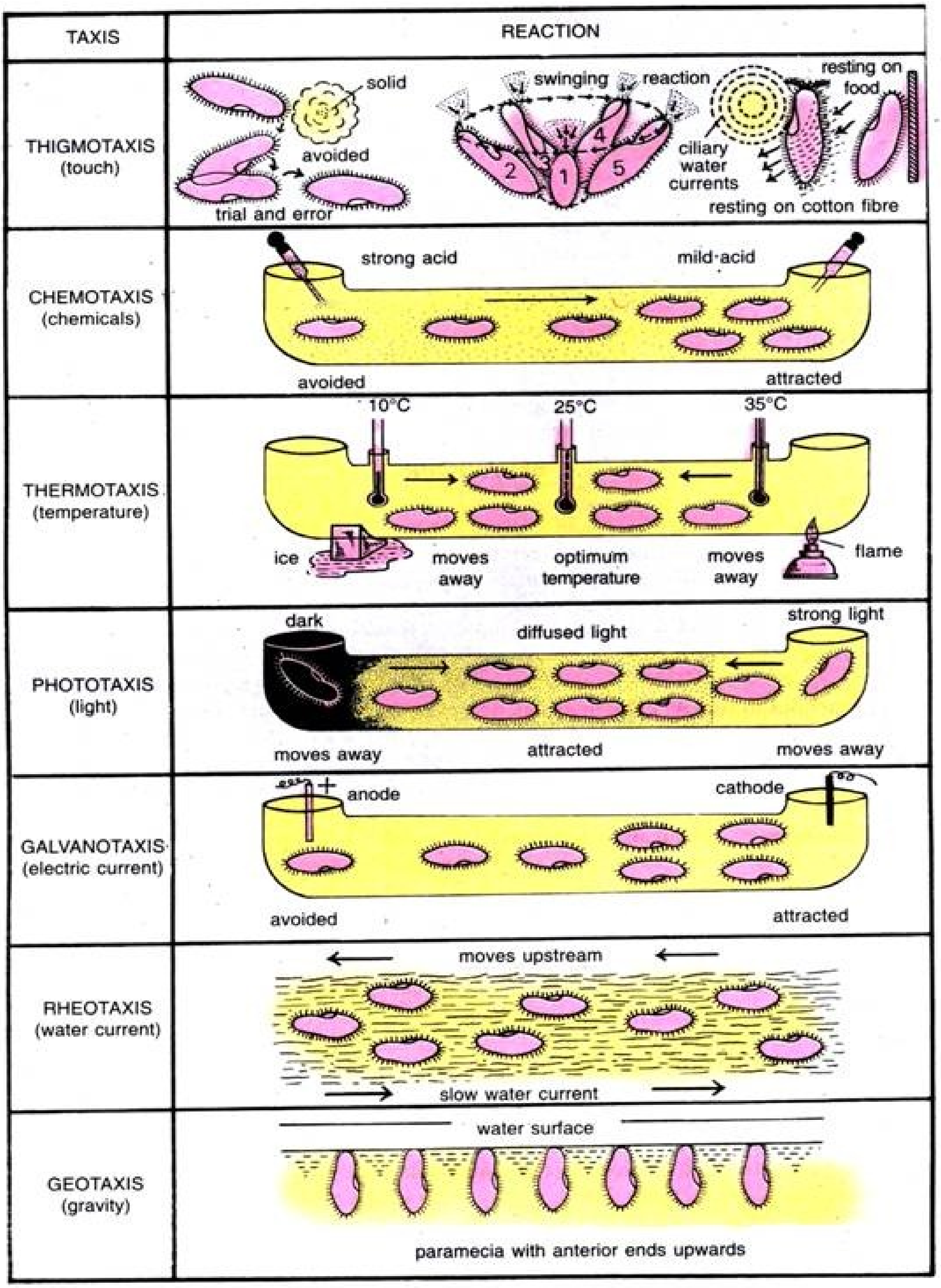


Fig. 20.19. *Paramecium*. Responses to different stimuli.

The responses of Paramecium Caudatum to various kinds of stimuli are learned by study of its reactions and of the grouping or scattering of individuals in a culture. The response is positive if the animal moves toward a stimulus and negative when it moves away. To an adverse stimulus the animal continues to give the avoiding reaction until it escapes.

In avoiding reaction, the ciliary beat reverses, the animal moves backward a short distance, and then rotates in a conical path by swerving the anterior end aborally while pivoting on the posterior tip. All adjustments are made by trial and error. Experiments have shown that the anterior end of the animal is more sensitive than the other parts.

The responses of Paramecium to different stimuli may be grouped as follows:
(i) Reactions to contact (Thigmotaxis):
Response to contact is varied in Paramecium. If the anterior end is lightly touched with a fine point, a strong avoiding reaction occurs. When a swimming Paramecium collides with some object in the water, but if touched elsewhere there may be no response. A slow moving individual often responds, positively to contact with an object by coming to rest upon it.

(ii) Reactions to chemicals (Chemotaxis):
Generally Paramecia respond to a chemical stimuli by means of avoiding reaction. If a drop of weak salt solution (0.5 per cent) is introduced in a Paramecium population on a micro-slide, the animals respond with the avoiding reaction and none enters the drop. To acids, however, the response is positive even when the concentration is of sufficient strength to kill them.

(iii) Reactions to temperature (Thermotaxis):
Paramecium seeks an optimum temperature of 24 to 28°C. When a temperature change occurs markedly above or below the optimal range, Paramecia show an avoiding reaction. Greater heat stimulates rapid movement and avoiding reactions until the animals escape or are killed.

(iv) Reactions to light (Phototaxis):
With the exception of the green Paramecium bursaria, which is positively phototactic, other species are indifferent to ordinary light. However, when the light

intensity is suddenly and sharply increased, a negative reaction generally follows. Paramecia exhibit an immediate negative response to ultraviolet rays.

(v) Reactions to electric current (Galvanotaxis):
Paramecia respond to electric stimuli. When two electrodes are placed opposite each other in a shallow dish containing Paramecia and a constant current applied, all the organisms swim in the same direction toward the cathode or negative electrode where they concentrate in large numbers.

If the direction of the electric current is reversed while the Paramecia are swimming toward the cathode, the organisms reverse the direction and swim toward the new cathode.

(vi) Reactions to water current (Rheotaxis):
Paramecia show a positive rheotaxis. In a gentle water current the Paramecia will mostly move with the flow with their anterior ends upstream.

(vii) Reactions to gravity (Geotaxis):
Paramecia generally exhibit a negative response to gravity as seen in a culture where many individuals gather close under the surface film with their anterior ends uppermost. If Paramecia are introduced in an inverted water filled U-shaped tube stoppered at both the ends, they immediately move upward into the horizontal part of the tube.