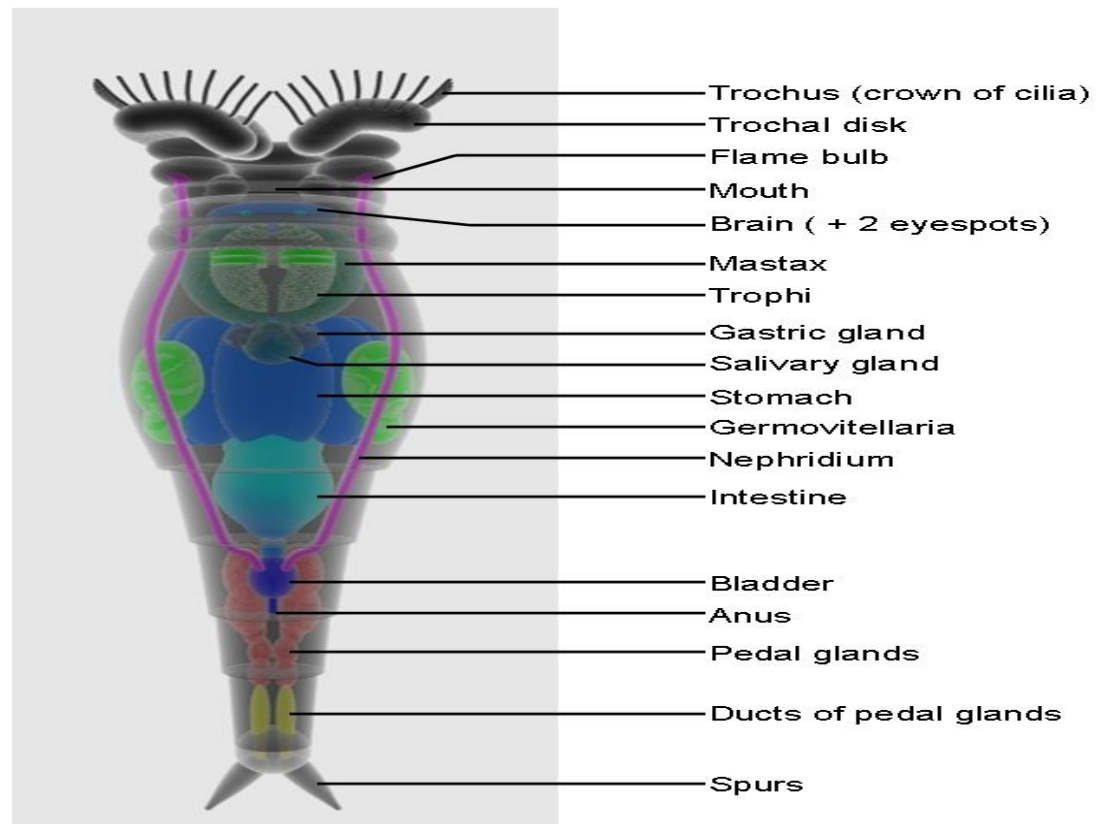


Structure and Affinities of Minor Phyla Rotifera

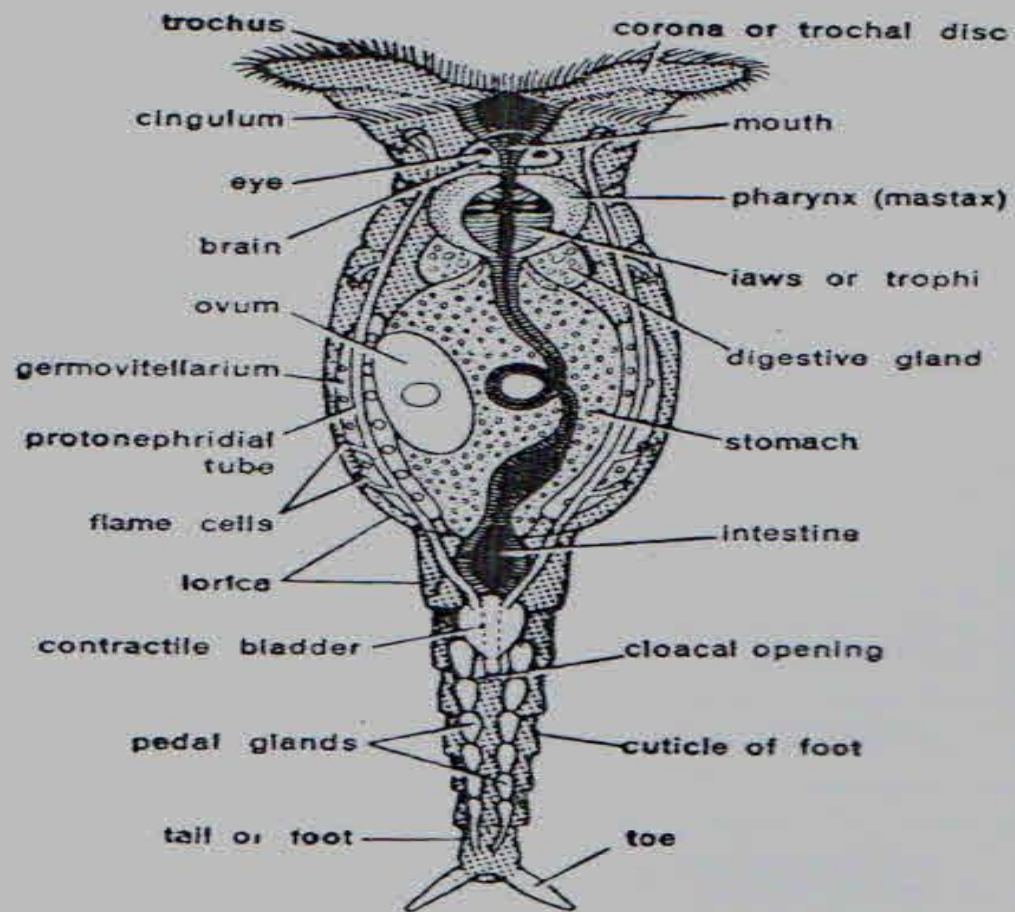
The Rotifers are very common and abundant freshwater animals, commonly designated as the “wheel animalcules”. The phylum name Rotifera is derived from two Latin words (*rota*-wheel; *ferre*-to bear) and means “wheel-bearers”. The common but old fashioned title of “wheel animalcules” refers to the rapid movements of cilia in a regular sequence on one or more disc-like lobes of the head, producing the appearance of a rotating wheel.

Habit and Habitat

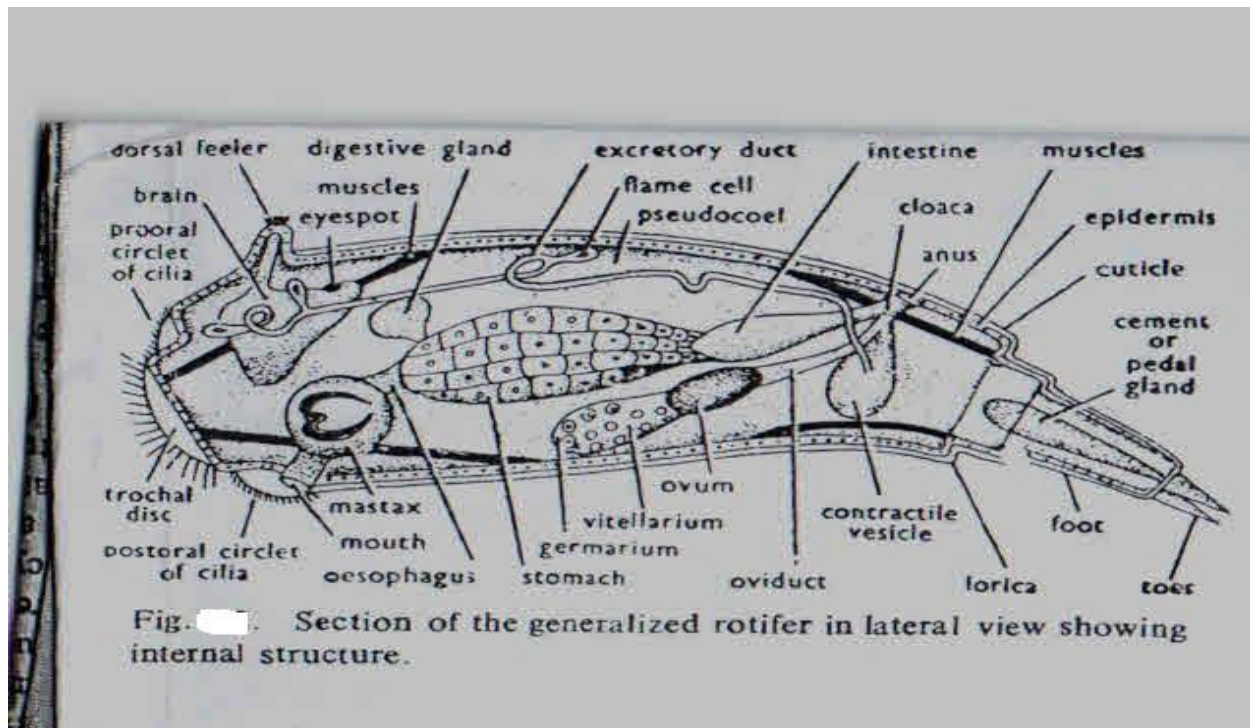
The rotifers are among the most common inhabitants of freshwaters everywhere. Some also live in brackish water and a few in the ocean or on land in damp sites. They have adopted a variety of habitats and ways of life.



A bdelloid rotifer (*Philodina*)

Fig. XXXX *Philodina rosela*.

or trochal disc, with a central unciliated apical field. The



External Characters:

Rotifers or wheel animalcules are minute animals ranging from 0.04 to 2 mm in length and most of them do not exceed 0.5 mm. The rotifer body is generally of elongated form and is divisible into the broad or narrowed or lobed anterior end, usually provided with a ciliary apparatus. An elongated trunk, often enlarged and a slender terminal region, the tail or foot. The body is covered with an evident yellowish cuticle that is often ringed throughout or in certain regions. The anterior end bearing the mouth corona and various projections is not definitely delimited as a head but may be called so for convenience.

It is typically broad and truncate or slightly convex, presenting an unciliated region, the apical field, encircled by a ciliated zone, the corona. The head may also bear a pair of prominent lateral ciliated projections, known as auricles. Eyes (pigment spot ocelli) appearing as red flecks, occur singly or paired in the brain, as lateral paired eyes in or near the corona and as paired frontal eyes on the apical field or on the rostrum. Characteristic trunk structures of rotifers are the dorsal and lateral antennae or palps. The dorsal antenna, usually single, sometimes and probably originally paired, is commonly situated in the mid-dorsal line of the anterior end of the trunk and when well developed is a finger like projection tipped with sensory hairs.

The anus is found in the mid dorsal line at or near the boundary of trunk and foot. The foot is commonly provided at or near its end with one to four movable projections known as toes, used in holding the substratum while creeping. The toes may be short and conical or slender and spine-like. The pedal glands commonly open at the tips of the toes. In addition to the toes, the foot may bear

either similar projection known as styles, spurs, etc. The rotifers are dioecious. In the majority of rotifers, the males are greatly reduced in size and morphology.

Corona of Rotifers

The corona or “**wheel organ**” is the most striking feature of the rotifers. The ground plan of the corona comprises a large oval ventral field, the buccal field evenly ciliated with short cilia and surrounding the mouth. A corona is absent in the adult females of the genera *Atrochus*, *Cupelopagis* and *Acyclus* but is present in normal form in the males and young females of these genera. The corona of male rotifers usually differs from that of females of the same species, being usually less modified.

Body wall and Associated glands of Rotifers

The body wall consists of cuticle, epidermis and sub-epidermal muscles. The cuticle, secreted by the epidermis, is not chitinous and presumably consists of scleroproteins. It is frequently divided into rings or segments that lend flexibility permitting a variety of body movements. In many rotifers the trunk cuticle is thickened and hardened into a lorica that, however, is slightly flexible. The epidermis is a thin syncytium containing scattered nuclei bilaterally arranged and constant in position and number for each species. Around each nucleus or group of nuclei the cytoplasm is heaped up into an elevation projecting into the pseudocoel. The principal glands attached to the epidermis are the retro-cerebral organ and the pedal glands.

Muscular System of Rotifers

In rotifers, the sub epidermal muscles consist of a number of muscles found in different parts of the body. In typical cases they are circular and longitudinal muscles. In addition to these body wall muscles there are cutaneovisceral muscles that extend to the viscera, especially the digestive tract, from the body wall, and visceral muscles in the walls of the viscera themselves.

The circular musculature of the body wall consists of a single muscle band, mostly three to seven, widely spaced running close to the underside of the epidermis in a circular direction. The contraction of the circular muscles serves to extend the body. The circular musculature is specially developed in the head directly behind the corona where it forms the coronal sphincter composed of one to several broad bands and serves to close the neck over the retracted corona. A similar pedal sphincter may occur at the junction of trunk and foot.

Digestive System of Rotifers

The mouth is rounded, slit-like or triangular, situated ventrally on the head, beneath the mouth the cingulum may form a definite lower tip. In forms with a large buccal field, the posterior end of the field may project as the so called chin. The mouth may open directly into the pharynx or may lead to the latter by way of ciliated tube, the buccal tube. The pharynx or mastax is characteristic and peculiar to rotifers. It is a highly muscular, rounded, trilobed or elongated organ of complicated

form and structure, whose inner wall bears the masticatory apparatus composed of hard cuticularised pieces, the trophi.

The trophi consist of seven main pieces the unpaired fulcrum and the paired rami, unci and manubria. The mastax is followed by a short or long tube, the oesophagus. The oesophagus is lined with cuticle or ciliated throughout or at the posterior end only. The oesophagus is devoid of glands. The oesophagus is followed by the stomach. It is an enlarged thick walled sac or tube. The stomach is followed by the intestine. In one case the intestine is tubular and in other bladder-like. The stomach and intestine are attached to the body wall by the usual cutaneovisceral muscles.

Nervous System of Rotifers

The nervous system consists of a main bilobed mass, the brain or cerebral ganglia, sensory and motor nerves from this to adjacent parts, some additional ganglionic masses and two main ventral nerve cords. The brain is a rounded, triangular or quadrangular body lying dorsal to the mastax. A number of paired sensory nerves extend to the brain from the various sense organs of the head, the eyes. The sensory bristles and pits on apical field, the rostrum and the dorsal antenna. The brain also sends motor nerves to the anterior parts of the various muscles, as the dorsal, lateral and central retractors and to the salivary glands. The main ventral nerves are ganglionated cords that spring from the sides of the brain and proceed backward in latero-ventral position into the foot.

Sensory Structures of Rotifers

The rotifers are richly supplied with sensory cells and sense organs. These occur abundantly on the anterior end in the form of sensory membranelles and styles, ciliated pits, sensory papillae, etc. A sensory organ constantly present in rotifers is the dorsal antenna or tentacle. This is typically a movable papillae or finger-like projection provided at its tip with one or more tufts of sensory hairs. The sensory membranelles or styles are single stiff bristles situated near the inner edge of the circumapical band and named from their position dorsolateral, lateral and ventrolateral styles. These styles seem to be tactile organs and each is underlined by one or two sensory nerve cells from which fibers go to brain. Paired ciliated pits, apparently chemo-receptors, may occur on the apical field. Conical or finger-like palps tipped with sensory hairs.

Excretory System of Rotifers

The excretory system consists of a pair of typical protonephridial tubules provided with flame-bulbs and opening posteriorly into a common urinary bladder. The main tubules extend lengthwise the animal, one on each side, commonly in coils and loops and often fork into an anterior and a posterior branch. The flame bulbs, usually two to eight on each side, open into a ciliated capillary that enters the end of the main tubule or its branches and may run alongside the main tubule for some distance. The thickened cap-like end frequently bears one to several protoplasmic filaments that anchor the bulb mostly to the body wall.

Reproductive System of Rotifers

The rotifers are exclusively dioecious. In rotifers, there exists a marked sexual dimorphism. The greatest sexual dimorphism is seen in the order Flosculariacea and Collothecacea, where the free swimming males are one tenth or less the size of the females and have a simple ciliated anterior end in place of the elaborate coronal lobes of the female. In the majority of rotifers, the female reproductive system consists of a single syncytial ovary and syncytial vitellarium bound together in a common membrane that continues to the cloaca as a simple tubular oviduct. The male reproductive system consists of a single large sacciform testis from which a ciliated sperm duct receiving a pair, sometimes more, of prostatic glands proceeds to the genital pore. The posterior end of the sperm duct is eversible as cirrus and is lined with hardened cuticle; or it may bear a cuticular tube protrusible as a penis; or the body wall around the gonopore can assume a tubular form and so act as copulatory organ.

Affinities of Rotifers

1. Affinities with Arthropoda: It was based on the following resemblances:
 - Body covered by a cuticle.
 - Superficial metamerism
 - Presence of two jaws (trophi).
 - The moving bristle-bearing arms of *Pedalia* suggest the appendages of a crustacean larva.
2. Affinities with trochophore:
 - Some adult rotifers bear a close resemblance with the free swimming trochophore larva of Annelida, Mollusca, Nemertinea and Bryozoa.
 - The peculiar rotifer, *Trochosphaera*, appears almost like a sexually mature trochophore with mastax.
 - Its ciliary girdle, bent intestine and excretory organs are topographically similar to corresponding parts of the trochophore.
 - The striking resemblance led Hatschek to propound his famous trochophore theory, which maintains that the living rotifers are closely related to the ancestral Mollusca, Annelida and certain other groups.
3. Affinities with Platyhelminthes:
 - The anatomy and embryology both incline to the origin of the rotifers from some low grade creeping bilateral type such as a primitive flatworm.
 - The primitive type of corona may be the remnant of a former complete or ventral ciliation such as found in the Turbellaria.
 - The strongest point of resemblance between rotifers and turbellarians is, however, the protonephridial system which is practically identical with that of the rhabdocoels.
 - The presence of this type of excretory system practically precludes the derivation of the rotifers from any higher group since none of the higher groups have protonephridia with flame bulbs.
 - The retro-cerebral organ is probably homologous with the frontal organ of Turbellaria.

- The division of the female gonad into ovary and vitellarium is another resemblance to flatworms.

On the other hand the rotifers differ from flatworms in the presence of anus and the lack of a sub-epidermal muscle sheath and of the sub-epidermal nerve plexus so characteristic of the Turbellaria. On the whole the rotifera show a great resemblance to the Turbellaria than to any other invertebrate group and may be considered as relating the Aschelminthes to the Platyhelminthes.