D.B.S. P.G. COLLEGE,

KANPUR

DEPARTMENT	ZOOLOGY
CLASS	B.Sc
SEM,	5TH
PAPER	2
PAPER CODE	BO50502T
UNIT	1
TOPIC	HERDMANIA-1
BY	DR ANUPAM DUBEY

HERDMANIA : A SEA SQUIRT

- The members of **the subphylum *Urochordata* or *Tunicata*** are mostly sessile and **exclusively marine** animals.
- The genus ***Herdmania*** belongs to the class **Ascidiacea** popularly called the ***'ascidians'* or *'sea squirts'***.
- The genus ***Rhabdocynthia*** was first established by **Herdman in 1891.**
- **Systematic Position**

Phylum	**Chordata**
Subphylum	**Urochordata**
Class	**Ascidiacea**
Subclass	**Pleurogona**
Order	**Stolidobranchia**
Family	**Pyuridae**
Type	***Herdmania* (*sea squirt*)**

Derivation of Names

- The **urochordates** are characterized by the confinement of the '**notochord**' and the nerve cord to the tail of their tadpole larva, hence the name ***Urochordata* (Gr. *tiros,*= tail; *chorda,*= cord**).
- **Urochordates** are commonly called '**ascidians**'.
- The other name of the subphylum, i.e., ***Tunicata*** (L. ***tunica,* outer covering),** is due to a protective leathery case, called ***tunic* or *test,***.
- Which is surrounds the entire body of the degenerate adult.
- The ascidians, when **disturbed**, forcefully eject two **jets of water** from the two siphons by sudden contraction, hence the popular name ***'sea squirts'***.
- **In Tamilnadu**, the fishermen refer to ***Herdmania* or an ascidian as**
- ***'undapasei(****undo,* = round; *pasi,* = weed) meaning **'round weed'**, because its more or less oval body is covered by a **green sea-alga.**
- Another **Tamil name given** to it is *'**mulaikanna'** (**mulai,*- breast; *kanna,*= teats**) which signifies the two teat-like projecting siphons at the free end of the ascidian.

External Morphology

Shape, size and colouration.

- The body is laterally compressed and somewhat oblong or rectangular in shape with the attached end slightly narrower than the free end.
- The whole animal looks like a purse, bag or potato.
- An average adult measures about **9.5 cm long, 7 cm broad and 4 cm thick**.
- The foot, when present, measures **3 to 4 cm long**.
- The **size, however, increases** with age and some older individuals as large as **13 x 8 x 4.5 cm** have been recorded.
- Fresh specimens are pinkish in colour due to distribution of superficial blood capillaries in the test.
- It shows scattered bright red patches due to vascular ampullae, which is a characteristic feature of ***Herdmania*** **(ascidians**).
- Preserved specimens appear yellowish-brown colour .

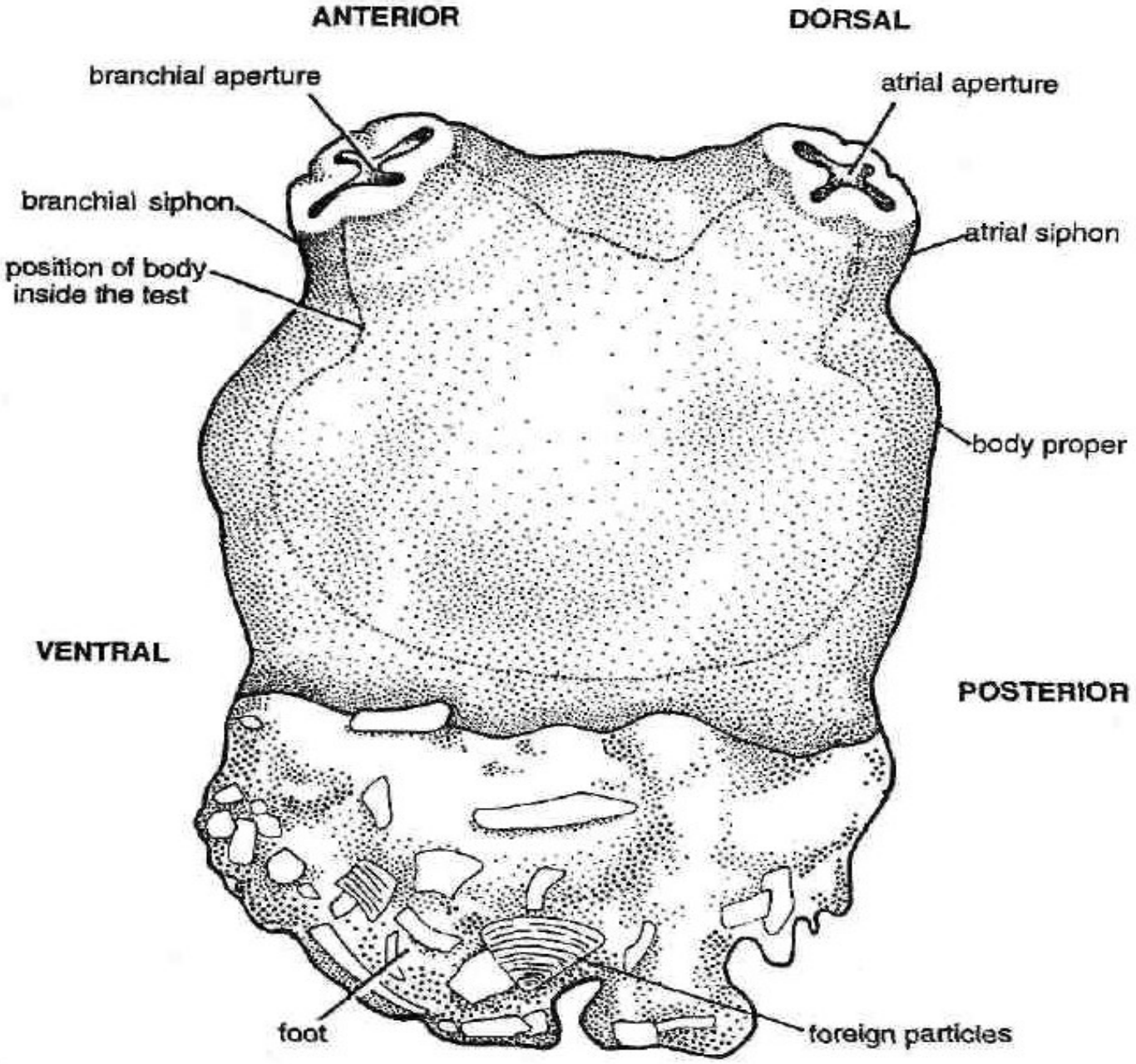
Division of body.

The body is covered by the test and divisible into two parts : ***body proper*** **and** ***fool***

1. Body proper.

- The distal free part of the animal is ***body proper***.
- It is broader and longer than the **basal part or foot**.
- The free end of the body proper is drawn into two short cylindrical projections called the ***branchial*** **and** ***atrial siphons*** **or** ***funnels***.
- Both the siphons are situated at the same level.
- The *branchial* or *oral siphon* is smaller**, about 1 cm long** and directed outwards. It bears a terminal opening called the ***branchial aperture*** **or** ***mouth*** **or** ***incurrent opening***.
- The **atrial or cloacal siphon is larger**, **about 1.5 cm** long and directed upwards.
- Its terminal opening is called the **aerial** aperture **or excurrent opening**.
- Each aperture is guarded by four distinct lobes **or lips** formed by the much elastic test.
- At the slightest disturbance, they contract and close the aperture.
- The margin of each aperture is marked by a bright red line when fully expanded.
- The branchial aperture is considerably wider in comparison to the **atrial** aperture, to

allow better influx of water carrying food, oxygen, etc.



Herdmania. External features in left view.

2. Foot.

- The foot is entirely made by the **test or tunic**.
- It **is dirty in colour** and rough due to **sand particles**, shell pieces and other foreign bodies attached to it.
- **Its shape and size is variable**.
- If the **substratum** is **quite hard**, such as a rock or **a mollusc shell**, the body proper becomes attached by forming a broad, **flajt** or **concave *base*,** and the foot is absent.
- On a sandy bottom, the animal **anchore**s its body by extending a foot **which** may be narrow, elongated, oval or irregular depending on the nature of substratum.
- A fully extended foot may attain a length **of 3 to 4 cm**.
- Besides attachment and anchorage, the foot acts as a balancer (being heavier than body) to keep the body erect

when detached.

Orientation.

- The body of *Herdmania* has a definite but peculiar orientation.
- The two flat surfaces represent the ***right*** **and** ***left lateral sides***.
- The ***anterior*** **and** ***dorsal ends*** are demarcated by the branchial and **atrial apertures, respectively**.
- Their opposite sides correspondingly represent the ***posterior*** **and** ***ventral ends*** which are partly free and partly attached.
- This unusual orientation is caused by the **rotatory changes** undergone by the larva during **metamorphosis.**

Test or Tunic

- The test or tunic forms a **protective jacket (covering)** around the body and also acts as an accessory **respiratory organ and** a receptor organ.
- It is **soft, 4-8 mm thick**, leathery and transluscent.
- It is almost transparent in young stage but becomes opaque in the adult due to thickening.
- The test is wrinkled in appearance with a number of folds and depressions running all over the surface.
- It **wears** off **continuously from** the outer surface and replaced from inside by the epidermis of mantle which secretes it.
- The entire foot is made of test only.
- As already described, the test **harbours** a large number of organisms such as algae, hydroids, anemones, molluscs, barnacles and other nonascidians .
- The **test cuts like** soft cartilage and is **composed** of

  (i) A clear gelatinous matrix in which cells are embedded,

  (ii) Corpuscles of various types,

  (iii) Interlacing fibrils,

  (iv) Branching blood vessels

  (v) Calcareous spicules.

1. Matrix.

- The **gelatinous matrix or** ground substance is made of a **poly-saccharide called tunicine*** which is similar to plant cellulose, some proteins and minerals.

2. Corpuscles.

- The cells found in matrix are mesodermal in origin and are **of 6 or 7 different types** :
- (i) large eosinophilous cells are spherical in shape and fewer in number. These cells stain bright red with eosin.
- (ii) small amoeboid cells are small cells, amoeboid in nature, without any constant shape,
- (iii) small eosinophilous cells possess an eccentric nucleus and are more numerous,

- (iv) spherical vacuolated cells are small in size, possessing vacuoles and nucleus is invisible,
- (v) granular receptor cells are probably sensory in function.

  - These cells are less abundant and are surrounded by nerve fibers,
- (vi) small branched nerve cells are small and possess two to six long processes (dendrites).

  - These cells are more numerous than the receptor cells.

  - Nerve cells are supposed to play an important role in communication of the stimuli from the receptor cells to the other **parts of the test.**

  - **According to Das (1936**), the sensitiveness of Herdmania is due to the presence of nerve cells in the **test, and**
- (vii) **squamous epithelial cells .**

3. Interlacing fibrils.

- These from a fine network in the test.
- Some of them are like smooth muscle fibres, while others **resemble nerve fibres**.

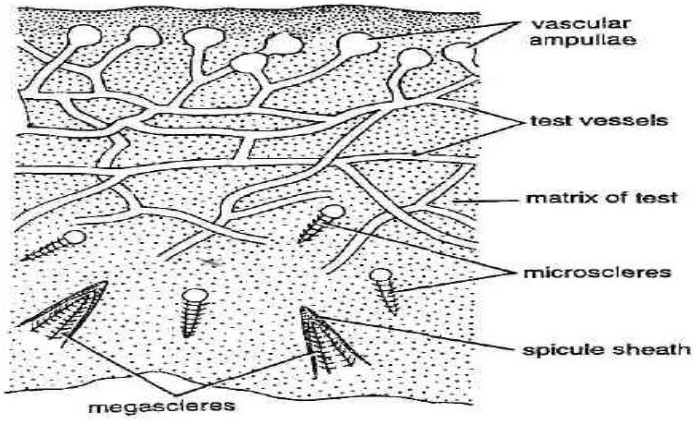
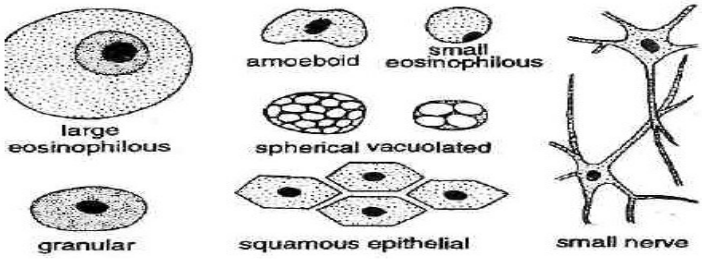


Fig. 2. *Herdmania*. V.S. test.



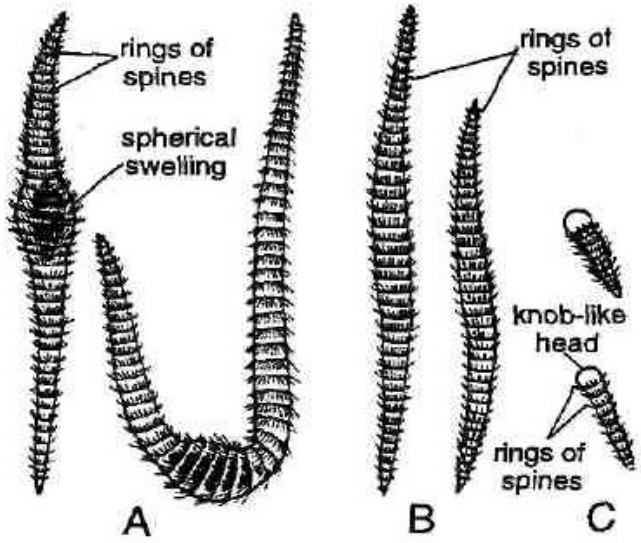
Herdmania. Different types of cells found in test.

4. Blood vessels.

- These form an **anastomosing s**ystem in the test.
- Numerous **branches near** the surface form oval or **pear-shaped *terminal knobs* or *ampullae*** responsible for red patches visible on the surface of test.
- The **ampullae serve** as accessory respiratory as well as receptor organs, being connected to nerve cells.

5. Spicules.

- ***Herdmania*** has large numbers of calcareous **spicules of two types.**
- All the **spicules bear severa equi-distant** rings of minute spines all pointing in the same direction all along their length.



Herdmania. Types of spicules. A — Pipette-shaped megascleres. B—spindle-shaped megascleres. C —Micro scleres.

(a) ***Megascleres.***

- The large sized **megasclere**s occur in all the parts of body except the heart.
- They are again of two varieties,
- (i) ***Pipette'shaped*** **megascleres** reach **upto 3.5 mm in length**.
- They may be straight or curved with pointed ends.
- Each has a large spherical swelling in the middle acquiring the characteristic pipette-like appearance,
- (ii) ***Spindle-shaped*** **megascleres** are only **1.5 to 2.5 mm** long, more abundant and usually present in bundles.
- Equipped with 20-60 equally spaced rings of spines.

(b) ***Microscleres.***

- These are very small in size, **only 40 to 80|i long**, and confined to the test only.
- Each resembles a paper pin having a rounded **knob-like** ***head*** and **a tapering** ***body***.
- The body is beset with **5-20 equidistant** rings of spines.

- The **spicules p**rovide an internal rigid supporting framework like endoskeleton*, keep the mantle firmly fixed to the test, stiffen the walls of blood vessels to avoid their collapse, and ward off the predators.

Mantle or Bodywall

- Beneath the test lies **the** ***bodywall*** or *mantle* which is visible on removal of the test which it secretes.
- The mantle is suspended inside the test and attached only at the branchial and atrial apertures forming the corresponding siphons.
- It is not developed uniformly throughout the body, being thick, highly muscular and opaque on the **antero-dorsal side but thin**, transparent and almost without muscles on the **postero-ventral side** where the internal organs (viscera) are quite visible through it.
- Mantle encloses a large water-filled cavity, **the** ***atrium.***

- **Histologically**, the mantle is composed of three cellular layers: outer epidermis, middle mesenchyme and inner **epidermi**s.

1. Outer epidermis.

- The outer eidermis is made of single layer of flat, hexagonal cells.
- Atthe branchial and atrial apertures it is inturned to reach up to the base of die siphons and **forming stomodaeum and proctodaeum**, respectively.
- The outer epidermis secretes the test.

2. Mesenchyme.

- **It** lies below the outer epidermis and is derived from mesoderm.
- It consists of connective tissue fibres traversed by nerve fibres, muscle fibres and extensive blood sinuses.
- Muscle fibres are unstriated and arranged in three sets.
- *Annular muscles* surround each siphon in several circular rings.
- They cause the contraction of the siphon.
- The more numerous *longitudinal muscles* start from branchial and atrial apertures and radiate beneath annular muscles up to the middle of body on each side.
- They bring about the contraction of the body.
- A few *branchio-atrial* muscles extend deeper between the two siphons.
- The connective tissue cells present in the middle layer are mostly amoeboid as vacuolated cells.

3. Inner epidermis.

- It is the inner ectodermal single layer of flat polygonal cells lining the atrial cavity.

Internal Organs (Viscera)

- The foot has no soft part of the body inside, being entirely made of test.
- All the soft *internal* or *visceral organs* are present inside the body proper enclosed within the somewhat transparent bodywall or mantle.
- Viscera is visible when the test is removed.
- The structures visible from the left side are :

(i) The two *siphons* with their outer annular and internal longitudinal *muscles,* and respective apertures each guarded by four lips;

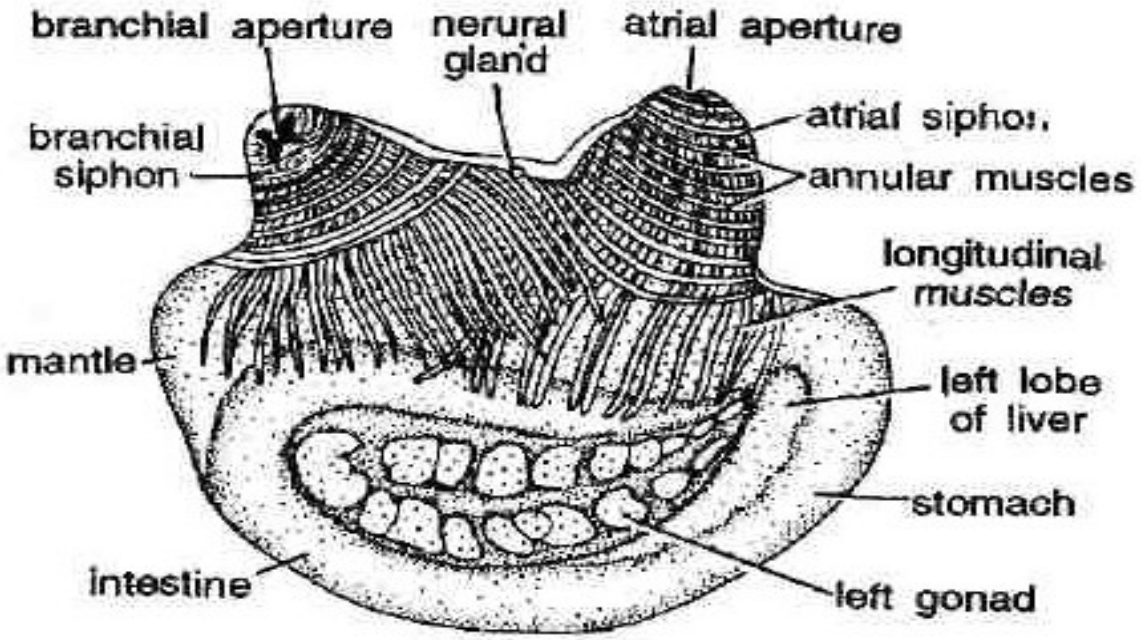
(ii) stomach, intestine and rectum, the *intestine* forming a wide loop;

(iii) chocolate-coloured *left liver lobe* in front of stomach;

(iv) pink-coloured *left gonad* lying in the intestinal loop; and

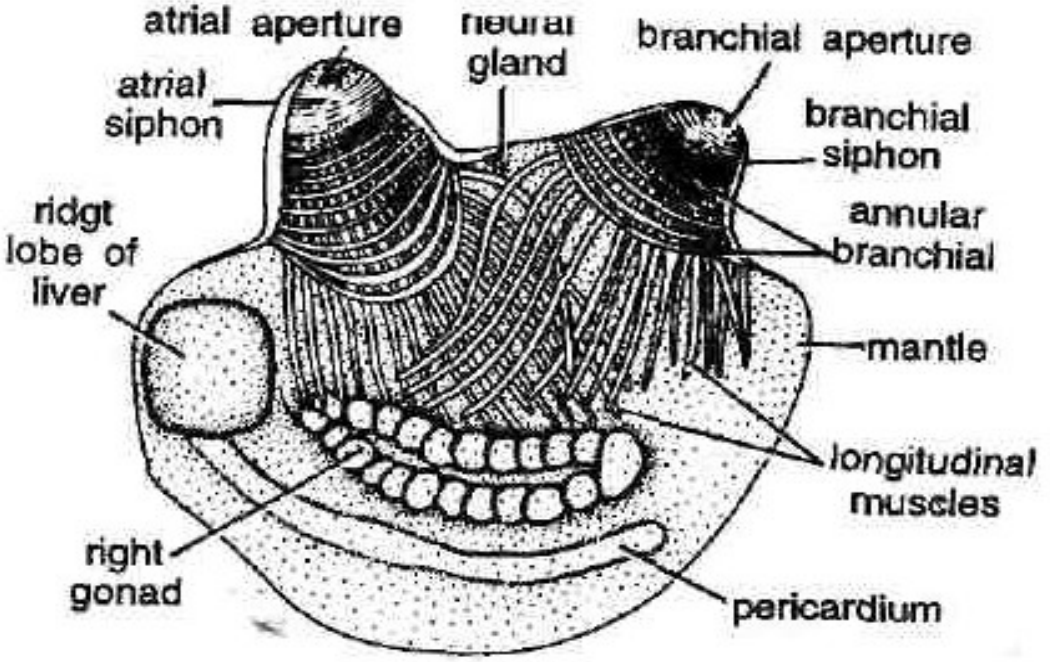
(v) opaque rod-like *endostyle* along the ventral margin of pharynx

.



Herdmania. Viscera seen from left side after removal of

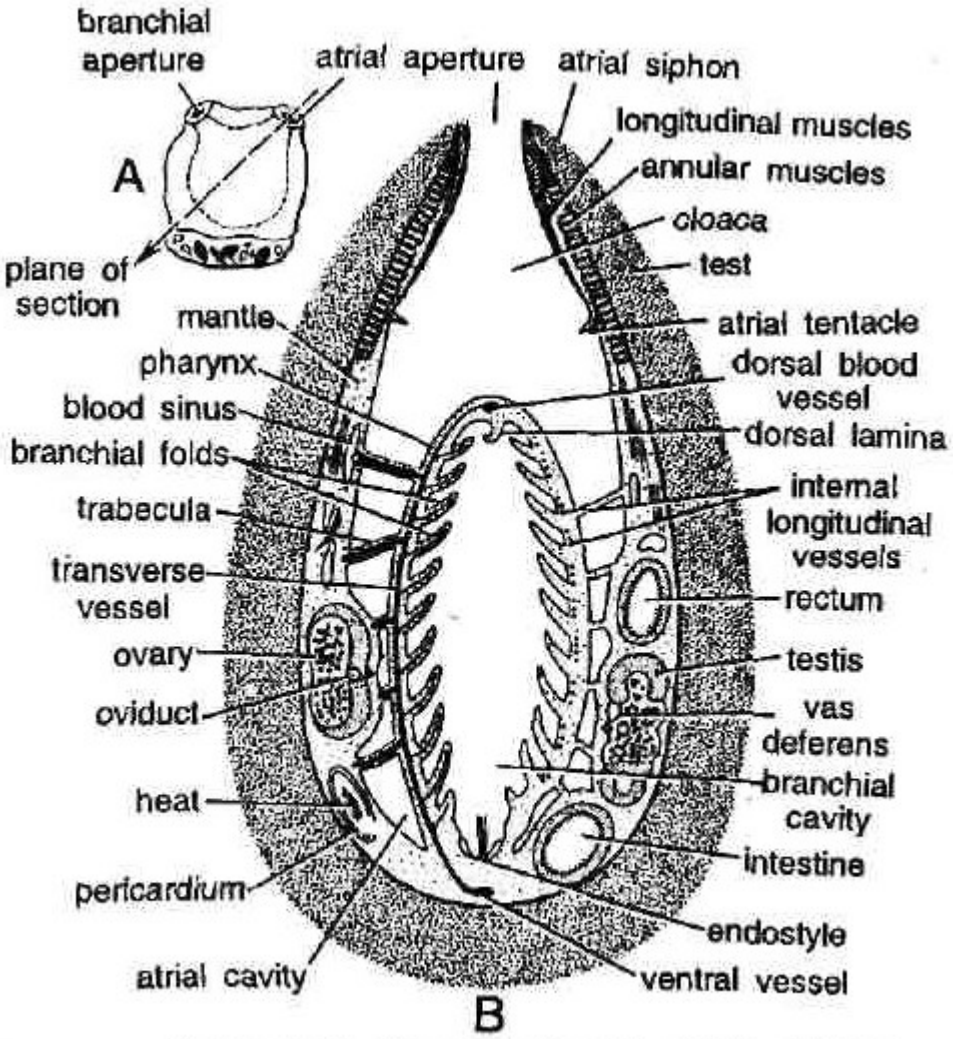
- On examination of the viscera from the right side, the structures visible are-
- (i) The two *siphons* with their *musculature* and *apertures,*
- (ii) *neural gland* in the inter-siphonal region,
- (iii) *right liver lobe,*
- (iv) *pericardium,*
- (v) *right gonad,* and
- (vi) the *endostyle* .



Herdmania. Viscera seen from right side after removal of test.

Coelom and Atrium

- ***True coelom*** in ascidians is greatly reduced due to over **development of atrium**, and exists in few doubtful derivatives like pericardial cavity, gonads, and neural gland.
- Reduction of coelom is regarded to be a result of degeneration.
- The spacious cavity lying between the mantle and the pharynx, and enclosing the visceral organs, is called *atrium.*
- It is lined by the inner epidermis of mantle.
- The atrial cavity is continuous throughout the body except in the anterior and ventral regions where the pharynx and mantle become fused.
- It is narrow on the two lateral sides of the pharynx and called the *peribronchial cavity* which communicates with the cavity of pharynx through *stigmata* in the wall of pharynx.
- Above pharynx, the atrial cavity is wide and known as *cloaca* into which open the anus and the gonopores.
- The cloaca leads to exterior through the atrial siphon and *atrial aperture* or *atriopore.*
- Around the base of atrial siphon is a strong *sphincter muscles,* near which a ring of slightly serrated processes, called *atrial tentacles,* project into the siphon .



Herdmania. A —Plane of section. B —Section of body showing relations of atrial cavity, pharynx, mantle and test.

Locomotion and Movement

- Adult ***Herdmania*** **is sessile**.
- Only visible movements noticed during the contraction of body, while squirting out of water through atrial and branchial siphons.
- For this contraction three set of specialized muscles-oral muscle group, atrial muscle group and atrio-oral muscle groups operate.
- Both oral and atrial muscle groups are formed of annular and longitudinal muscles.
- The atrio-oral muscle group is composed of our muscle band running between oral and atrial funnels and two pairs of muscles situated on either sides of the neural gland.
- These muscles extend longitudinally from one runnel to another.
- Contraction of body is caused by contraction of longitudinal muscles and contraction of funnel is effected by the annular muscles.